



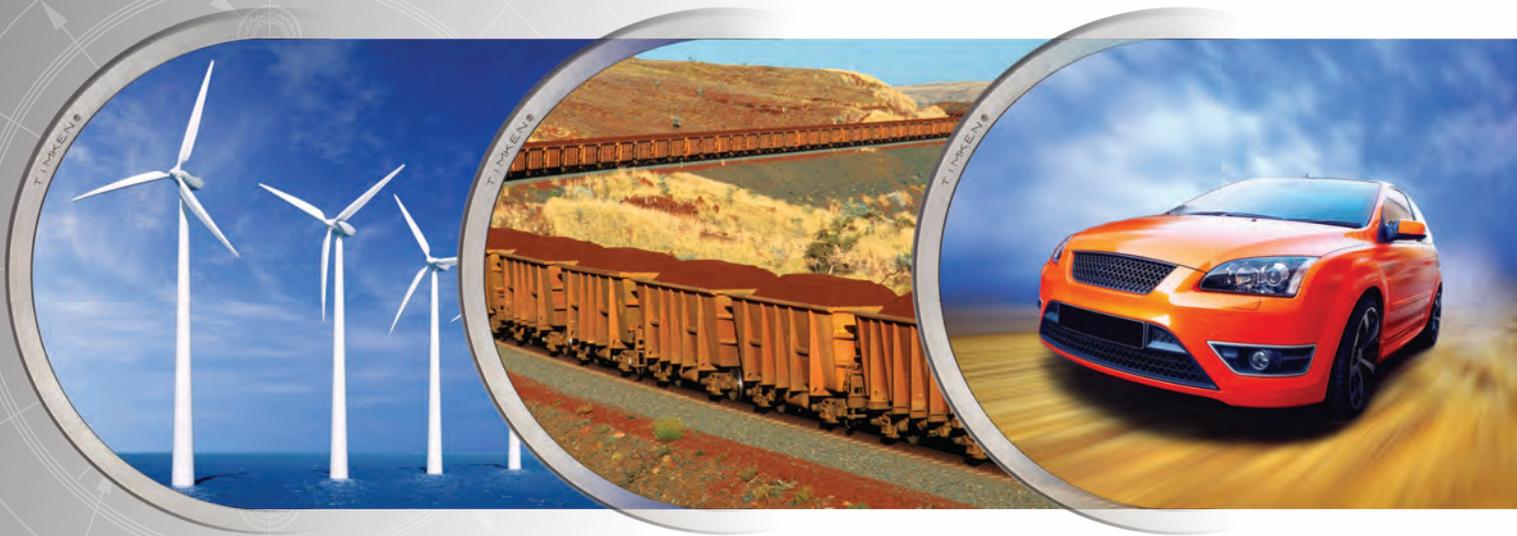
# **WTC 2017**

## **THE 6<sup>th</sup> WORLD TRIBOLOGY CONGRESS**

**September 17 - 22, 2017 • Beijing, China**

# **PROGRAMME**





# It's not just what we make. It's what we know.

There's engineering innovation and know-how behind every product we supply.

We design and make bearings for the most demanding industries. We know the right way to make products and the best materials to use.

From wind farms in the North Sea to freight cars in the Sahara, we deliver products tough enough to perform reliably while operating with the most high-efficient design for your operating model.

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*Together, we can move beyond expectations to achieve even more.*

# TIMKEN

**Stronger. By Design.**

## WELCOME TO WTC 2017

The Sixth World Tribology Congress (WTC 2017), organized by the Chinese Tribology Institute (CTI), will be held in Beijing, China, on September 17-22, 2017.

The objective of this congress is to highlight recent important progress in all aspects of tribology and strengthen the links between academia and industry by exploring various researches on fundamental and applied Tribology. Presentations, exhibition and networking at WTC2017 are designed to broaden knowledge and provide a range of perspectives on topics as diverse as Science of Tribology, Wear & Surface Engineering, Lubrication and Lubricants, Biotribology & Biomimetics, Tribology in Manufacturing, Engine and Transmission Tribology, Industrial Tribo-systems, Tribotest and Monitoring, and Tribology in future.

More than 900 oral presentations and over 300 poster presentations have been accepted inside 9 Tracks and organized into 170 oral sessions and 2 poster sessions. An Opening Ceremony and Plenary Lectures are planned on the morning of the first day. Some Keynote Speeches and Invited Talks are included in the oral sessions. A technical exhibition and some visits to the State Key Laboratory of Tribology (SKLT) at Tsinghua University are organized.

When 1500 scientists and researchers representing 51 countries come to Beijing between September 17th and 22th, 2017, they will experience an innovative and updated version of the WTC congress, following the very well attended sessions in Torino (2013), Kyoto (2009), Washington DC (2005), Vienna (2001), London (1997).

We are honored to have you in Beijing, as Beijing is famous of being a modernized historic city, facilitated with world-class convention centers, hotels and resorts which will serve WTC 2017 with a high level horizon!

With our warmest welcome!



**Chair**

Prof. Dr. Jianbin Luo  
Tsinghua University  
China



**Co-chair**

Prof. Dr. Weimin Liu  
Lanzhou Institute of Chemical Physics of the  
Chinese Academy of Sciences  
China



**Co-chair**

Prof. Dr. Shirong Ge  
China University of Mining and Technology  
China

# CONTENTS

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<b>COMMITTEES AND ORGANIZERS</b>	<b>4</b>
<b>GENERAL INFORMATION</b>	<b>7</b>
<b>OPENING CEREMONY AND PLENARY TALKS</b>	<b>16</b>
<b>PROGRAM OVERVIEW</b>	<b>20</b>
<b>FLOOR PLAN</b>	<b>27</b>
<b>TRAINING AND WORKSHOPS</b>	<b>31</b>
<b>TECHNICAL SESSIONS</b>	<b>35</b>
<b>POSTER TIME</b>	<b>96</b>
<b>AUTHOR INDEX</b>	<b>112</b>

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***COMMITTEES***  
***& ORGANIZERS***



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Chinese Academy of Sciences*

Shirong Ge *China University of Mining and Technology*

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Yu Tian *Tsinghua University*

**Deputy Secretary General**

Feng Zhou *Lanzhou Institute of Chemical Physics, Chinese  
Academy of Sciences*

Xiuqin Bai *Wuhan University of Technology*

Yong Luo *China University of Mining and Technology*

Chenhui Zhang *Tsinghua University*

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Yu Tian	Yuanzhong Hu	Jiadao Wang
Zhongmin Jin	Guoxin Xie	Kun Liu
Xinping Yan	Ming Ma	Hongyu Zhang
Tianbao Ma	Yongzheng Zhang	Yonggang Meng
Dewen Zhao	Jiliang Mo	Feng Zhou
Linmao Qian	Dong Zhu	

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**TRACK ORGANIZERS****Track 1 Science of Tribology**

Organizer: Mark Robbins

Co-organizers:

Yonggang Meng, Antonius Lubrecht, Quanshui Zheng, Daniel Nelias, Hiroshi Matsukawa, Zhendong Dai, Feng Zhou

**Track 2 Wear & Surface Engineering**

Organizer: Ali Erdemir

Co-organizers:

Tianmin Shao, Izhak Etsion, Kenneth Holmberg, Haidou Wang

**Track 3 Lubrication and Lubricants**

Organizer: Hugh A. Spikes

Co-organizers:

Weimin Liu, Yuanzhong Hu, Roland Larsson, Mori Shigeyuki, Pingyu Zhang

**Track 4 Biotribology & Biomimetics**

Organizer: John Fisher

Co-organizers:

Shirong Ge, Ming Zhou, Yoshinori Sawae, Philippa M. Cann, Zhongmin Jin, Zhongrong Zhou

**Track 5 Tribology in Manufacturing**

Organizer: Dohda Kuniaki

Co-organizers:

Kun Liu, Xinchun Lu, Satish V. Kailas

**Track 6 Tribology in Manufacturing**

Organizer: Victor Wong

Co-organizers:

Dong Zhu, Simon Tung, Michel Fillon, Wei Chen, Liqin Wang

**Track 7 Industrial Tribo-systems**

Organizer: Georg Jacobs

Co-organizers:

Yongzhen Zhang, Jian Li, Mitjan Kalin, Dan Guo, George Totten,  
Qian Zou

**Track 8 Tribotest and Monitoring**

Organizer: Takahisa Kato

Co-organizers:

Gwidon Stachowiak, Xinping Yan, Braham Prakash, Jose Daniel  
Biasoli de Mello, Jun Xiao, Chenhui Gao, Jiadao Wang, Xiangjun  
Zhang

**Track 9 Forum of Young Tribologists-Organized by CTI & STLE**

Organizer: Yu Tian, David Burris

Co-organizers:

Haosheng Chen, Linmao Qian, Martin Dienwiebel, Markus  
Valtiner



# **GENERAL** INFORMATION



## CONGRESS VENUE

Beijing International Convention Center (BICC)

The Beijing International Convention Center is a well-known enterprise in Beijing. Opened in 1990, the convention center has served almost 1,000 different international and domestic conventions, exhibitions and meetings each year since its conception.

In 2002 the convention center merged together under North Star Industrial Group, creating a stronger reputation with more effective management. The Center is situated on the site of the Asian Games Village, a flourishing area of Beijing which has a collection of conference centers, businesses, shopping centers and entertainment venues. It is located on the North Fourth Ring road, just 20 kilometers from the International Capital Airport and 9 kilometers from the city center. The Center is also very close to the Olympic Games central area, including the Bird's Nest.

The Beijing International Conference Center provides 5 star services and comprises 48 different conference rooms. The exhibition hall is 5,000 square meters. The North Star Continental Grand Hotel is a 4 star hotel with 538 guest rooms and 5 restaurants serving different types of cuisine. It's the ideal place to conduct international and domestic conferences, display cultural events and hold business meetings.

[www.bicc.com.cn](http://www.bicc.com.cn)



## HOW TO GET TO THE BEIJING INTERNATIONAL CONVENTION CENTER (BICC)?

From Beijing Capital Airport to BICC



### (1) Taxi

Beijing Capital International Airport provides taxi stations at the airport, so you can take a taxi from the airport to the congress venue.

#### Taxi Locations:

**Terminal 1:** Outside Gate 1 on F1

**Terminal 2:** Outside Gate 5 to 9 on F1

**Terminal 3:** Please refer to the signs inside the terminal building

**Fare:** About RMB 120 (USD \$ 20 including toll). The cost is subject to change depending on actual traffic conditions.



### (2) By Airport Shuttle

Take the Airport Shuttle Bus Line 5 (to Zhongguancun) and get off at Asian Games Village (Anhui Bridge) station, then Public Bus No.419 to Wali South station. Then walk towards the south for about 400 meters to the BICC.

**Fare:** RMB 24 (USD \$4)



### (3) By Airport Express

1. Airport Express (get off at Sanyuanqiao)-Subway Line 10(get off at Anzhenmen )-Public Bus No.380(get off at Anhuiqiao Bei)

2. Airport Express (get off at Sanyuanqiao)-Subway Line 10(get off at Beitucheng )-Subway Line 8(get off at Aotizhongxin)



From Railway Station to BICC



### 1. From Beijing Railway Station to BICC

- 1) Subway Line 2 (get off at Gulou Dajie)-Subway Line 8 (get off at Aotizhongxin)
- 2) Public Bus No. 387 (get off at Anhuiqiao Bei)
- 3) Subway Line 2(get off at Andingmen)-Public Bus No. 426 (get off at Anhuiqiao Bei)
- 4) Subway Line 2(get off at Guloudajie)-Subway Line 8 (get off at Aotizhongxin)
- 5) Special Public Bus No. 2 (get off at Anhuiqiaobei)

### 2. From Beijing West Railway Station

- 1) Subway Line 9 (get off at National Library)-Subway Line 6(get off at Nanluoguxiang) - Subway Line 8 (get off at Aotizhongxin)
- 2) Public Bus No. 9 (get off at Zhengyilu)-Special Public Bus No. 11 (get off at Anhuiqiaobei)
- 3) Public Bus No. 387 (get off at Anhuiqiao Bei)

### 3. From Beijing South Railway Station

- 1) Subway Line 4 (get off at Xisi)-Public Bus No. 124(get off Anhuiqiao Bei)
- 2) Subway Line 4 (get off at Pinganli)-Special Public Bus No. 13 (get off at Qijiahuozi)-Public Bus No. 658 (get off at Yayuncun)
- 3) Subway Line 4 (get off at Xuanwumen)-Subway Line 2 ( get off at Andingmen)-Public Bus No. 426 (get off at Anhuiqiao Bei)
- 4) Subway Line 4 (get off at Xuanwumen)-Subway Line 2 (get off at Guloudajie)-Subway Line 8 (get off at Aotizhongxin)

#### Remarks:

1. You may change money at the Banks or Money Exchange at the airport beforehand since you need Chinese money (RMB) to pay for the means of transportation.
2. There will be quite some walk with ups and downs especially at the subway station for transfers if you choose to go to BICC by either airport shuttle, airport express or subway. Our previous conference delegates complained a lot about the inconveniences caused by taking airport express and subway, so it is preferred that you go to BICC by taxi.

#### LIABILITY

The organizers cannot accept liability for any personal accidents, loss of belongings or damage to private property of participants and accompanying persons that may occur during the Congress.

#### CURRENCY, EXCHANGE AND CREDIT CARDS

The currency used in China is the Renminbi Yuan (RMB or ¥).

Euros and US Dollars can be exchanged at your hotel or at any bank. Traveller's cheques can only be exchanged at the Bank of China.

Banks usually open from 9 a.m. to 5 p.m. From Monday to Friday and 9 a.m. to 4 p.m. on Saturday and Sunday.

Credit cards are very common. It is advisable to carry some cash, since for small purchase shops do prefer to be paid by cash.

#### ELECTRICITY

The electric current used in China is 220V 50Hz. Hotels provide 220V and 110V (shavers only) power outlets. Please note that plug adapters and converters might be required.

#### TIPPING

Gratuities are not customary in China. However, in hotels and during group travels, tipping is practiced for porters, tour guides and drivers.



### SMOKING

Smoking in indoor public places has been banned in Beijing from June 1, 2015 following the rolling out of the toughest ever antismoking regulation in China. The regulation extends smoking bans to include all indoor public areas and workplaces, plus a number of outdoor areas including schools, seating areas in sports stadiums and hospitals where women or children are treated.

### TIME

China covers four time zones. Beijing time is the only official time throughout the country; punctuality is highly appreciated.

### TRANSPORTATION

#### *Public Buses*

Buses are the main means of transport in Beijing. Please prepare small bills as not all buses will carry change. Buses can be very crowded during peak times, which are generally from 7-9 a.m. and 4-6 p.m.

#### *The Subway*

The subway system in Beijing has 15 lines. The fare is 3 - 9 yuan. Trains run from 5:30 in the morning until 11:00 in the evening. A ticket can be bought at the ticket office at each station or at an automatic ticketing machine. Subway stops are announced over the train's speaker system in Chinese and English.

#### *Taxis*

Taxis in Beijing have several colours. All of them show a taximeter inside. You can easily find them in every part of Beijing. All Taxis will charge 2.3 yuan per kilometer with a base rate or minimum charge of 13 yuan.



## ACCOMMODATION

Several recommended hotels nearby BICC are listed as following:

- Hotel 1** **NORTH STAR YAYUNCUN HOTEL**  
( 北辰亚运村宾馆 )
- Room Type** Standard Room (Twin beds/King bed)
- Room Rate** 300 RMB
- Remark** The room rate includes 1 or 2 breakfast, service charge and taxes
- Dist. to BICC** 15 minutes walk
- Internet** Free WIFI
- Introduction** With both Asian Games village and Olympic Park as its neighbors, Yayuncun Hotel is only few minutes walking distance from the "Bird's Nest"
- Shuttle** Not Available
- Contact** Mr. Zhou Bin  
E-mail: zhoubin8522@qq.com  
Tel: 0086 186 1125 0221
- Hotel 2** **NORTH STAR HUIYUAN PRIME HOTEL**  
( 北辰汇园酒店公寓贵宾楼 )
- | Room Type        | Standard Room<br>(Twin beds) | One Bedroom Suite<br>(Twin beds/King bed) | Two-Bedroom Suite<br>(1 king bedroom and<br>1 twin bedroom) |
|------------------|------------------------------|---|---|
| <b>Room Rate</b> | 660 RMB                      | 760 RMB                                   | 980 RMB   |
- Remark** The room rate includes 1 or 2 breakfast, service charge and taxes.
- Internet** Free WIFI
- Introduction** Huiyuan Prime Hotel is only 27 km to Capital International Airport and 20 km to Beijing West Railway Station. The hotel offers easy access to the neighboring key destinations, like Minzu Park.
- Dist. to BICC** 15 minutes walk
- Shuttle** Not Available
- Contact** Mr. Zhou Bin  
E-mail: zhoubin8522@qq.com  
Tel: 0086 186 1125 0221
- Hotel 3** **BEIJING CONTINENTAL GRAND HOTEL**  
( 五洲大酒店 )
- Room Type** Deluxe Room (Twin beds/King bed)
- Room Rate** 770RMB
- Remark** The room rate includes 1 or 2 breakfast, service charge and taxes
- Internet** Free WIFI
- Introduction** Beijing North Star Continental Grand Hotel is a large four star hotel with 538 elegant and comfortable rooms. The guest rooms are renovated recently, representing advanced technology which demonstrates the international quality and hospitality
- Dist. to BICC** Sharing the same building with BICC
- Hotel 4** **V-CONTINENT BEIJING PARKVIEW WUZHOU HOTEL**  
( 北辰五洲皇冠国际酒店 )
- Room Type** Superior Room (Twin beds/King bed)
- Room Rate** 1020 RMB
- Dist. to BICC** 5 minutes walk
- Internet** Free WIFI
- Introduction** V-Continent Beijing Parkview Wuzhou Hotel is adjacent to the Beijing International Convention Center, one kilometer from Olympic Park and eight kilometers from Beijing city center.
- Shuttle** Not Available
- Contact** E-mail: reservation@v-continent.com  
Tel: 0086 10 64817138
- Hotel 5** **CELEBRITY INTERNATIONAL GRAND HOTEL**  
( 北京名人国际大酒店 )
- | Room Type        | Standard Room (Twin<br>beds/King bed) | Business Suite (Twin<br>beds/King bed) |
|------------------|---------------------------------------|--|
| <b>Room Rate</b> | 700 RMB                               | 880 RMB                                |
- Remark** The room rate includes 1 or 2 breakfast, service charge and taxes
- Dist. to BICC** 25 minutes walk
- Internet** Free WIFI
- Introduction** The 25-story Celebrity International Grand Hotel is located just north of the Anhui Bridge over North Fourth Ring Road in Beijing. It is about three blocks from a subway station and 25 kilometers from Capital Airport.
- Shuttle** Not Available
- Contact** E-mail: 13581773237@126.com  
Tel: 0086 10 5865 1166 ext 6116
- Hotel 6** **NORTH STAR YUANCHENXIN INTERNATIONAL HOTEL**  
( 北辰元辰鑫国际酒店 )
- Room Type** Standard Twin bed Room
- Room Rate** 580 RMB
- Remark** The room rate includes 1 or 2 breakfast, service charge and taxes
- Dist. to BICC** Take the Bus 658 from Jiandemen Bridge North Station to Yayuncun Station
- Internet** Free WIFI
- Shuttle** Not Available
- Contact** E-mail: yudingbu@bicc.com.cn  
Tel: 0086 10 8498 0105



**Introduction** Yuanchenxin International Hotel, is a four star business hotel. It is located at the northern area of the city, right at the junction of the North 3rd Ring Road and the Expressway linking to Badaling Great Wall, convenient to the relic of the capital of the Yuan dynasty in ancient China, and adjoin the China International Science Technology Convention Center(CISTCC).

**Shuttle** Not Available

**Contact** E-mail: zhaogurong\_1314@126.com

Tel: 0086 10 8225 0362 +86 15910973379

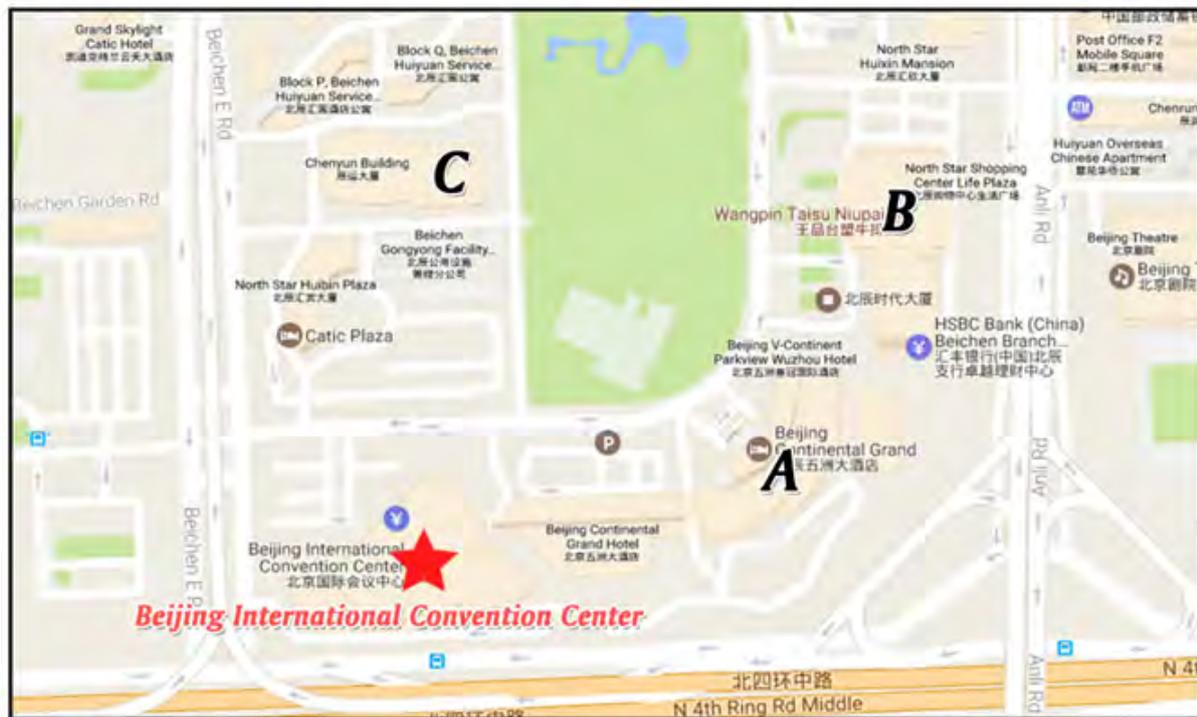


- |                                   |  |
|-----------------------------------|--|
| ① North Star Yayuncun Hotel       | ④ V-Continent Beijing Parkview Wuzhou Hotel  |
| ② North Star Huiyuan Prime Hotel  | ⑤ Celebrity International Grand Hotel        |
| ③ Beijing Continental Grand Hotel | ⑥ North Star Yuanchenxin International Hotel |



## DINING

You can have meals at the restaurants nearby the Beijing International Convention Center.



**A:**Café Asia, Yue Feng Ge Chinese Restaurant, Brazilian Churascos  
**B:**Subway, Burger King, Starburks, Ajisen Ramen and some Chinese local restuarants  
**C:**Chinese local restuarants and cafes

**\*The walking distance from BICC to the recommended dining areas**

1. 5 minutes walking to the A
2. 10-15 minutes walking to the B & C

## INSTRUCTIONS FOR LECTURES AND ORAL PRESENTATION

Speakers have two options to present their talks.

- A. Speakers are encouraged to upload their files to the Slide Centre the day before, if the presentation is in a morning session, or at least 2 hours before the beginning of the session, in the case of an afternoon session.
- B. Speakers can also use their own computers to present. Please bring an appropriate adapter with you.

Microsoft PowerPoint Windows-Office 2013/2017 will be recommended to present your talk..

If you have a Macintosh computer, please bring an appropriate converter with you.

## INSTRUCTIONS FOR POSTER PRESENTATION

Poster will be displayed divided into 2 sessions:

Time: 15:30 - 16:30, 19 September Venue: Lounge Area, Level 3

Time: 15:30 - 16:30, 20 September Venue: Lounge Area, Level 3

Authors are invited to hang their posters the day of their presentation preferably half hour before the session start.

Authors must guarantee their presence nearby the poster during the time of their presentation. Poster size is 120cm (height) and 90cm (width). Modality to stick the poster: adhesive tape. Pins are not usable.

Adhesive tapes and scissors will be available at the Registration Desk.



### LABORATORY VISIT

To enhance a broad and in-depth exchange in academic field, the Organizing Committee of the 6th World Tribology Congress decided to arrange a visit to the State Key Laboratory of Tribology (SKLT) at Tsinghua University.

The SKLT at Tsinghua University was established in 1986. Accredited by the state and open to the public in November 1988, it was one of the earliest State Key Laboratories at Tsinghua University, also in the field of mechanical engineering in China. The SKLT serves as a leading scientific research platform in the fields of tribology, surface and interface sciences, bio-tribology and bio-mechanics, micro/nano manufacturing theory and technology and micro/nano photoelectronic measurement technology. It also carries out related technology development and consultation service.

Optional Time Schedule:

20th Sept. 2017 (Wednesday)

13:00-15:00 including round way transfer, pick up and return point is BICC Lobby.

14:00-16:00 including round way transfer, pick up and return point is BICC Lobby.

15:00-17:00 including round way transfer, pick up and return point is BICC Lobby.

16:00-18:00 including round way transfer, pick up and return point is BICC Lobby.

22nd Sept. 2017 (Friday)

13:00-15:00 including round way transfer, pick up and return point is BICC Lobby.

14:00-16:00 including round way transfer, pick up and return point is BICC Lobby.

15:00-17:00 including round way transfer, pick up and return point is BICC Lobby.

16:00-18:00 including round way transfer, pick up and return point is BICC Lobby.

Attention: With regard to the acceptance capacity and making you a better experience, SKLT plans to accommodate totally 200 persons' visit each afternoon. Please enjoy the visit according to your pre-registration.

### TOURS

We would like to recommend two full day tours on 23rd Sept. and 24th Sept. separately. For the detail please refer to the information below.

Tour Code	Price/per person	Description	Date Schedule
FDT-170923-01	US\$150.00	Morning: Tian'an Men Square and the Forbidden City and lunch at local Restaurant. Afternoon: Hutong Tour, dinner is on own	23rd Sept. 2017
FDT-170923-02	US\$170.00	Morning: Temple of Heaven and lunch at Local Restaurant Afternoon: Badaling Great Wall, dinner is on own	
FDT-170924-01	US\$150.00	Morning: Tian'an Men Square and the Forbidden City and lunch at local Restaurant. Afternoon: Hutong Tour, dinner is on own.	24th Sept. 2017
FDT-170924-02	US\$170.00	Morning: Temple of Heaven and lunch at Local Restaurant. Afternoon: Badaling Great Wall, dinner is on own.	

Remarks:

1. The cost is based on a group of minimum 2 paying guests.
2. The cost includes a private English speaking guide & a private vehicle, entrance fee and lunch (excluding drinks) at local restaurant.



Cultural Tour Recommendation For The 6th World Tribology Congress

Two Optional Tours Each Day on 23rd and 24th Sept. 2017

Optional 1

**Tour Code:**

FDT-170923-01 on 23rd Sept. 2017

FDT-170924-01 on 24th Sept. 2017

**Morning:** Tian'an Men Square and the Forbidden City

**Lunch:** Local Restaurant

**Afternoon:** Hutong Tour

Dinner is on own

Hour by Hour Schedule

08:30-09:30 Transfer from Beijing Continental Grand Hotel (Lobby) to the Tian'an Men Square

09:30-12:00 Visit to the Tian'an Men Square and the Forbidden City

12:00-12:30 Transfer to the Local Restaurant for lunch

12:30-13:30 Lunch at the Local Restaurant

13:30-15:30 Visit to the Hutong Area incl. rickshaw ride and family visit

15:30-16:10 Transfer back to the Beijing Continental Grand Hotel

**Remarks:**

The cost is based on a group of minimum 2 paying guests.

**US\$150 per person** The cost includes a private English speaking guide & a private vehicle, entrance fee and local lunch (excluding drinks) at local restaurant



A Hutong is a unique form of community that exists only in China. The Hutong, built during the Yuan, Ming, and Qing dynasties, is the narrow network of lanes created by closely built quadrangular homes. The houses and courtyards, hidden away and boxed, are closed off with wooden gates that often have carved characters intended to bring good fortune to the house owner.

Optional 2

**Tour Code:**

FDT-170923-02 on 23rd Sept. 2017

FDT-170924-02 on 24th Sept. 2017

**Morning:** Temple of Heaven

**Lunch:** Local Restaurant

**Afternoon:** Badaling Great Wall

Dinner is on own

Hour by Hour Schedule

08:30-09:30 Transfer from Beijing Continental Grand Hotel (Lobby) to the Temple of Heaven

09:30-12:00 Visit to the Temple of Heaven

12:00-12:30 Transfer to the Local Restaurant for lunch

12:30-13:30 Lunch at the Local Restaurant

13:30-15:30 Visit to the Badaling Great Wall

15:30-16:10 Transfer back to the Beijing Continental Grand Hotel

**Remarks:**

The cost is based on a group of minimum 2 paying guests.

**US\$150 per person** The cost includes a private English speaking guide & a private vehicle, entrance fee and local lunch (excluding drinks) at local restaurant





***OPENING CEREMONY***  
***& PLENARY TALKS***

**OPENING CEREMONY**

9:00-10:00 Monday 18<sup>th</sup> September- CONVENTION HALL No.1

**PLENARY TALKS**

CONVENTION HALL No.1

**Monday 18<sup>th</sup> September**

10:20-11:00

**Tribology for Space Technology**

Prof. Weimin Liu

*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China*

11:00-11:40

**Biolubrication: Beyond Tribology**

Prof. Jacob Klein

*Weizmann Institute of Science, Israel*

**Tuesday 19<sup>th</sup> September**

8:30-9:10

**Advances in Tribological Coatings for More Efficient and Green Transportation Technologies**

Prof. Ali Erdemir

*Argonne National Laboratory, United States*

9:10-9:50

**Recent Lubrication Research Activities in SKLT**

Prof. Yonggang Meng

*State Key Laboratory of Tribology, Tsinghua University, China*

**Wednesday 20<sup>th</sup> September**

8:30-9:10

**Multiphysic Interfaces of Contact and Relative Motion**

Prof. Qian Jane Wang

*Northwestern University, United States*

9:10-9:50

**Influence of Tribology on Global Energy Consumption, Costs and Emissions**

Prof. Kenneth Holmberg

*VTT Technical Research Centre of Finland, Finland*

**Thursday 21<sup>st</sup> September**

8:30-9:10

**Stress-Induced Thermal Activation in Tribology: From Rheology to Tribochemistry**

Prof. Hugh A. Spikes

*Imperial College London, United Kingdom*

9:10-9:50

**Tribology and Materials for Hydrogen Energy (Society)**

Prof. Joichi Sugimura

*Kyushu University, Japan*

**PLENARY SPEAKERS**

Weimin Liu



Weimin LIU, received his Ph.D. in lubricating materials and Tribology from Lanzhou Institute of Chemical Physics (LICP) of the Chinese Academy of Sciences in 1990. After that, he joined the State Key Laboratory of Solid Lubrication (LSL) of the LICP. From June 1993 to June 1994, he worked as a Visiting Scholar at Pennsylvania State University, USA. In 2013, he was elected the Member of the Chinese Academy of Sciences. In 2016, he was elected the Fellow of The World Academy of Sciences (TWAS). Currently, he is head of the State Key Laboratory of Solid Lubrication, and one of the Editor of journal of Tribology International.

Prof. LIU has been working in tribology for over 30 years and made great contributions to develop advanced lubricating materials for China's space, aviation and heavy duty industries in which lubrication is the key to guarantee long term service of moving components. Up to now, he has published more than 600 papers with citation over 21000 times. He holds 80 Chinese patents and 1 US patent; won 2 National Awards for Natural Sciences (second class) and 2 National Awards for Technological Invention (second class). He is the winner of the Ho Leung Ho Lee Foundation Materials Prize of 2016. His research interests mainly focus on space and aviation lubrication, high performance lubricating materials and Tribochemistry.

Jacob Klein



Jacob Klein, born 1949, is the Herman Mark Professor of Polymer Physics at the Weizmann Institute in Israel. Klein gained his BA in Physics at the University of Cambridge, where in 1977 he also received his M.A. and PhD at the Cavendish Laboratory. He did his postdoc at the Weizmann Institute in Israel, and from 1980-1984 was a Senior Scientist at the Weizmann Institute and a University Demonstrator at the Cavendish Laboratory. In 1984 he was appointed Professor at the Weizmann Institute (full Professor from 1987), and subsequently headed its Polymer Research department and was Chairman of its Scientific Council. From 2000-2007 Klein was the Dr. Lee's Professor of Chemistry at the University of Oxford and Head of its Physical and Theoretical Chemistry Laboratory (2000-2005). His interests in soft matter have ranged from the dynamics and interfacial properties of polymers to the behaviour of confined fluids and biological lubrication, and, more recently, tissue engineering. Klein has published over 230 papers, including over 20 in *Science* and *Nature*. His work has been cited some 10,000 times, with an H-factor 53. His honours include the Charles Vernon Boys Prize of the Institute of Physics, UK (1984), the High Polymer Physics Prize of the American Physical Society (1995), the 2010 Prize of the Israel Chemical Society and the 2011 Soft Matter and Biophysical Chemistry Award of the UK Royal Society of Chemistry and the 2012 Tribology Gold Medal. In 2009, he received an ERC Advanced Grant. In 2013 he was elected to the European Academy.

Ali Erdemir



ALI ERDEMIR is a Distinguished Fellow of Argonne National Laboratory and the current President of the Society of Tribologist and Lubrication Engineers (STLE). He received his B.S. degree from Istanbul Technical University in 1977 and M.S. and Ph.D. degrees in Materials Science and Engineering from the Georgia Institute of Technology in 1982 and 1986, respectively. In recognition of his pioneering research, Dr. Erdemir has received numerous coveted awards and honors, including the University of Chicago's Medal of Distinguished Performance, six R&D 100 Awards, Mayo D. Hersey Award of ASME, two AI Sonntag Awards and an Edmond E. Bisson Award from STLE. He is a Fellow of ASME, STLE, AVS, and ASM-International, authored/co-authored more than 300 research articles (240 of which are peer-reviewed) and 18 book/handbook chapters, edited three books, presented more than 160 invited/keynote/plenary talks, and holds 17 U.S. patents. His current research is directed toward nano-scale design and large-scale manufacturing of new materials, coatings, and lubricants for a broad range of applications in transportation, manufacturing, and other energy conversion and utilization systems.

Yonggang Meng



Yonggang Meng is a Professor in mechanical engineering, and serves as the Director of the State Key Laboratory of Tribology (SKLT), Tsinghua University, China. Before he joined the SKLT in 1990, he obtained his Master and Ph.D degrees in mechanical engineering from Kumamoto University, Japan, in 1986 and 1989 respectively. He is the author or co-author of over 160 peer-reviewed papers and 4 book chapters. His research area covers engineering tribology, surface and interface sciences and micro/nanomanufacturing.



Qian Jane Wang



Qian Jane Wang received her Ph. D from Northwestern University, USA, 1993. She taught for five years at Florida International University, USA, and is now a Professor in the Mechanical Engineering Department at Northwestern University, USA. She is also an Adjunct Professor in the School of Mechanical Engineering at Southwest Jiaotong University, China.

She is the receiver of the 2015 Society of Tribologists and Lubrication Engineers (STLE) International Award. She was elected Fellow of the American Society of Mechanical Engineers (ASME) in 2009 and STLE in 2007. She and co-workers won the 2014 and 1997 Captain Alfred E. Hunt Best Paper Award from STLE, the 2015 and 2013 Best Paper Award from ASME Journal of Tribology, the 2013 and 2011 Best Paper Award from STLE Surface Engineering Committee, and the 2010 Edmond E Bisson Best Written Contribution Award from STLE. She also received a CAREER Award 1997 US National Science Foundation. She was one of the two Editors of Encyclopedia of Tribology, published by Springer; she served the professional communities as a Board of Director of STLE during 2008-2009, Chair of the 2011 ASME/STLE International Joint Tribology Conference, Chair of the STLE Annual Meeting Program Committee during 2007-2008, Secretary of the 2005 World Tribology Congress Technical Program Committee, and Member of the Organization Committee of the 2007 International Symposium of Computational Mechanics.

Kenneth Holmberg



Kenneth Holmberg, Dr Tech, is Research Professor in tribology, condition monitoring and operational reliability at the VTT Technical Research Centre of Finland. He is the author and editor of several books and he has given 46 invited keynote lectures at international conferences. He has published more than 200 scientific papers mainly in areas of tribology, surface engineering, lubrication, computational material modelling and simulation, operational reliability, maintenance and diagnostics. He is vice president of the International Tribology Council. He was president of the OECD IRG Wear group 1992-2006 and chairman of the European COST 516&532 TRIBOLOGY joint research actions 1995-2008. He is Chief Engineer Councillor at the Supreme Administrative Court of Finland and a frequently used expert in the European Community and European Science Foundation research actions and programmes. He is in the editorial board of 10 scientific journals and he has been responsible for organising major international conferences in tribology, monitoring and diagnostics e.g. EUROTRIB'89, COMADEM'97 and NORDTRIB'00 & 16. He is member of the Board of Directors at the Taiho Kogyo Tribology Research Foundation (Japan), member of the Steering Committee of the Leonardo Centre of Tribology and Surface Technology at the Sheffield University (UK), member of the Programme Committee for Materials Research at the Foundation of Strategic Research (Sweden), member of the Programme Committee for Strategic Materials Research at FIMECC (Finland), and a frequently used consultant for industrial contracts and R&D projects. At VTT he is presently coordinating the strategic computational materials modelling and simulation research.

Hugh A. Spikes



Hugh Spikes graduated in Natural Sciences from the University of Cambridge in 1968 and obtained his PhD for research in Tribology from Imperial College in 1972. He is currently Emeritus Professor in the Tribology Group at Imperial College London.

Professor Spikes is a Fellow of the Royal Academy of Engineering and also of the Society of Tribologists and Lubrication Engineers. He has been involved in research in tribology for over forty years and has received a number of recognitions for his research achievements including the ASME Mayo D Hersey Award and the STLE International Award. In 2004 he was awarded the Tribology Trust Tribology Gold Medal. Ten of his research publications have received best paper awards, from STLE, IMechE and ASME.

Professor Spikes' research interests span a wide range of liquid lubrication research, including hydrodynamic, elastohydrodynamic and boundary lubrication. A particular research interest has been thin film lubrication and the influence of lubricant molecular composition on the film-forming properties of lubricants and thus on friction and wear performance. Although generally fundamental in nature much of his research has been carried out in collaboration with, and has been funded by, industry and it has made significant contributions to our ability to design low friction lubricants.

Joichi Sugimura



Joichi Sugimura graduated from the University of Tokyo in 1981, and obtained a doctoral degree in 1986. He has been working for Kyushu University since 1986. His research areas are tribology and machine elements. He has also been working for research and education on hydrogen as an energy carrier, and he now directs Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS). He is also a principal investigator in International Institute for Carbon-Neutral Energy Research (I2CNER) at Kyushu University. His current research interests are tribo-interface in hydrogen and various environments, sealing mechanisms and failures, greases, and modeling of surface microgeometry.



# ***PROGRAM*** *OVERVIEW*



**PROGRAMME OVERVIEW**

SUNDAY, SEPTEMBER 17, 2017		DAY 1 - MONDAY, SEPTEMBER 18, 2017	
LOBBY	9:00-20:00	LOBBY	8:00-18:00
	Registration		Registration
ROOM 201	13:00-18:00	Morning	
	Training Course	9:00-10:00	10:20-11:40
		CONVENTION HALL No.1	Opening Ceremony
			Break
			Plenary Lectures
		Lunch Break	
		Afternoon	
CONVENTION HALL No.1	19:00-20:30	13:30-15:30	15:30-15:50
	Welcome Reception	ROOM 201A	Track1:Science of Tribology Friction Fundamental I
		ROOM 201B	Track1: Science of Tribology Molecular and Boundary Film Lubrication I
		ROOM 201D	Track2:Wear & Surface Engineering Wear I
		ROOM 203A	Track2:Wear & Surface Engineering Coatings I
		ROOM 203B	Track2:Wear & Surface Engineering Texturing I
		ROOM 203C	Track3:Lubrication & Lubricants Chemistry of Lubricants I
		ROOM 305A	Track3:Lubrication & Lubricants Additives I
		ROOM 305C	Track4:Biotribology & Biomimetics Biomimetics I
		ROOM 303	Track5:Tribology in Manufacturing Machning I
		ROOM 305E	Track6:Engine & Transmission Tribology Rolling Bearings I
		ROOM 307	Track6:Engine & Transmission Tribology Fluid Film Bearings I
		ROOM 308	Track7:Industrial Tribo-Systems HDDs & Microsystems I
		ROOM 311A	Track8:Tribotest & Monitoring Tribotest I
CONVENTION HALL No.4 & No.5	9:00-18:00	Coffee Break	
	Exhibits Setup		Track1:Science of Tribology Friction Fundamental II
			Track1: Science of Tribology Molecular and Boundary Film Lubrication II
			Track2:Wear & Surface Engineering Wear II
			Track2:Wear & Surface Engineering Coatings II
			Track2:Wear & Surface Engineering Texturing II
			Track3:Lubrication & Lubricants Rheology of Lubricants I
			Track3:Lubrication & Lubricants Additives II
			Track4:Biotribology & Biomimetics Biomimetics II
			Track5:Tribology in Manufacturing Machning II
			Track6:Engine & Transmission Tribology Rolling Bearings II
			Track6:Engine & Transmission Tribology Fluid Film Bearings II
			Track7:Industrial Tribo-Systems HDDs & Microsystems II
			Track8:Tribotest & Monitoring Tribotest II

## PROGRAMME OVERVIEW

**DAY 2 - TUESDAY, SEPTEMBER 19, 2017**

		Morning			Afternoon		
LOBBY	8:00-12:00	Registration	LOBBY	13:30-18:00	Registration		
	8:30-9:50	10:10-12:00	12:00-13:30	13:30-15:30	15:30-16:30	16:30-18:30	
CONVENTION HALL No.1	Plenary Lectures		<b>Lunch Break</b>		<b>Coffee Break &amp; Poster Session (Lounge Area, Level 3)</b>		
ROOM 201A		Track1: Science of Tribology Friction Fundamental III		ROOM 201A	Track1: Science of Tribology Friction Fundamental IV	Track1: Science of Tribology Friction Fundamental V	
ROOM 201B		Track1: Science of Tribology Elastohydrodynamic Lubrication I		ROOM 201B	Track1: Science of Tribology Elastohydrodynamic Lubrication II	Track1: Science of Tribology Elastohydrodynamic Lubrication III	
ROOM 201D		Track2: Wear & Surface Engineering Wear III		ROOM 201D	Track2: Wear & Surface Engineering Wear IV	Track2: Wear & Surface Engineering Wear V	
ROOM 203A		Track2: Wear & Surface Engineering Coatings III		ROOM 203A	Track2: Wear & Surface Engineering Coatings IV	Track2: Wear & Surface Engineering Coatings V	
ROOM 203B		Track2: Wear & Surface Engineering Texturing III		ROOM 203B	Track2: Wear & Surface Engineering Texturing IV	Track2: Wear & Surface Engineering Texturing V	
ROOM 203C		Track3: Lubrication & Lubricants Chemistry of Lubricants II		ROOM 203C	Track3: Lubrication & Lubricants Solid Lubricants I	Track3: Lubrication & Lubricants Solid Lubricants II	
ROOM 305A		Track3: Lubrication & Lubricants Additives III		ROOM 305A	Track3: Lubrication & Lubricants Additives IV	Track3: Lubrication & Lubricants Additives V	
ROOM 305C		Track4: Biotribology & Biomimetics Artificial Joints I		ROOM 305C	Track4: Biotribology & Biomimetics Artificial Joints II	Track4: Biotribology & Biomimetics Artificial Joints III	
ROOM 303		Track5: Tribology in Manufacturing Metal Forming & Advanced Processing I		ROOM 303	Track5: Tribology in Manufacturing Metal Forming & Advanced Processing II	Track5: Tribology in Manufacturing Micro-Nanofabrication	
ROOM 305E		Track6: Engine & Transmission Tribology Rolling Bearings III		ROOM 305E	Track6: Engine & Transmission Tribology Rolling Bearings IV	Track6: Engine & Transmission Tribology Rolling Bearings V	
ROOM 307		Track6: Engine & Transmission Tribology Fluid Film Bearings III		ROOM 307	Track6: Engine & Transmission Tribology Fluid Film Bearings IV	Track6: Engine & Transmission Tribology Fluid Film Bearings V	
ROOM 308		Track7: Industrial Tribo-Systems Automotive Tribology I		ROOM 308	Track7: Industrial Tribo-Systems Automotive Tribology II	Track7: Industrial Tribo-Systems Space & Aerospace	
ROOM 311A		Track8: Tribotest & Monitoring Condition Monitoring & Data Analysis I		ROOM 311A	Track8: Tribotest & Monitoring Condition Monitoring & Data Analysis II	Track8: Tribotest & Monitoring Measurement & Instruments I	
			<b>Coffee Break</b>				

# PROGRAMME OVERVIEW

## DAY 3 - WEDNESDAY, SEPTEMBER 20, 2017

		Morning			Afternoon		
LOBBY	8:00-12:00	Registration	LOBBY	13:30-18:00	Registration	LOBBY	13:30-18:00
CONVENTION HALL No.1	Plenary Lectures	9:50-10:10	CONVENTION HALL No.1		15:30-16:30	CONVENTION HALL No.1	16:30-18:30
ROOM 201A		Track1: Science of Tribology Tribotechnology I	ROOM 201A	Track1: Science of Tribology Tribotechnology II		ROOM 201A	Track1: Science of Tribology Tribotechnology III
ROOM 201B		Track1: Science of Tribology Hydrodynamic and Mixed Lubrication	ROOM 201B	Track1: Science of Tribology Elastohydrodynamic Lubrication IV		ROOM 201B	Track1: Science of Tribology Elastohydrodynamic Lubrication V
ROOM 201D		Track2: Wear & Surface Engineering Wear VI	ROOM 201D	Track2: Wear & Surface Engineering Wear VII		ROOM 201D	Track2: Wear & Surface Engineering Wear VIII
ROOM 203A		Track2: Wear & Surface Engineering Coatings VI	ROOM 203A	Track2: Wear & Surface Engineering Coatings VII		ROOM 203A	Track2: Wear & Surface Engineering Coatings VIII
ROOM 203B		Track9: Tribology in Future Nanotribology	ROOM 203B	Track9: Tribology in Future Lubrication		ROOM 203B	Track9: Tribology in Future Biotribology
ROOM 203C		Track3: Lubrication & Lubricants Liquid Lubricants I	ROOM 203C	Track3: Lubrication & Lubricants Rheology of Lubricants II		ROOM 203C	Track3: Lubrication & Lubricants Liquid Lubricants II
ROOM 305A		Track3: Lubrication & Lubricants Additives VI	ROOM 305A	Track3: Lubrication & Lubricants Additives VII		ROOM 305A	Track3: Lubrication & Lubricants Additives VIII
ROOM 305C		Track4: Biotribology & Biomimetics Artificial Joints IV	ROOM 305C	Track4: Biotribology & Biomimetics Artificial Joints V		ROOM 305C	Track4: Biotribology & Biomimetics Organs & Tissues I: Tooth
ROOM 303		Track5: Tribology in Manufacturing CMP & Surface Processing I	ROOM 303	Track5: Tribology in Manufacturing CMP & Surface Processing II		ROOM 303	Track5: Tribology in Manufacturing CMP & Surface Processing III
ROOM 305E		Track6: Engine & Transmission Engine I	ROOM 305E	Track6: Engine & Transmission Engine II		ROOM 305E	Track6: Engine & Transmission Tribology Engine III
ROOM 307		Track6: Engine & Transmission Fluid Film Bearings VI	ROOM 307	Track6: Engine & Transmission Tribology Sealing I		ROOM 307	Track6: Engine & Transmission Tribology Sealing II
ROOM 308		Track7: Industrial Tribo-Systems Green Tribology	ROOM 308	Track7: Industrial Tribo-Systems Railway I		ROOM 308	Track7: Industrial Tribo-Systems Railway II
ROOM 311A		Track8: Tribotest & Monitoring Measurement & Instruments II	ROOM 311A	Track8: Tribotest & Monitoring Measurement & Instruments III		ROOM 311A	Track8: Tribotest & Monitoring Measurement & Instruments IV
<b>Coffee Break &amp; Poster Session (Lounge Area, Level 3)</b>							
<b>Lunch Break</b>							
<b>Coffee Break</b>							

## PROGRAMME OVERVIEW

**DAY 4 - THURSDAY, SEPTEMBER 21, 2017**

		Morning		Afternoon	
LOBBY	8:00-12:00	Registration	LOBBY	19:00-21:00	Banquet Dinner
CONVENTION HALL No.1	8:30-9:50	10:10-12:00	CONVENTION HALL No.1	13:30-15:30	15:30-15:50
	Plenary Lectures				
ROOM 201A		Track1: Science of Tribology Wear Fundamental I	ROOM 201A	Track1: Science of Tribology Wear Fundamental II	Track1: Science of Tribology Wear Fundamental III
ROOM 201B		Track1: Science of Tribology Nanotribology I	ROOM 201B	Track1: Science of Tribology Nanotribology II	Track1: Science of Tribology Nanotribology III
ROOM 201D		Track2: Wear & Surface Engineering Tribo-Materials I	ROOM 201D	Track2: Wear & Surface Engineering Tribo-Materials II	Track2: Wear & Surface Engineering Tribo-Materials III
ROOM 203A		Track2: Wear & Surface Engineering Coatings IX	ROOM 203A	Track2: Wear & Surface Engineering Coatings X	Track2: Wear & Surface Engineering Coatings XI
ROOM 203B		Track9: Tribology in Future Wear and Friction Control	ROOM 203B	Track9: Tribology in Future Carbon Based Materials	Track9: Tribology in Future Tribomaterials
ROOM 203C		Track3: Lubrication & Lubricants Liquid Lubricants III	ROOM 203C	Track3: Lubrication & Lubricants Liquid Lubricants IV	Track3: Lubrication & Lubricants Grease
ROOM 305A		Track3: Lubrication & Lubricants Ionic Liquids	ROOM 305A	Track7: Industrial Tribo-Systems Heavy Machinery I	Track7: Industrial Tribo-Systems Heavy Machinery II
ROOM 305C		Track4: Biotribology & Biomimetics Organs & Tissues II: Skin	ROOM 305C	Track4: Biotribology & Biomimetics Organs & Tissues III	Track4: Biotribology & Biomimetics Organs & Tissues IV
ROOM 303		Track1: Science of Tribology Tribophysics I	ROOM 303	Track1: Science of Tribology Tribophysics II	Track1: Science of Tribology Tribophysics III
ROOM 305E		Track6: Engine & Transmission Tribology Engine IV	ROOM 305E	Track6: Engine & Transmission Tribology Engine V	Track6: Engine & Transmission Tribology Gas Bearings
ROOM 307		Track6: Engine & Transmission Tribology Sealing III	ROOM 307	Track6: Engine & Transmission Tribology Sealing IV	Track6: Engine & Transmission Tribology Materials I
ROOM 308			ROOM 308	Track7: Industrial Tribo-Systems Energy Equipment I	Track7: Industrial Tribo-Systems Energy Equipment II
ROOM 311A		Track1: Science of Tribology Contact Mechanics I	ROOM 311A	Track1: Science of Tribology Contact Mechanics II	Track1: Science of Tribology Contact Mechanics III
					<b>Lunch Break</b>
					<b>Coffee Break</b>

# PROGRAMME OVERVIEW

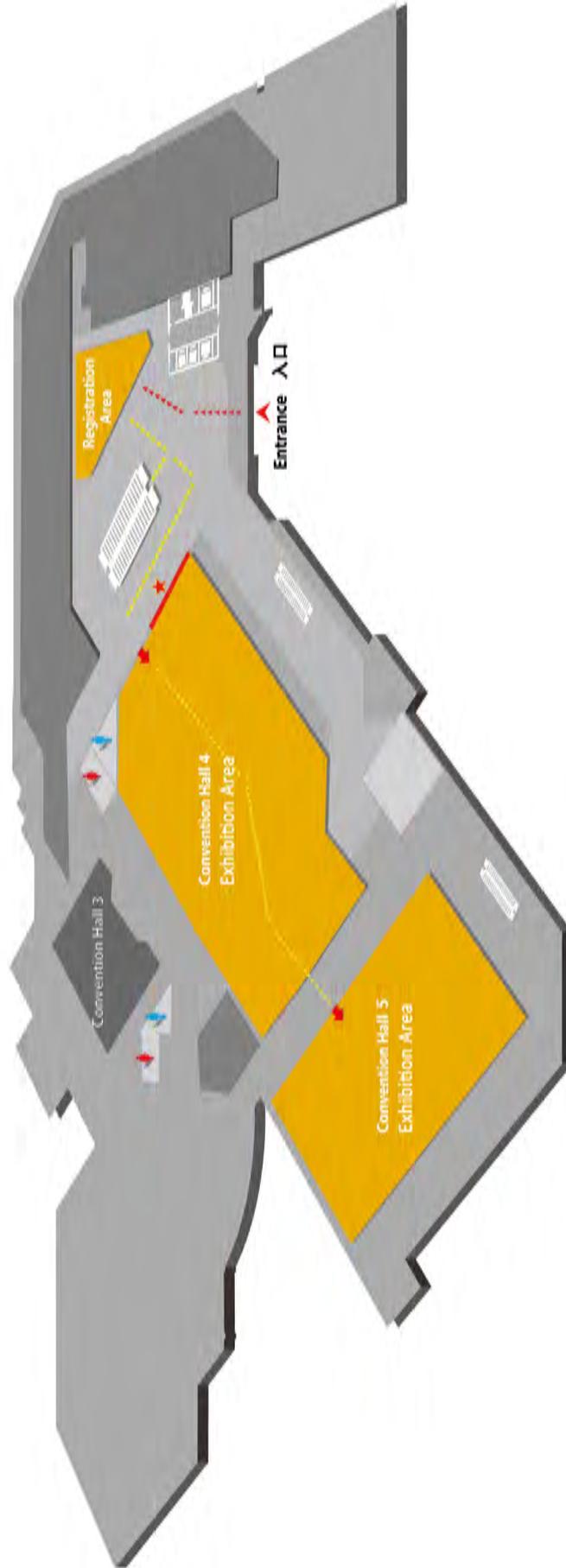
DAY 5 - FRIDAY, SEPTEMBER 22, 2017

		Morning			Afternoon		
		8:00-10:00	10:10-10:30	10:30-12:00	12:00-13:30	13:30-15:30	15:30-15:50
LOBBY			Registration				
			Coffee Break				
ROOM 201A	Track1:Science of Tribology Superlubricity I	Track1:Science of Tribology Superlubricity II	Lunch Break			Track1:Science of Tribology Superlubricity III	15:50-18:30
ROOM 201B	Track1:Science of Tribology Nanotribology IV						
ROOM 201D	Track2:Wear & Surface Engineering Tribo-Materials IV	Track2:Wear & Surface Engineering Tribo-Materials V				Track2:Wear & Surface Engineering Heat Treatment I	Track2:Wear & Surface Engineering Heat Treatment II
ROOM 203A	Track2:Wear & Surface Engineering Surface Modification I	Track2:Wear & Surface Engineering Surface Modification II				Track2:Wear & Surface Engineering Surface Modification III	
ROOM 203B	Track2:Wear & Surface Engineering Tribo-Corrosion I	Track2:Wear & Surface Engineering Tribo-Corrosion II				Track2:Wear & Surface Engineering Tribo-Corrosion III	Track2:Wear & Surface Engineering Surface Exploration
ROOM 203C							
ROOM 305A							
ROOM 305C	Track4:Biortribology & Biomimetics Biosurface & Contact I	Track4:Biortribology & Biomimetics Biosurface & Contact II				Track4:Biortribology & Biomimetics Biomaterials I	Track4:Biortribology & Biomimetics Biomaterials II
ROOM 305E	Track6:Engine & Transmission Tribology Gears I	Track6:Engine & Transmission Tribology Gears II	Track6:Engine & Transmission Tribology Gears III			Track6:Engine & Transmission Tribology Gears III	Track6:Engine & Transmission Tribology Gears IV
ROOM 307	Track6:Engine & Transmission Tribology Materials II	Track6:Engine & Transmission Tribology Materials III					
ROOM 308	Track7:Industrial Tribo-Systems Tribology of Machine Elements I	Track7:Industrial Tribo-Systems Tribology of Machine Elements II					
ROOM 311A	Track1:Science of Tribology Contact Mechanics IV	Track1:Science of Tribology Contact Mechanics V					

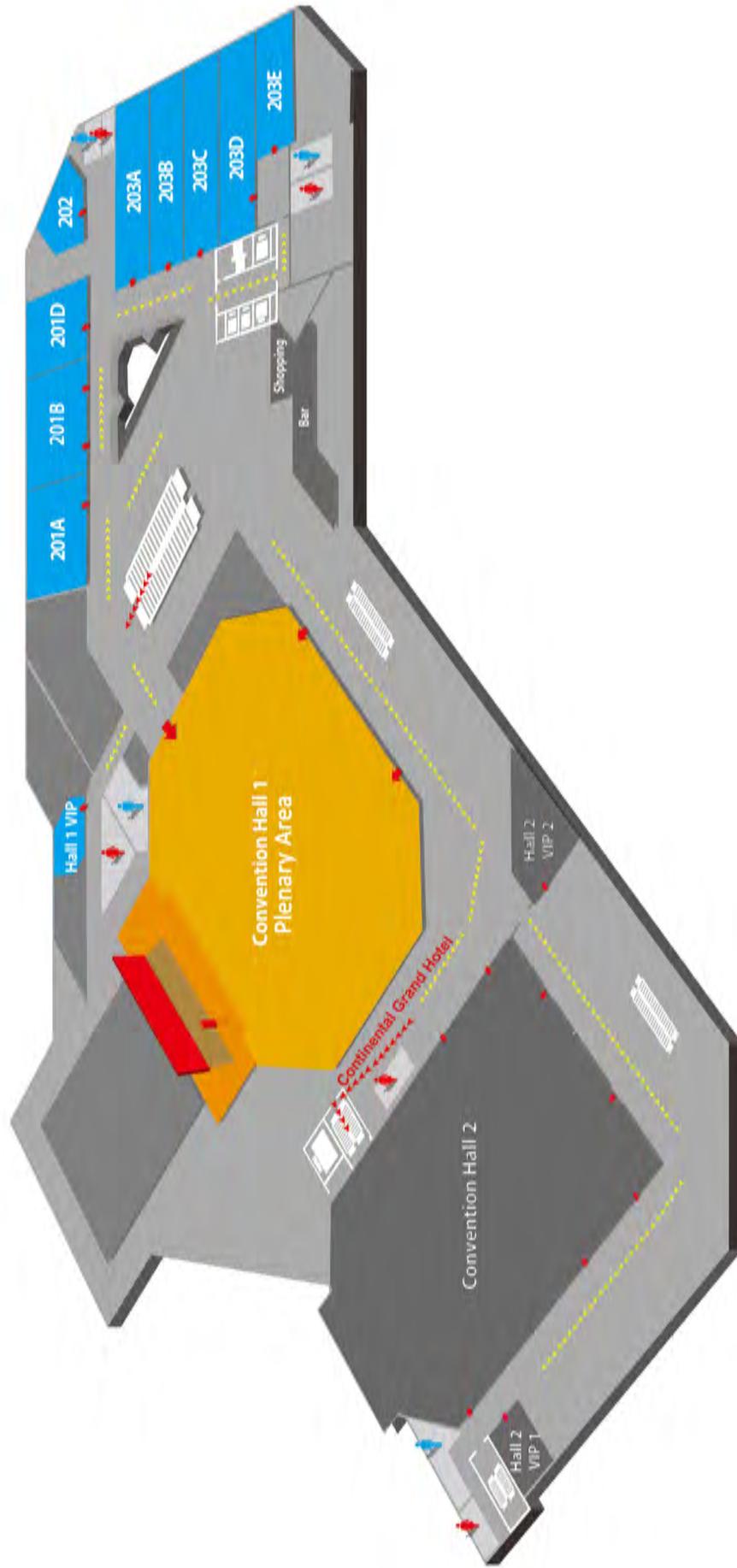
# ***FLOOR PLAN***



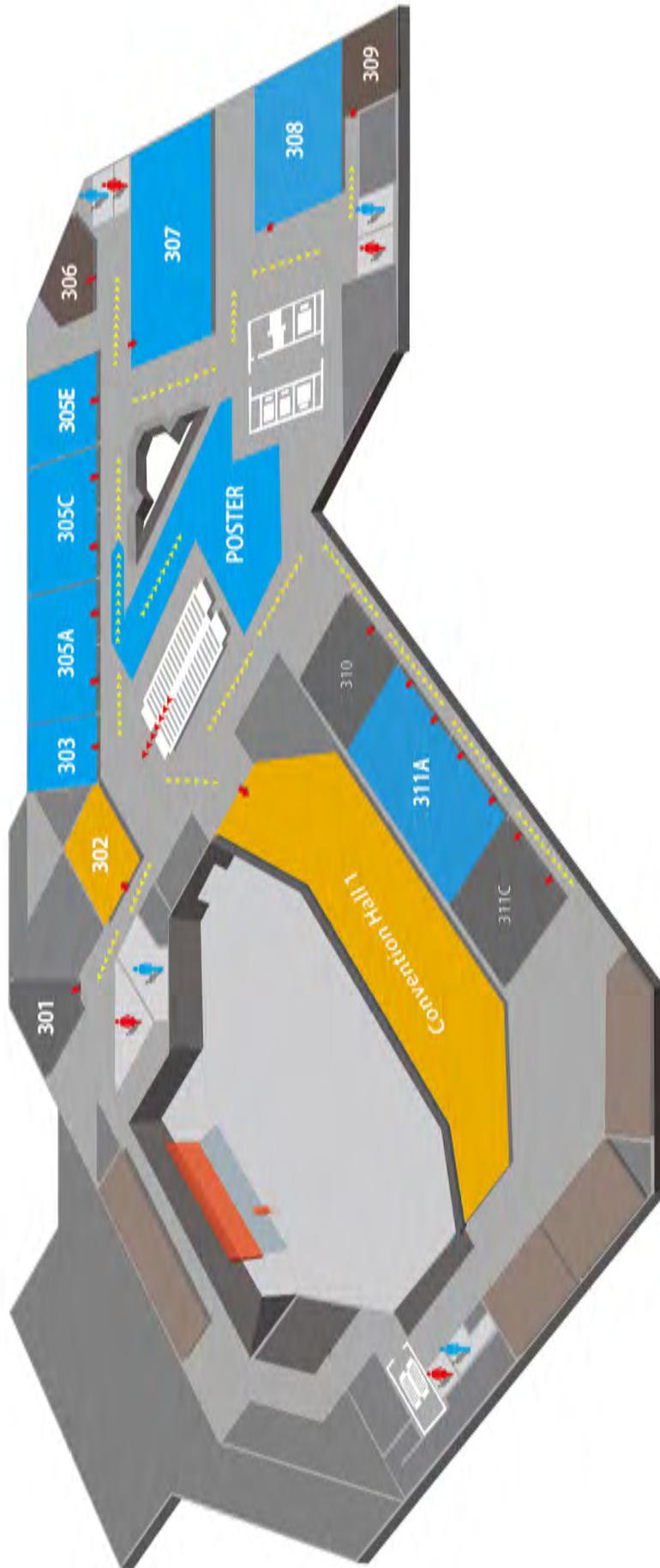
# Plan of BICC Level 1



# Plan of BICC Level 2



### Plan of BICC Level 3



# ***TRAINING*** ***& WORKSHOPS***





# 2017 World Tribology Congress • Plenary Training Lecture

**WTC 2017** BEIJING CHINA  
6th World Tribology Congress



**6 Top Experts** share with you the frontier trends of tribology. Content covers the frontier and foundation of friction and lubrication, physical chemistry, lubricating material, etc. In here, you can feel the wisdom of academicians, listen to the voices of international experts and touch the pinnacle of friction and lubrication field.

## Experts

**Xue Qunji**, Member of the Chinese Academy of Engineering. Prof. Xue's research includes special lubricating materials and material chemistry, he is one of the major academic leaders in this field.

Awards Won :

Supreme Achievement Award in Tribology in 2009;

Tribology Gold Medal in 2011, which is the top prize in the international field of tribology.

**Wilfried J. Bartz**, Key Scientist at AC<sup>2</sup>T Research GmbH, Consultant for Tribology at Technical Academy Esslingen. He is engaged in non-Newtonian lubricants in journal bearings, gear lubrication, engine lubrication and solid and synthetic lubricants.

Awards Won :

German Distinguished Service Cross; Tribology Gold Medal, The Tribology Trust Fund; Austrian I. Class Cross of Honour for Science and Arts; International Tribology Award of STLE; Honorary Doctor of Science, V.A. Belyi Metal-Polymer Research Institute, Gomel

**Ali Erdemir**, Member of the Argonne National Laboratory

He is an Argonne Distinguished Fellow and Senior Scientist with international recognition and significant accomplishments in the fields of materials science, surface engineering and tribology.

He has received numerous awards, including 6 R&D 100 Awards; he holds 15 U.S. patents; and has published more than 300 papers, 18 invited book and handbook chapters, and 3 edited books.

**Raymund Policarpio**, Regional BD Manager - APAC, SGS

SGS is the world's leading inspection, verification, testing and certification company, which is recognized as the global benchmark for quality and integrity.

**Michael Anderson**

International Sales Manager, Falex Corp. Certified Lubrication Specialist of STLE

**Greg Croce**

Technical Manager, Chevron Lubricants. Certified Lubrication Specialist of STLE

They are frequent contributors to technical education courses. Greg currently serves as the chairman of STLE's Education Committee. Both of them have earned the STLE Certified Lubrication Specialist designation, the only independent certification for the lubrication professional that verifies your broad lubrication engineering knowledge.

## Agenda

**TIME** (09/17, 2017)

## Lecturers & Topics

09:00-13:00

Registration

**13:00-13:05**

**Opening Remarks**

13:05-13:50

Xue Qunji, Tribochemistry

13:50-14:35

Wilfried J. Bartz, From Combustion Engines to Electromobility – Tribological Aspects

14:35-15:20

Ali Erdemir, Friction Control Technology: A Pathway to Energy Savings and Environmental Sustainability

**15:20-15:30**

**Break**

15:30-16:15

Raymund Policarpio, Oil Analysis Fundamentals

16:15-17:00

Michael Anderson, Tribology: The Science and How to Measure It

17:00-17:45

Greg Croce, Additive Chemistry: Fundamental Concepts and Advanced Formulation Issues

**Registration Fee** :1) The participants have registered WTC 2017, free of charge

2) The participants have not registered WTC 2017, 800RMB per person

**Address:** Room 201, Beijing International Conference Center

**Sponsor:**

STLE;

State Key Laboratory of Tribology Tsinghua University

Tel: +86-22-84819351; +86-18522505480

Email: zhoupf@tsinghua-tj.org

**Organizer:**

Tsing Yan Testing (Tianjin) Co., Ltd.

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# WTC- 2017 C&U Group WORKSHOP Agenda

Conference theme: **Bearing & tribology**

Guest speakers: **Mr. Jiaqun He, Mr. Lianchun Zhao Mr. Changjian Guo**

Conference time: **13:30-16:00, 19th September 2017**

Conference location: **Beijing China National Convention Center, Conference Room No.302**

Conference duration: **2.5 hours**

Conferee: **University scholars invited by C&U, WTC conferee**



**Mr. Jiaqun He**  
National science award  
evaluation expert  
Professor level senior engineer  
Special member of China  
bearing industry association



**Mr. Lianchun Zhao**  
Ph,D in Engineering Tribology  
of Zhejiang University,  
Professorate Senior Engineer,  
Vice General Secretary of  
SAT/TC98

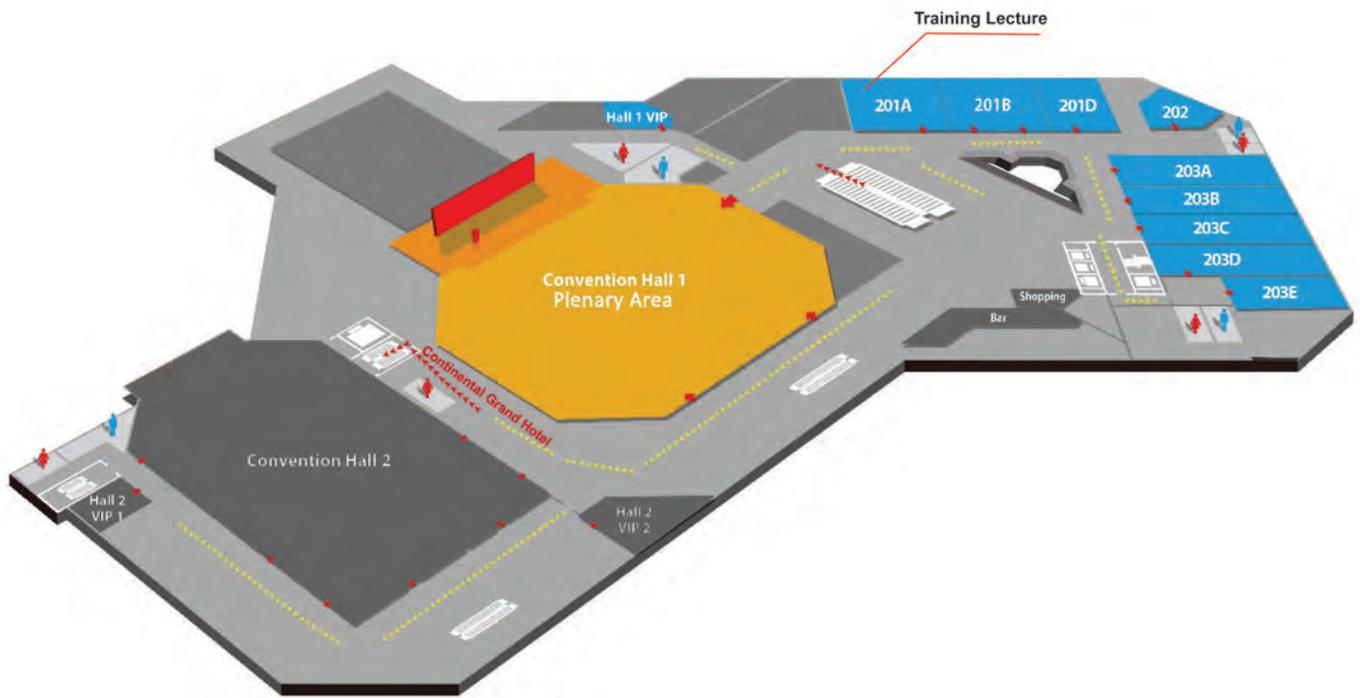


**Mr. Changjian Guo**  
Director C&U Group R&D  
Center, Member of Technical  
Committee of CBIA, Member of  
Expert Committee of CBIA

## Conference agenda details:

Process	Content	Responsible person	Time
1	Opening	Conference theme, process Guests, C&U introduction Express welcome and guide into speech	10mins
		Mr. Ning Zhang (Host) Miss Fang Lu (Interpreter)	
2	Speech 1	Low friction design applied in bearing	30mins
3	Speech 2	Development status and trend of China and world bearing industry	30mins
		Mr. Jiaqun He (Presenter) Miss Fang Lu (Interpreter)	
4	Break time	Break and communication time	10mins
		Mr. Ning Zhang (Host) Conference service staffs	
5	Speech 3	Tribology failure and lubrication of rolling bearings	30mins
6	Q & A	Q & A about the speech of three guest speakers and related questions about theme of this workshop	30mins
		Mr. Ning Zhang (Host) Miss Fang Lu (Interpreter) Conference service staffs	
		Mr. Ning Zhang (Host) Miss Fang Lu (Interpreter)	
7	Summary	Summarize the topic of conference Express gratitude to conferee	5mins
		Mr. Ning Zhang (Host) Miss Fang Lu (Interpreter)	

Warmly welcome every guest and representative!



# ***TECHNICAL*** *SESSIONS*



**Room 201A****Track1: Science of Tribology****Friction Fundamental I**Chair: Michael URBAKH, *Tel Aviv University, Israel***13:30-14:00 Keynote**

Scale dependence of friction and contact from nanometer to millimeter tip radii

Mark ROBBINS

*The Johns Hopkins University, USA***14:00-14:25 Invited**

Amontons' law between randomly rough surfaces

Hiroshi MATSUKAWA

*Aoyama Gakuin University, Japan***14:25-14:45**

Sliding friction of graphene/h-BN heterojunctions: towards robust solid nano-lubrication

Davide MANDELLI, Itai LEVEN, Oded HOD, Michael URBAKH

*Tel Aviv University, Israel***14:45-15:05**Friction coefficient measured on a single WS<sub>2</sub> nanoparticle: an in situ transmission electron microscope experiment

Fabrice DASSENOY, Istvan JENEI

*Ecole Centrale de Lyon, France***15:05-15:25**

From the multi-contact to rate-state model

Wengen OUYANG<sup>1</sup>, Ming MA<sup>2</sup>, Michael URBAKH<sup>1</sup><sup>1</sup>*Tel Aviv University, Israel;* <sup>2</sup>*Tsinghua University, China***15:30-15:50**

Coffee Break

**Room 201A****Track1: Science of Tribology****Friction Fundamental II**Chair: Hiroshi MATSUKAWA, *Aoyama Gakuin University, Japan***15:50-16:10**

Tribochemical wear of bare silicon in humid air and alkali solutions

Cheng CHEN, Peng ZHANG, Chen XIAO, Lei CHEN, Linmao QIAN

*Southwest Jiaotong University, China***16:10-16:30**

Low-friction characterization of random-textured surface of microcrystalline diamond coatings, thanks to the relaxation tribometer technique

Michel BELIN<sup>1</sup>, Hiroyuki MIKI<sup>2</sup>, Toshiyuki TAKAGI<sup>2</sup><sup>1</sup>*CNRS, France;* <sup>2</sup>*Tohoku University, Japan***16:30-16:50**

Numerical prediction of the optimal surface roughness of boundary friction

Xiaogang ZHANG<sup>1</sup>, Yali ZHANG<sup>2</sup>, Tonghai WU<sup>3</sup>, SangarapillaiKANAPATHIPILLAI<sup>1</sup>, Zhongxiao PENG<sup>1</sup><sup>1</sup>*The University of New South Wales, Australia;* <sup>2</sup>*Southwest Jiaotong University, China;* <sup>3</sup>*Xi'an Jiaotong University, China***16:50-17:10**

Superlubricity of graphene at the microscale

Tianbao MA

*Tsinghua University, China***17:10-17:30**

A numerical approach to predict tribological behaviour in soft contacts

Qian WANG<sup>1</sup>, Tom REDDYHOFF<sup>1</sup>, Nicolaas-Alexander GOTZEN<sup>2</sup>, Wim BUSEYNE<sup>2</sup>, Daniele DINI<sup>1</sup><sup>1</sup>*Imperial College London, UK;* <sup>2</sup>*Robert Bosch Produktie N.V., Belgium***17:30-17:50**

Numerical analysis of surface forces of diamond-like-carbon surface covered with molecularly thin lubricant film

Kyosuke ONO

*Tokyo Institute of Technology, Japan***17:50-18:10**

Numerical simulation on the adhesive contact between rough surfaces

Jiunn-Jong WU

*Chang Gung University, Taiwan, China***18:10-18:30**

Threshold energy for tribochemical removal of silicon surface

Chen XIAO, Lei CHEN, Cheng CHEN, Peng ZHANG, Linmao QIAN

*Southwest Jiaotong University, China***Room 201B****Track1: Science of Tribology****Molecular and Boundary Film Lubrication I**Chair: Yu TIAN, *Tsinghua University, China***13:30-13:55 Invited**

The relationship between wetting and lubrication

Feng ZHOU

*Lanzhou Institute of Chemical Physics, China***13:55-14:15**

Boundary film formation and competitive adsorption

Sophie CAMPEN, Janet WONG

*Imperial College London, UK***14:15-14:35**

Asperity scale description of initial stages of a boundary lubricated contact

Peter JACOBS<sup>1</sup>, Andrew KONICEK<sup>1</sup>, Fang CAO<sup>1</sup>, Gary HUNTER<sup>1</sup>, Martin WEBSTER<sup>1</sup>, Simon MEDINA<sup>1</sup>, Daniele DINI<sup>2,3</sup><sup>1</sup>*ExxonMobil Corporate Strategic Research, USA;* <sup>2</sup>*Imperial Consultants, UK;*<sup>3</sup>*Imperial College, UK***14:35-14:55**

Liquid/solid interface of ionic liquids: an investigation of molecular behavior

Haoyu LI, Liran MA, Jianbin LUO

*Tsinghua University, China***14:55-15:15**

Effect of lubricant volume on thin film hydrodynamic lubrication

Liang GUO<sup>1</sup>, Patrick WONG<sup>1</sup>, Feng GUO<sup>2</sup><sup>1</sup>*City University of Hong Kong, Hong Kong, China;* <sup>2</sup>*Qingdao University of Technology, China*

15:15-15:50  
Coffee Break

**Room 201B**

**Track 1: Science of Tribology**

**Molecular and Boundary Film Lubrication II**

Chair: Feng ZHOU, Lanzhou Institute of Chemical Physics, China

15:50-16:15 **Invited**

Excellent lubrication of liquid metal under extremely high load  
Yu TIAN

Tsinghua University, China

16:15-16:40 **Invited**

In-situ tracking of the dynamic structure evolution in nanometer confined liquids by combining X-Ray reflectivity and white light interferometry in a surface forces apparatus

Markus VALTINER<sup>1,3</sup>, Sadhanaa BUVANESWARAN<sup>1</sup>, Henning WEISS<sup>2</sup>, Hsiu-Wei CHENG<sup>1</sup>, Claudia MEROLA<sup>1</sup>, Julian MARS<sup>2</sup>, Markus MEZGER<sup>2</sup>

<sup>1</sup>Max-Planck-Institut f. Eisenforschung GmbH, Germany; <sup>2</sup>Max-Planck-Institut f. Polymerforschung, Germany; <sup>3</sup>Technische Universität Bergakademie Freiberg, Germany

16:40-17:00

Forced oscillations and real-time insights of lubricated interfaces

Malik YAHIAOUI, Emmanuel RIGAUD, Denis MAZUYER, Juliette CAYER-BARRIOZ

Ecole Centrale de Lyon, France

17:00-17:20

Probing the soft spot: fluid confinement in contact

Rok SIMIC, Christian H MATHIS, Nicholas D SPENCER

ETH Zurich, Switzerland

17:20-17:40

A deterministic model for boundary lubrication and flash temperature in a transient elliptical contact

Dichu XU<sup>1</sup>, Jiugen WANG<sup>1</sup>, Anne NEVILLE<sup>2</sup>, Ardian MORINA<sup>2</sup>

<sup>1</sup>Zhejiang University, China; <sup>2</sup>University of Leeds, UK

17:40-18:00

Experimental investigation on the friction modifier effect of vegetable oil derived biodiesels

Siti Hartini HAMDAN<sup>1,3</sup>, William Woei Fong CHONG<sup>2</sup>

<sup>1</sup>University of Southampton Malaysia Campus, Malaysia; <sup>2</sup>Universiti Teknologi Malaysia, Malaysia; <sup>3</sup>University Kuala Lumpur, Malaysia

**Room 201D**

**Track 2: Wear & Surface Engineering**

**Wear I**

Chair: Noritsugu UMEHARA, Nagoya University, Japan

13:30-14:00 **Keynote**

Erosion by solid, liquid droplet and micro-jet (due to bubble collapse) impact: the importance of stress waves

Robert JK WOOD

University of Southampton, United Kingdom

14:00-14:25 **Invited**

Erosive, abrasive and sliding wear characteristics of super-hard, ultra-thick nanocomposite coatings

Ronghua WEI

Southwest Research Institute, United States

14:25-14:45

Friction and wear behaviour in dry sliding of hard metals

Andreas BLUTMAGER<sup>1</sup>, Markus VARGA<sup>2</sup>, Paul Heinz MAYRHOFER<sup>3</sup>, Walter FRIESENBICHLER<sup>1</sup>

<sup>1</sup>Montanuniversität Leoben, Austria; <sup>2</sup>AC2T research GmbH, Austria; <sup>3</sup>TU Wien, Austria

14:45-15:05

Transition of heat generation behavior during scuffing process of steel

Yasuo MATSUZAKI, Kazuyuki YAGI, Joichi SUGIMURA

Kyushu University, Japan

15:05-15:25

Influence of ceramic tribo-elements on friction and wear of smooth steel surfaces

Andrzej DZIERWA<sup>1</sup>, Pawel PAWLUS<sup>1</sup>, Rafal REIZER<sup>2</sup>

<sup>1</sup>Rzeszow University of Technology, Poland; <sup>2</sup>University of Rzeszow, Poland

15:25-15:50

Coffee Break

**Room 201D**

**Track 2: Wear & Surface Engineering**

**Wear II**

Chair: Jianhua ZHANG, Shanghai University, China

15:50-16:15 **Invited**

White etching cracks (WECs) in wind turbine bearings

Ling WANG<sup>1</sup>, Walter HOLWEGGER<sup>2</sup>

<sup>1</sup>nCATS, Faculty of Engineering and the Environment, University of Southampton, UK; <sup>2</sup>Schaeffler Technologies AG & Co. KG, Germany

16:15-16:35

Tribological investigations of particle of phase change reinforced nylon under high load and speed

Bingli PAN

Henan University of Science and Technology, China

16:35-16:55

Influence of different abrasive wear methods on the surface of nanoausferritic ductile iron castings

Dawid MYSZKA<sup>1</sup>, Andrzej N. WIECZOREK<sup>2</sup>

<sup>1</sup>Warsaw University of Technology, Poland; <sup>2</sup>Silesian University of Technology, Poland

16:55-17:15

Tribological behavior of nitrided ductile cast iron D6510 under different contacting conditions

Xueyuan NIE, Chen ZHAO, Ran CAI, Jingzeng ZHANG

University of Windsor, Canada

17:15-17:35

Wear behavior of tetrahedral amorphous carbon nitride sliding against steel and alumina disks under PAO oil lubrication

Xiaoxu LIU, Ryo YAMAGUCHI, Noritsugu UMEHARA, Motoyuki MURASHIMA  
Nagoya University, Japan



**17:35-17:55**

Effect of applied load on wear property of tetrahedral amorphous carbon and hydrogenated amorphous carbon under the oil boundary

Li XIANG<sup>1</sup>, Noritsugu UMEHARA<sup>1</sup>, Hiroyuki KOUSAKA<sup>2</sup>

<sup>1</sup>Nagoya University, Japan; <sup>2</sup>Gifu University, Japan

**17:55-18:15**

Tribological behavior of electron beam melting printed Ti-6Al-4V samples

Weiquan TOH<sup>1</sup>, Xipeng TAN<sup>1</sup>, Erjia LIU<sup>2</sup>, Shu Beng TOR<sup>2</sup>

<sup>1</sup>Singapore Center for 3D Printing, Singapore; <sup>2</sup>Nanyang Technological University, Singapore

**18:15-18:35**

A new methodology to evaluate the abrasion property of polymer surface

Shuai LIU, Vincent LE HOUEROU, Christian GAUTHIER

Intitut Charles Sadron, France

**Room 203A****Track 2: Wear & Surface Engineering****Coatings I**

Chair: Haidou WANG, Academy of Armored Forces Engineering, China

**13:30-14:00 Keynote**

Continuous formation of nanointerface to promote super-low friction of carbon-based coatings

Koshi ADACHI

Tohoku University, Japan

**14:00-14:20**

Ultralow friction of ZrO<sub>2</sub> ball sliding against DLC films under different testing environments and temperatures

Qunfeng ZENG<sup>1,2</sup>, Ali ERDEMIR<sup>2</sup>, Osman ERYLIMAZ<sup>2</sup>, Giovanni RAMIREZ<sup>2</sup>

<sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Argonne National Laboratory, United States

**14:20-14:40**

Carbonaceous tribo-layer for the super-low friction of carbon nitride coatings

Naohiro YAMADA, Takanori TAKENO, Koshi ADACHI

Tohoku University, Japan

**14:40-15:00**

Low friction Induced by 1 nm alternative layer in nanocrystalline multilayer carbon films

Peidong XUE<sup>1</sup>, Lei YANG<sup>1</sup>, Dongfeng DIAO<sup>2</sup>

<sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Guangdong Provincial Key Laboratory of Micro/Nano Optomechatronics Engineering, China

**15:00-15:20**

Effect of tribofilm's morphology on the tribological properties of DLC: ZnDTP derived tribofilm characterization by 3D SEM observation

Kouami Auxence Melardot ABOUA

Nagoya University, Japan

**15:30-15:50**

Coffee Break

**Room 203A****Track 2: Wear & Surface Engineering****Coatings II**

Chair: Dae-Eun KIM, Yonsei University, Korea

**15:50-16:15 Invited**

Surface chemistry and Structural Changes of Compliant Hard Carbon Coatings for achieving superlubricity

Maria Isabel DE BARROS BOUCHET, Jean-Michel MARTIN

Laboratoire de Tribologie et Dynamique des Systèmes, Université de Lyon, France

**16:15-16:35**

Atmospheric helium plasma irradiation to Si containing DLC surface during sliding against plastic balls

Hiroyuki KOUSAKA<sup>1,2</sup>, Shunsuke OKUMURA<sup>2</sup>, Noritsugu UMEHARA<sup>2</sup>,

Motoyuki OKUMURA<sup>2</sup>

<sup>1</sup>Gifu University, Japan; <sup>2</sup>Nagoya University, Japan

**16:35-16:55**

Tribology of different types of very hard carbon

Volker WEIHNACHT, Stefan MAKOWSKI, Frank SCHALLER, Andreas LESON

Fraunhofer IWS, Germany

**16:55-17:15**

Tribological study of thick ta-C coating at elevated temperatures prepared under different substrate bias voltages

Woo Young LEE<sup>1</sup>, Noritsugu UMEHARA<sup>1</sup>, Takayuki TOKOROYAMA<sup>1</sup>, Motoyuki

MURASHIMA<sup>1</sup>, Young Jun JANG<sup>2</sup>, Jong Kuk KIM<sup>2</sup>

<sup>1</sup>Nagoya University, Japan; <sup>2</sup>Korea Institute of Materials Science, Korea

**17:15-17:35**

High-temperature friction coefficients and wear of an amorphous hydrogenated DLC coating

Youfeng ZHANG, Andreas POLYCARPOU

Texas A & M University, United States

**17:35-17:55**

The effect of penetrated diamond-like carbon overcoat on the fretting wear performance

Zhengqiang TANG, Dongdong ZHOU, Huijie ZHANG

Guizhou University, China

**17:55-18:15**

Molecular dynamics study on nanoindentation of ultra-thin amorphous carbon films on silicon substrate

Qingkang LIU, Longqiu LI, Guangyu ZHANG, Guangbin SHAO

Harbin Institute of Technology, China

**18:15-18:35**

Effect of lubricant formulations on the tribological performance of diamond-like carbon (DLC) coated direct-acting valve train components

Rehan ZAHID<sup>1,2</sup>, Masjuki HASSAN<sup>1</sup>, Abul KALAM<sup>1</sup>, Mahendra VARMAN<sup>1</sup>, Riaz

MUFTI<sup>2</sup>, Nurin ZULKIFLI<sup>1</sup>, Mubashir GULZAR<sup>1</sup>, Usman ABDULLAH<sup>2</sup>, Usman

BHUTTA<sup>2</sup>, Mian ASHFAP<sup>2</sup>

<sup>1</sup>University of Malaya, Malaysia; <sup>2</sup>NUST School, China



## Room 203B

## Track 2: Wear &amp; Surface Engineering

## Texturing I

Chair: Izhak ETSION, Technion-Israel Institute of Technology, Israel

13:30-13:50

The tribological performance of roller and ball bearings by direct laser interference patterning

Chia-Jui HSU<sup>1</sup>, Carsten GACHOT<sup>2</sup>, Andreas STRATMANN<sup>3</sup><sup>1</sup>Saarland University, Germany; <sup>2</sup>Vienna University of Technology, Austria;<sup>3</sup>RWTH Aachen University, Germany

13:50-14:10

The combined effects of surface textures and friction modifier MoDDP under flooded and starved lubrication conditions

Linqing BAI<sup>1</sup>, Yonggang MENG<sup>1</sup>, Varian ZHANG<sup>2</sup><sup>1</sup>State Key Laboratory of Tribology, China; <sup>2</sup>Shell (Shanghai) Technology Ltd., China

14:10-14:30

Tribological properties of carbon film with pit-type array fabricated by plasma etching through pre-substrate filter

Sicheng CHEN<sup>1</sup>, Lei YANG<sup>1</sup>, Dongfeng DIAO<sup>2</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Shenzhen University, China

14:30-14:50

Formation of nanoholes and nanobumps by multiple laser pulses irradiation of silica spheres

Dong FENG, Jiadao WANG, Songling XING

Tsinghua University, China

14:50-15:10

Piston surface textures to improve the lubrication performance of swash plate pump

Xuan MA<sup>1,2</sup>, Xiqun LU<sup>1</sup>, Viral S. MEHTA<sup>3</sup>, Qian Jane WANG<sup>2</sup><sup>1</sup>Harbin Engineering University, China; <sup>2</sup>Northwestern University, USA;<sup>3</sup>Caterpillar, USA

15:10-15:30

Patterning on different scales to guide lubricants effectively

Philipp GRÜTZMACHER<sup>1</sup>, Andreas ROSENKRANZ<sup>2</sup>, Carsten GACHOT<sup>3</sup>, Frank MÜCKLICH<sup>1</sup><sup>1</sup>Saarland University, Germany; <sup>2</sup>University of California, USA; <sup>3</sup>Vienna University of Technology, Austria

15:30-15:50

Coffee Break

## Room 203B

## Track 2: Wear &amp; Surface Engineering

## Texturing II

Chair: Jiliang MO, Southwest Jiaotong University, China

15:50-16:15 Invited

A critical review about past, present and future developments in surface texturing for tribological applications

Gachot CARSTEN

Vienna University of Technology, Austria

16:15-16:35

Design, manufacturing and tribological performance of microtextured bucket tappets for friction reduction in the valve train

Max MARIAN<sup>1</sup>, Michael ZAHNER<sup>2</sup>, Stephan TREMMEL<sup>1</sup>, Kolja ANDREAS<sup>2</sup>, Marion MERKLEIN<sup>2</sup>, Sandro WARTZACK<sup>1</sup><sup>1</sup>Engineering Design, FAU Erlangen-Nuremberg, Germany; <sup>2</sup>Manufacturing Technology, FAU Erlangen-Nuremberg, Germany

16:35-16:55

Effect of microdimple textured surface on friction under elastic dry reciprocating contacts

Muthu Kumar MARIAPPAN, M. S. BOBJI

Indian Institute Of Science, India

17:10-17:30

Thermohydrodynamic lubrication analysis of a surface textured parallel thrust bearings

Tae-Jo PARK, Min-Gyu KIM

Gyeongsang National University, Korea

17:30-17:50

Effect of surface texturing and air-plasma treatment on the adhesive strength of high build epoxy coatings on metallic substrates

Bobby SATHEESAN, Abdul Samad MOHAMMED

King Fahd University of Petroleum and Minerals, Saudi Arabia

17:50-18:10

Influence of internal wall ripple structure on cavitation flow characteristics of organ pipe nozzle

Xiang XU, Jun SUN, Xinze ZHAO, Hongling QIN, Meiyun ZHAO

China Three Gorges University, China

18:10-18:30

Effect of aloe glue on the tribological properties of multi-level textured Mg alloy surface

Dongya ZHANG, Yanfeng GE, Jianlei WANG

Xi'an University of Technology, China

## Room 203C

## Track3: Lubrication and Lubricants

## Chemistry of lubricants I

Chair: W Gregory SAWYER, University of Florida, USA

13:30-14:00 Keynote

Moving tribochemistry into the third dimension

Nicholas D. SPENCER

ETH Zurich, Switzerland

14:00-14:25 Invited

Reaction pathway and kinetic modeling of the gas-phase lubrication of copper by dialkyl disulfides

Wilfred TYSOE<sup>1</sup>, Heather ADAMS<sup>1</sup>, Ashlie MARTIN<sup>2</sup><sup>1</sup>University of Wisconsin-Milwaukee, USA; <sup>2</sup>University of California-Merced, USA

14:25-14:45

Effects of temperature on friction and wear properties of poly-alpha-olefin in reciprocating sliding tests

Lichun HAO, He YANG, Ying XUE

RIPP, China



**14:45-15:05**

Relationships between molecular structure and properties of polyalphaolefin (pao): spectral, thermal and oxidation stabilities

Jiusheng LI, Yuefeng MA, Jian XU

*Shanghai Advanced Research Institute, Chinese Academy of Sciences, China***15:05-15:25**Adsorption and thin film lubrication of aqueous tri-block copolymer lubricant on 3D rough TiO<sub>2</sub> surfaces

Thi Dinh TA, Anh Kiet TIEU, Hongtao ZHU, Ha Manh LE, Huong Thi Thuy TA

*University of Wollongong, Australia***15:25-15:50**

Coffee Break

**Room 203C****Track3: Lubrication and Lubricants****Rheology of lubricants II****Chair: W Gregory SAWYER, University of Florida, USA****15:50-16:15 Invited**

Lubricant rheology and lubrication of rough surfaces

Petr SPERKA, Ivan KRUPKA, Martin HARTL

*Brno University of Technology, Czech***16:15-16:35**

The application of a molecular-continuum coupling strategy for the modelling of liquid lubricants

Fernandez Eduardo RAMOS, Edward SMITH, Daniele DINI

*Imperial College London, UK***16:35-16:55**

Elastohydrodynamic lubrication and the glass transition: linking experiment and simulation at high rates and pressures

Mark ROBBINS<sup>1</sup>, Vikram JADHAO<sup>1,2</sup>*<sup>1</sup>Johns Hopkins University, UK; <sup>2</sup>Indiana University, USA***16:55-17:15**

A new rheology model based on the time of recovery and simulations of the rheological behavior for oils with various viscosity

Ping YANG, Jinlei CUI, Xiaoling LIU, Peiran YANG

*Qingdao university of technology, China***17:15-17:35**

Study on the development of oil film state in a rotating disk

Dingming WANG, Bo CHEN, Zhongtao GU

*Southwest University of Science and Technology, China***17:35-17:55**

Inhomogeneous film formation of solidified lubricant in elastohydrodynamic lubrication conditions

Kazuyuki YAGI, Kazuki NISHIDA, Joichi SUGIMURA

*Kyushu University, Japan***17:55-18:15**

New mensuration of high pressure density upto 1.2 GPa for Lubricants

Bo ZHANG, Yohei SAKAMOTO, Toshifumi MAWATARI

*Saga University, Japan***Room 305A****Track3: Lubrication and Lubricants****Additives I****Chair: Janet WONG, Imperial College London, UK****13:30-13:55 Invited**Tribological behavior of industrial WS<sub>2</sub> nanoparticles in PAO base oil on smooth and rough surfacesFabrice DASSENNOY<sup>1</sup>, Paula USSA<sup>1,2</sup>, Thierry LE MOGNE<sup>1</sup>, Béatrice VACHER<sup>1</sup>, Benoit THIEBAUT<sup>2</sup>*<sup>1</sup>Ecole Centrale de Lyon, France; <sup>2</sup>TOTAL, France***13:55-14:15**

Influences of sulfur-containing additives on grease decomposition by nascent metal surface

Peng YAO<sup>1</sup>, Tomoya UETA<sup>1</sup>, Kyoji KONDO<sup>1</sup>, Toshiaki WAKABAYASHI<sup>1</sup>, Yasuha TOKUMO<sup>2</sup>, Yusuke AYAME<sup>2</sup>, Yuji SHITARA<sup>2</sup>*<sup>1</sup>Kagawa University, Japan; <sup>2</sup>JX Nippon Oil & Energy Corporation, Japan***14:15-14:35**

The study of quantitative structure tribo-ability relationship for organic compounds as lubricant additives

Xinlei GAO<sup>1</sup>, Kang DAI<sup>2</sup>, Zhan WANG<sup>1</sup>, Tingting WANG<sup>1</sup>*<sup>1</sup>Wuhan Polytechnic University, China; <sup>2</sup>South-Central University for Nationalities, China***14:35-14:55**The importance of spectrum or actual loading in milled MoS<sub>2</sub> powder greases using four ball wear test

Gabi NEHME

*University of Balamand, Lebanon***14:55-15:15**

Effect of fatty acid additives on viscoelastic properties of poly-alfa-olefin lubricants confined and sheared in nanometer-sized gap

Shintaro ITOH, Kento KAMIYA, Kenji FUKUZAWA, Hedong ZHANG

*Nagoya University, Japan***15:15-15:35**

The size effect on the tribological properties of few-layer graphene oxide sheets as water-based lubricant additives

Zhe CHEN, Yuhong LIU, Jianbin LUO

*Tsinghua University, China***15:35-15:50**

Coffee Break

**Room 305A****Track3: Lubrication and Lubricants****Additives II****Chair: C.H. VENNER, University of Twente, Netherland****15:50-16:10**

Adsorption behaviour and nanotribological property of sodium carboxylate on Fe substrate in water

Naoki AKAMATSU, Tomoko HIRAYAMA, Takashi MATSUOKA, Hideaki HATTORI, Fumiaki TAKAGI, Norifumi YAMADA

*Doshisha University, JST Presto, Idemitsu Kosan Co. Ltd., KEK, Japan*

**16:10-16:30****Microencapsulation of additives**

Stephen HSU, Fei ZHAO, Sulaksha PARAB  
George Washington University, United States

**16:30-16:50**

Interactions of IF-MeS<sub>2</sub> (Me=Metal) nanoparticle additives with lubricant co-additives

Fabrice DASSENNOY<sup>1</sup>, Paula USSA<sup>1</sup>, Pierre RABASO<sup>3</sup>, Fabrice VILLE<sup>3</sup>, Michel BELIN<sup>1</sup>, Thierry LE MOGNE<sup>1</sup>, Béatrice VACHER<sup>1</sup>, Jérôme CAVORET<sup>3</sup>, Moussa DIABY<sup>4</sup>, Benoit THIEBAUT<sup>2</sup>

<sup>1</sup>Ecole Centrale de Lyon, France; <sup>2</sup>TOTAL, France; <sup>3</sup>INSA de Lyon, France; <sup>4</sup>PSA, France

**16:50-17:10****Effect of addition of ceramic-based particles with friction modifier additive in base oil on tribological behaviour of steel – steel contacts**

Pushkar DESHPANDE, Clotilde MINFRAY, Fabrice DASSENNOY, Benoit THIEBAUT, Frederic JARNIAS, Thierry LE MOGNE, Beatrice VACHER  
Laboratoire de Tribologie et Dynamique des Systèmes, France

**17:10-17:30****Ideal organic friction modifier solutions**

Ben FRY, Sophie CAMPEN, Hugh SPIKES, Janet WONG  
Imperial College London, United Kingdom

**17:30-17:50****Effect of additives on load capacity improvement of DLC coated sliding surface**

Kimio IMAI<sup>1</sup>, Fumihito ITOIGAWA<sup>1</sup>, Atsushi AKAMATSU<sup>2</sup>, Akira WATANABE<sup>2</sup>, Takashi NAKAMURA<sup>1</sup>

<sup>1</sup>Nagoya Institute of Technology, Japan; <sup>2</sup>Cosmo Oil Lubricants CO.,LTD., Japan

**17:50-18:10****The preparation of nano-PVDF and its tribological properties as lubricant additives**

Xing LI, Hailin LU, Guangneng DONG  
Key Laboratory of Modern Design and Rotor-Bearing System of Education Ministry, Xi'an Jiaotong University, China

**18:10-18:30****Preparation and tribological properties of water-soluble copper/silica nanocomposite as a water-based lubricant additive**

Tiantian LIU  
National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, China

**Room 305C****Track4: Biotribology & Biomimetics****Biomimics I**

**Chair: Zhiwu HAN**, Key Laboratory of Bionic Engineering, Ministry of Education, Jilin University, China

**13:30-13:55 Invited****Biomimetics on gecko locomotion: mechanism, dynamics and gecko-inspired robots**

Zhendong DAI, Yi SONG, Zhouyi WANG  
Nanjing University of Aeronautics and Astronautics, China

**13:55-14:15****An experimental based analytical model for the effect of counter-face roughness on the friction of gecko-like biomimetic microstructure**

Haytam KASEM<sup>1</sup>, Yossi COHEN<sup>2</sup>  
<sup>1</sup>Azrieli College of Engineering, Jerusalem Israel; <sup>2</sup>Tribology Labs. Israel Institute of Metals, Israel

**14:15-14:35****Robust self-cleaning and micromanipulation capabilities of gecko spatulae and their bio-mimics**

Quan XU<sup>1</sup>, Yiyang WAN<sup>3</sup>, Dashuai TAO<sup>2</sup>, Yu TIAN<sup>2</sup>, Zhenhai XIA<sup>3</sup>  
<sup>1</sup>China University of Petroleum (Beijing), China; <sup>2</sup>Tsinghua University, China; <sup>3</sup>University of North Texas, USA

**14:35-14:55****Fish drag-reducing mechanism based on the bioelectricity effect**

Na SUN<sup>1</sup>, Shiqing SUN<sup>1</sup>, Bao WANG<sup>2</sup>, Dangguo LI<sup>2</sup>, Darong CHEN<sup>2</sup>, Lina SI<sup>1</sup>, Xiaoli WANG<sup>1</sup>  
<sup>1</sup>Beijing Institute of Technology, China; <sup>2</sup>Tsinghua University, China

**14:55-15:15****Investigation of drag reduction performance of micro-trapezoidal groove surfaces**

Xiuqin BAI, Linshan ZHAO, Yifeng FU, Chengqing YUAN, Xiping YAN  
Wuhan University of Technology, China

**15:15-15:35****Development of clean biomimetic dry adhesive**

Peter BREITMAN<sup>1</sup>, Yuri KLIGERMAN<sup>1</sup>, Michael VARENBERG<sup>2</sup>  
<sup>1</sup>Technion - Israel Institute of Technology, Israel; <sup>2</sup>Georgia Institute of Technology, America

**15:35-15:50****Coffee Break****Room 305C****Track4: Biotribology & Biomimetics****Biomimics II**

**Chair: Zhendong DAI**, Nanjing University of Aeronautics and Astronautics, China

**15:50-16:15 Invited****Bioinspiration on eccentric structure characteristics and mechanical properties of tamarisk (Tamarix Aphylla)**

Zhiwu HAN, Yin WEI, Junqiu ZHANG, Luquan REN  
Key Laboratory of Bionic Engineering, Ministry of Education, Jilin University, China

**16:15-16:35****Adhesion characteristics of polymeric plants leaf replicas: influence of micro-structuring, morphology, and intricacy**

Charchit KUMAR<sup>1</sup>, Thomas SPECK<sup>1</sup>, Holger F. BOHN<sup>1</sup>, Vincent LE HOUEROU<sup>2</sup>  
<sup>1</sup>University of Freiburg, Germany; <sup>2</sup>University of Strasbourg, France

**16:35-16:55****Surface contact characteristics of banana Leaves**

Mariyam Jameelah GHAZALI<sup>1</sup>, Hasrawati Abu HASSAN<sup>1</sup>, Che Husna AZHARIL<sup>1</sup>, Cevdet MERIC<sup>2</sup>  
<sup>1</sup>Universiti Kebangsaan Malaysia, Malaysia; <sup>2</sup>Fatih university, Turkey



**16:55-17:15**

Taro-leaf-inspired patterning of Oleophobic surfaces with high wear resistance

Hiroshi TANI, Naoya YAMASHITA, Shinji KOGANEZAWA, Norio TAGAWA  
*Kansai University, Japan***17:15-17:35**

A Study on the wettability of sphagnum moss surface

Tianchi CHEN, Hongtao LIU

*China University of Mining and Technology, China***17:35-18:15**

Revealing secrets of staying on water surface based on shadow method

Hongyu LU, Wei YIN, Yelong ZHENG, Dashuai TAO, Yu TIAN

*Tsinghua University, China***18:15-18:35**

Oleophilicity behaviour of fresh and dry pistia stratiotes

Salmiah KASOLANG<sup>1</sup>, Najibah AB. LATIF<sup>1</sup><sup>1</sup>University Teknologi Mara, Mara; <sup>2</sup>Malaysian Tribology Society Mytribos, Maraa**Room 303****Track5: Tribology in Manufacturing  
Machining I****Chair: Braham PRAKASH, Lulea University of Technology, Sweden****13:30-14:00 Keynote**

Extreme surface layers – a concept for future tribology

Mitjan KALIN

*University of Ljubljana, Slovenia***14:00-14:20**

Development of an ultra-high speed air bearing spindle for micro-milling

Takuya AOTSUKA, Masaaki MIYATAKE, Shigeka YOSHIMOTO

*Tokyo University of Science, Japan***14:20-14:40**

Cutting tools and wear protection through nickel bonded Niobium Carbide (NbC) as a substitute for cobalt bonded tungsten carbide (WC)

Mathias WOYDT<sup>1</sup>, Shuigen HUANG<sup>2</sup>, Jef VLEUGELS<sup>2</sup>, Hardy MOHRBACHER<sup>3</sup><sup>1</sup>Federal Institute for Materials Research and Testing BAM, Germany;<sup>2</sup>Katholieke Universiteit Leuven, The Kingdom Of Belgium; <sup>3</sup>NiobelCon bvba,*The Kingdom of Belgium***14:40-15:00**

Machining influence on cemented tungsten carbide (WC-CoNi) by ultra-short pulse laser

Shiqi FANG<sup>2,3,4</sup>, Chia-Jui HSU<sup>5</sup>, Sven KLEIN<sup>4</sup>, Luis LLANES<sup>2,3</sup>, Dirk BÄHRE<sup>4</sup>, Frank MÜCKLICH<sup>5</sup><sup>1</sup>CIEFMA-Departament de Ciència del Materials i Enginyeria Metal·lúrgica,*Spain; <sup>2</sup>CIEFMA – Dept. Materials Science and Engineering, Universitat**Politécnica de Catalunya, EEBE-Campus Diagonal Besòs, Spain; <sup>3</sup>Barcelona**Research Center in Multiscale Science and Engineering, Universitat Politècnica**de Catalunya, Spain; <sup>4</sup>Institute of Production Engineering, Saarland University,**Germany; <sup>5</sup>Institute of Functional Materials, Saarland University, Germany***15:00-15:20**

Development of tapping tool coated with nickel/abrasive particle composite film for preventing chip snarling

Yasuyoshi SAITO<sup>1</sup>, Takeshi YAMAGUCHI<sup>1</sup>, Ryo ITAGAKI<sup>1</sup>, Kei SHIBATA<sup>1</sup>,Takeshi KUBO<sup>2</sup>, Wataru WATANABE<sup>2</sup>, Satoru OYAMA<sup>2</sup>, Kazuo HOKKIRIGAWA<sup>1</sup><sup>1</sup>Tohoku University, Japan; <sup>2</sup>MIYAGITANOI MFG. CO., LTD, Japan**15:20-15:50**

Coffee Break

**Room 303****Track5: Tribology in Manufacturing  
Machining II****Chair: Mitjan KALIN, University of Ljubljana, Slovenia****15:50-16:15 Invited**

High temperature tribology in metalworking processes

Braham PRAKASH

*Lulea University of Technology, Sweden***16:15-16:35**

Contact deformation behavior of silicone/SiC soft elastic abrasive in grinding and polishing progress

Ning LI

*Zhejiang Normal University, China***16:35-16:55**

Study on cryogenic and high speed grinding manufacturing method for high-precision flexible polymer film

Shangxiong ZHANG<sup>1</sup>, Ying YAN<sup>1</sup>, Xiaoguang GUO<sup>1</sup>, Ping ZHOU<sup>1</sup>, HuipingWANG<sup>2</sup><sup>1</sup>Dalian University of Technology, China; <sup>2</sup>Dalian Jiaotong University, China**16:55-17:15**

Effect of surface texturing on tribological performance and lubricant infiltration at tool-chip interface

Jiaxin YE, Xiaojun LIU, Minghua PANG, Kun LIU

*Hefei University of Technology, China***17:15-17:35**

The lubricity of organic phosphate esters type additives on titanium alloys

Yan WANG, Chenhui ZHANG, Ye YANG, Jianbin LUO

*State Key Laboratory of Tribology, Tsinghua University, China***Room 305E****Track6: Engine and Transmission Tribology  
Rolling Bearings I****Chair: Xiaoyang CHEN, Shanghai University, China****13:30-14:00 Keynote**

Trend of rolling machine elements for automotive transmission

Hirotohi ARAMAKI

*NSK, Japan***14:00-14:20**

Evolution of microstructure formed from nitrocarburizing of bearing cage and its countermeasures

Bin LIU, Changjian GUO

*C&amp;U GROUP CO.LTD., China*

**14:20-14:40****Effect of the defects in races on the dynamic behavior of ball bearing**

Ziqiang ZHAO, Xuebin YIN, Wenzhong WANG

*Beijing Institute of Technology, China***14:40-15:00****The influence of tribolayer development on micropitting in bearing contacts**Victor BRIZMER<sup>1</sup>, Christine MATTA<sup>1</sup>, Ileana NEDELUCU<sup>1</sup>, Bo HAN<sup>2</sup>, Guillermo Enrique MORALES-ESPEJEL<sup>1,3</sup><sup>1</sup>SKF B.V., Netherlands; <sup>2</sup>SKF Global Technical Center China, China; <sup>3</sup>Université de Lyon, INSA-Lyon, CNRS LaMCoS, France**15:00-15:20****Formation of white etching cracks in rolling bearing steel: root causes and their relationship to premature bearing failures**

Francesco MANIERI, Amir KADIRIC

*Imperial College, UK***15:20-15:50**

Coffee Break

**Room 305E****Track6: Engine and Transmission Tribology  
Rolling Bearings II**

Chair: Ning REN, Valvoline Co., USA

**15:50-16:10****Effect of residual stress on the damage accumulation evolution of M50 steel during rolling contact fatigue**

Jian GUAN, Liqin WANG, Xinxin MA

*Harbin Institute of Technology, China***16:10-16:30****Evolution of rolling contact fatigue microstructure alterations in 100Cr6 martensitic bearings**Viktorija SMELOVA<sup>1</sup>, Alexander SCHWEDT<sup>2</sup>, Ling WANG<sup>1</sup>, Joachim MAYER<sup>2</sup>, Walter HOLWEGGER<sup>1,3</sup><sup>1</sup>University of Southampton, UK; <sup>2</sup>RWTH Aachen University, Germany;<sup>3</sup>Schaeffler Group, Germany**16:30-16:50****Experimental investigations of rolling element bearings exposed to centrifugal load at a centripetal acceleration up to 3000 times gravity**David HOCHREIN<sup>1</sup>, Stephan TREMMEL<sup>1</sup>, Oliver GRAF-GOLLER<sup>2</sup>, Sandro WARTZACK<sup>1</sup><sup>1</sup>Lehrstuhl für Konstruktionstechnik, Germany; <sup>2</sup>Schaeffler Technologies AG & Co.KG, Germany**16:50-17:10****Propagation of surface initiated rolling contact fatigue cracks in bearing steels**

Amir KADIRIC, Pawel RYCERZ

*Imperial College London, UK***17:10-17:30****Influencing factors on rolling contact fatigue life in hydrogen gas**

Yuanlin KOU, Hao YAO, Hiroki YAMADA, Hideyuki UYAMA

*NSK, Japan***17:30-17:50****Hydrogen embrittlement in rolling bearing steel and its protection: application case study**

Xiaobo ZHOU

*SKF, Netherlands***17:50-18:10****An experimental study into the mechanism of false brinelling contact damage and potential preventative measures**

Rachel JANUSZEWSKI, Amir KADIRIC

*Imperial College, UK***18:10-18:30****Simulation on the influence of prestress on the fatigue life of flexible bearing in harmonic drive**Yazhen WANG<sup>1</sup>, Yi JIANG<sup>1</sup>, Qun TONG<sup>2</sup>, Dashi SU<sup>2</sup>, Li SONG<sup>2</sup><sup>1</sup>Shanghai University, China; <sup>2</sup>Technology Centre of Cixing Bearing GROUP CO. LTD, China**Room 307****Track6: Engine and Transmission Tribology****Fluid-film Bearings I**

Chair: Michel FILLON, University of Poitiers, France

**13:30-13:55 Invited****Hydro dynamic bearings with soft textured layers:****Effects on oscillating motion and start stop conditions**

BJØRN HAUGEN

*Norwegian University of Technology and Science, Norway***13:55-14:20 Invited****On lubricating film building by limited lubricant supply (LLS) and interface effect**Feng GUO<sup>1</sup>, Shuyan ZANG<sup>1</sup>, Pat Lam WONG<sup>2</sup>, Chao LI<sup>1</sup><sup>1</sup>Qingdao University of Technology, China; <sup>2</sup>City University of Hong Kong, China**14:20-14:40****Research of oil film incremental effect by truncating the surface roughness under EHL conditions**

Hiroaki TAKEUCHI

*Mitsubishi Heavy Industries, Japan***14:40-15:00****Effect of Reynolds number on the static characteristics of fully textured journal bearings**

Hiroo TAURA, Hiyoyuki YAMADA, Satoru KANEKO

*Nagaoka University of Technology, Japan***15:00-15:20****A large-scale simulation of elastohydrodynamic lubrication in journal bearings with many-core architectures**

Hiroki FUKAGAWA, Kazuyuki YAGI

*Kyushu University, Japan***15:20-15:50**

Coffee Break



## Room 307

**Track6: Engine and Transmission Tribology**  
**Fluid-film Bearings II**

Chair: Benyebka BOU-SAID, INSA Lyon, France

**15:50-16:10****Investigation of textured bearings effects on vibrations of small-sized rotors**Jocelyn REBUFA<sup>1</sup>, Fabrice THOUVEREZ<sup>1</sup>, Erick LE GUYADEC<sup>2</sup>, Denis MAZUYER<sup>1</sup><sup>1</sup>Ecole Centrale de Lyon, France; <sup>2</sup>CEA, DEN - DTEC, France**16:10-16:30****An experimental investigation of the influence of lubricant supply parameters and groove geometry on the performance of circumferential groove journal bearings**Alex-Florian CRISTEA<sup>1</sup>, Jean BOUYER<sup>2</sup>, Michel FILLON<sup>2</sup>, Mircea PASCOVICI<sup>3</sup><sup>1</sup>Tecnitas SAS, France; <sup>2</sup>University of Poitiers, France; <sup>3</sup>University Politehnica of Bucharest, Romania**16:30-16:50****Load capacity and stability analysis of partial slip texture multi-lobe journal bearings**T. V. V. L. N. RAO<sup>1</sup>, A. M. A. RANI<sup>2</sup>, N. M. MOHAMED<sup>2</sup>, H. H. YA<sup>2</sup>, M. AWANG<sup>2</sup>, F. M. HASHIM<sup>2</sup><sup>1</sup>The LNM Institute of Information Technology, India; <sup>2</sup>Universiti Teknologi PETRONAS, Malaysia**16:50-17:10****Effects of the recess geometry on flow characteristics of cryogenic hybrid journal bearings for rocket turbopumps**Mamoru OIKE<sup>1</sup>, Masataka KIKUCHI<sup>2</sup>, Satoshi TAKADA<sup>2</sup>, Takayuki SUDO<sup>2</sup>, Tomoyuki TAKANO<sup>3</sup><sup>1</sup>Ishinomaki Senshu University, Japan; <sup>2</sup>Japan Aerospace Exploration Agency, Japan; <sup>3</sup>Japan Aerospace Technology, Japan**17:10-17:30****Journal bearing with a double conical form – a numerical and experimental study**Balint PAP<sup>1</sup>, Michel FILLON<sup>1</sup>, Patrice GÉDIN<sup>2</sup>, Guillaume BECK<sup>2</sup><sup>1</sup>University of Poitiers, France; <sup>2</sup>Safran Transmission Systems, France**17:30-17:50****Characteristics of non-contact handling equipment using ultrasonic levitation**Kentaro MITA<sup>1</sup>, Masaaki MIYATAKE<sup>1</sup>, Mark ATHARTON<sup>2</sup>, Cristinel MARES<sup>2</sup>, Shigeka YOSHIMOTO<sup>1</sup>, Tadeusz STOLARSKI<sup>2</sup><sup>1</sup>Tokyo University of Science, Japan; <sup>2</sup>Brunel University London, UK**17:50-18:10****Investigation of the effect of a non-isothermal flow of the non-newtonian fluid in the thin layer on the dynamics of the flexible rotor of the turbo-machinery**

Elena ZADOROZHNYAYA, Igor LEVANOVA, Nadezhda KHOZENIUK, Vlad HUDYAKOV

South Ural State University, Russia

## Room 308

**Track7: Industrial Tribo-systems**  
**Hard Disk Drives and Microsystems I**

Chair: Takashi NAKAMURA, Nagoya Institute of Technology, Japan

**13:30-13:55 Invited****A review of tribology in hard drives**

Min YANG

Bruker Corporation, United States

**13:55-14:15****Nitrogen plasma treatment for continuous ultra-thin carbon nitride film on magnetic hard disk**Wah Lawrence NG<sup>1,2</sup>, Amalina Balqis BINTI ABU BAKAR<sup>1</sup>, Mohammad Azrul Firdhaus BIN AZMI<sup>1</sup>, Wee Shen KHOO<sup>1</sup>, Yonggang MENG<sup>2</sup><sup>1</sup>Fuji Electric (Malaysia) Sdn. Bhd., Malaysia; <sup>2</sup>Tsinghua University, China**14:15-14:35****Transport of hydrocarbon and organic contamination to the head-disk interface in magnetic recording devices**

Raman VEDANTHAM

Western Digital Corporation, United States

**14:35-14:55****Study of the formation and break of lubricant bridge in the head disk interface using molecular dynamic method**Xiangyu DAI<sup>1</sup>, Hui LI<sup>1</sup>, Shengnan SHEN<sup>1</sup>, Xiao LEI<sup>1</sup>, Sen LIU<sup>1</sup>, Hejun DU<sup>2</sup><sup>1</sup>Wuhan University, China; <sup>2</sup>Nanyang Technology University, China**14:55-15:15****Heat transfer in the air bearing film in magnetic disk drive with a void on the slider surface**Yaru SUN<sup>1</sup>, Baojun SHI<sup>1</sup>, Cancan JI<sup>1</sup>, Zisen HUA<sup>2</sup>, Chuanwei ZHANG<sup>3</sup><sup>1</sup>Shandong Jianzhu University, China; <sup>2</sup>Shandong University, China; <sup>3</sup>Harbin Institute of Technology, China**15:30-15:50****Coffee Break**

## Room 308

**Track7: Industrial Tribo-systems**  
**Hard Disk Drives and Microsystems II**

Chair: Min YANG, Bruker Corporation, United States

**15:50-16:10****Influence of accommodation coefficients on thermo-molecular gas-film lubrication (t-MGL) characteristics -analysis in the free molecular limit-**

Shigehisa FUKUI, Shoma SHIMIZU, Ryota ASADA, Fumiya SHINOHARA, Satoru MAEGAWA, Hiroshige MATSUOKA

Tottori University, Japan

**16:10-16:30****Modification of friction surface of piezoelectric actuators**Raimundas RUKUIZA<sup>1</sup>, Juozas PADGURSKAS<sup>1</sup>, Valentin MIHAILOV<sup>2</sup>, Audrius ZUNDA<sup>1</sup>, Albinas ANDRIUSIS<sup>1</sup><sup>1</sup>Aleksandras Stulginskis University, Lithuania; <sup>2</sup>Institute of Applied Physics, Republic of Moldova

**16:30-16:50**

Detection and classification of magnetic disk surface defects using a contact sensor integrated into a magnetic head in a hard disk drive

Ning LI<sup>1</sup>, Saurabh DEORAS<sup>1</sup>, Shunji KATSUMI<sup>2</sup>, Jorge ESCOBAR<sup>1</sup>, Mitchell POURROY<sup>1</sup>, Abhishek SRIVASTAVA<sup>1</sup>, Vedantham RAMAN<sup>1</sup>

<sup>1</sup>Western Digital Corporation, United States; <sup>2</sup>Western Digital Corporation, Japan

**16:50-17:10**

Numerical and experimental study of the head/disk interface in heat assisted magnetic recording using tip enhanced Raman spectroscopy

Longqiu LI<sup>1,2</sup>, Qingkang LIU<sup>1</sup>, Benjamin SUEN<sup>2</sup>, Kaipeng LIU<sup>1</sup>, Andrew KING<sup>3</sup>, Frank E. TALKE<sup>2</sup>

<sup>1</sup>Harbin Institute of Technology, China; <sup>2</sup>University of California, USA;

<sup>3</sup>Renishaw Inc., USA

**17:10-17:30**

Ultra-sensitive contact detection for hard disk drives

Shaomin XIONG, Erhard SCHRECK

Western Digital Company, United States

**17:30-17:50**

Modified model of molecular gas film lubrication equation for simulating ultra-thin gas film lubrication

Kai GUO, Baojun SHI, Shipeng HAO, Yaru SUN, Yujie FENG

Shandong Jianzhu University, China

**Room 311A****Track 8: Tribotest and Monitoring****Tribotest I**

Chair: Yuanqiang TAN, Huaqiao University, China

**13:30-14:00 Keynote**

Experimental rigs for testing components of advanced industrial applications

Enrico CIULLI

University of Pisa, Italy

**14:00-14:20**

Positron annihilation studies of subsurface zones created during friction in metals and their alloys

Jerzy Jerzy DRYZEK

Institute of Nuclear Physics Polish Academy of Sciences, Poland

**14:20-14:40**

Friction dissipation under tangential high frequency excitation

Per LINDHOLM<sup>1</sup>, Krystof KRYNISKI<sup>1</sup>, Su ZHAO<sup>1</sup>, Åsa Kassman RUDOLPHI<sup>2</sup>

<sup>1</sup>ABB, Sweden; <sup>2</sup>Uppsala University, Sweden

**14:40-15:00**

Tribology with Extended Stribeck Curves: Lubes, Cosmetics, Food and Beverages

Kartik PONDICHERRY, Charlotte REPPICH, Florian RUMMEL

Anton Paar GmbH, Austria

**15:00-15:20**

Simulation of initial conformability and seizure on tribo-test machine

Kotaro OKUSHI, Patrick BONNAU, Ryuji MIURA, Ai SUZUKI, Naoto MIYAMOTO, Nozomu HATAKEYAMA, Akira MIYAMOTO, Tomomi HOND

Tohoku University, Japan

**15:20-15:50**

Coffee Break

**Room 311A****Track 8: Tribotest and Monitoring****Tribotest II**

Chair: George TY WAN, Fuchs Lubricants (China) Ltd

**15:50-16:15 Invited**

Benchtop brake material screening: can we ever correlate with full-scale results?

Steve SHAFFER<sup>1</sup>, Peter FILIP<sup>2</sup>, Chuck GREENING<sup>3</sup>

<sup>1</sup>Bruker - TSOM, United States; <sup>2</sup>Southern Illinois University, United States;

<sup>3</sup>Greening Test Labs, United States

**16:15-16:35**

Study of surface roughness and surface orientation on friction in rolling/sliding contacts: barrel-on-disc versus twin-disc

Bergseth ELLEN<sup>1</sup>, Söderberg ANDERS<sup>1</sup>, ZhuYI<sup>2</sup>, Olofsson ULF<sup>1</sup>

<sup>1</sup>KTH Royal Institute of technology, Sweden; <sup>2</sup>Zhejiang University, China

**16:35-16:55**

The influence of crystallographic orientation on triboluminescence properties

Kuifang WANG, Liran MA

Tsinghua University, China

**16:55-17:15**

Comparison of wear methods based on AFM: Line-scanning and area-scanning

Peng ZHANG, Cheng CHEN, Chen XIAO, Lei CHEN, Linmao QIAN

Southwest Jiaotong University, China

**17:15-17:35**

Estimation of lubricity of green and commercial cutting fluid using tool chip tribometer

Suvin P S, V.Kailas SATISH

Indian Institute of Science, India

**17:35-17:55**

Study on mechanical properties of interface between silicate glass and stainless steel based on nanoindentation

Haosheng PANG, Chenghui GAO, Ming LIU

Fuzhou University, China

**17:55-18:15**

Experimental study into the influence of contact conditions and lubricant properties on the onset of scuffing using a new contra-rotation test method

Bo PENG, Guoquan HUANG, Amir KADIRIC

Imperial College London, United Kingdom

**18:15-18:35**

Tribo-test of high speed ball bearings under the cryogenic environment for turbo pump of liquid rocket engine

Yongbok LEE<sup>1</sup>, Wonil KWAK<sup>2</sup>, Bokseong CHO<sup>1</sup>

<sup>1</sup>Korea Institute of Science and Technology, Seoul, Korea; <sup>2</sup>Korea Institute of Science and Technology-UST, Seoul, Korea



**Room 201A****Track1: Science of Tribology  
Friction Fundamental III****Chair: Mark ROBBINS**, *The Johns Hopkins University, USA***10:10-10:35 Invited****Electrotunable friction with ionic liquid nanoscale films**Michael URBAKH<sup>1</sup>, Oscar FAJARDO<sup>1</sup>, Fernando BRESME<sup>2</sup>, Alexei KORNY SHEV<sup>2</sup><sup>1</sup>Tel Aviv University, Israel; <sup>2</sup>Imperial College, UK**10:35-11:00 Invited****Theory and simulation of nanoscale dissipation and friction**

Erio TOSATTI

*SISSA, Italy***11:00-11:20****Friction of textured surfaces in dry elastic contacts**

M. S. BOBBI, Muthu Kumar MARIAPPAN

*Indian Institute of Science, India***11:20-11:40****Generation of friction anisotropy by surface texturing under boundary lubrication**

Shota ITO, Yuki HIRATA, Shinya, SASAKI

*Tokyo University of Science, Japan***11:40-12:00****Modeling interlayer interactions in layered materials**

Oded HOD

*Tel Aviv University, Israel***12:15-13:30**

Lunch

**Room 201A****Track1: Science of Tribology  
Friction Fundamental IV****Chair: Nir KAMPF**, *Weizmann Institute of Science, Israel***13:30-14:00 Keynote****Modeling of energy dissipation due to adhesion in normal and sliding contacts**

Irina G. GORYACHEVA

*Institute for Problems in Mechanics, Russian Academy of Science, Russia***14:00-14:30 Keynote****Sliding bearings in wind turbines**Georg JACOBS<sup>1</sup>, Ralf SCHELENZ<sup>1</sup>, Dennis WITTER<sup>2</sup>, Dennis BOSSE<sup>1</sup>, Tim SCHRÖDER<sup>1</sup><sup>1</sup>RWTH Aachen University, Germany; <sup>2</sup>IME Aachen GmbH, Germany**14:30-14:50****Simulation of compliant third-bodies with a multibody meshfree approach**

Guilhem MOLLON

*INSA-Lyon, France***14:50-15:10****Fundamental simulations and experiments on tribological systems with partially filled gaps**

Michael MUELLER, Georg-Peter OSTERMEYER

*Braunschweig University of Technology, Germany***15:10-15:30****Scientific scaling-up from molecular dynamics simulation to friction behavior prediction**Shuaihang PAN<sup>1</sup>, Nian YIN<sup>2</sup>, Zhinan ZHANG<sup>2</sup><sup>1</sup>University of California-Los Angeles, USA; <sup>2</sup>Shanghai Jiao Tong University, China**15:30-16:30**

Coffee Break &amp; Poster Time

**Room 201A****Track1: Science of Tribology  
Friction Fundamental V****Chair: Erio TOSATTI**, *SISSA, Italy***16:30-16:55 Invited****Nanotribology of cationic surfactants**

Nir KAMPF

*Weizmann Institute of Science, Israel***16:55-17:15****Real time TEM observation of metallic nano-asperity friction**

Takaaki SATO, Menon VIVEK, Hiroyuki FUJITA

*University of Tokyo, Japan***17:15-17:35****Temperature and velocity dependences in the prandtl/tomlinson model for atomic sliding friction**Wilfred TYSOE<sup>1</sup>, Octavio FURLONG<sup>2</sup>, Sergio MANZI<sup>2</sup><sup>1</sup>University of Wisconsin-Milwaukee, USA; <sup>2</sup>National University of San Luis, Argentina**17:35-17:55****Evolution of wear and roughness in mixed lubrication regime**Nilanjan DAS CHAKLADAR<sup>1</sup>, Leiming GAO<sup>2</sup>, Richard M HALL<sup>1</sup>, Rob HEWSON<sup>2</sup><sup>1</sup>University of Leeds, UK; <sup>2</sup>Imperial College London, UK**17:55-18:15****Liquid-infused surface in active controlled patterned microfluidic device**

Yongjian LI, Yang GAO, Haosheng CHEN

*Tsinghua University, China***18:15-18:35****Microstructure evolution of impact contact surface layer in quasi-nanometer wear mechanisms**Xianghong REN<sup>1,2</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Xi'an Research Inst. of High-tech., China**Room 201B****Track1: Science of Tribology  
Elastohydrodynamic Lubrication I****Chair: Markus VALTINER**, *Max-Planck-Institut f. Eisenforschung GmbH, Germany***10:10-10:40 Keynote****Dimensionless parameters in lubrication**

Antonius LUBRECHT

*INSA-Lyon, France***10:40-11:00****Variation of surface dimple in EHL contacts by the effect of oil starvation**Jing WANG<sup>1</sup>, Xianghua MENG<sup>1</sup>, Shun CUI<sup>1</sup>, Binbin ZHANG<sup>2</sup><sup>1</sup>Qindao Technological University, China; <sup>2</sup>University of Twente, Netherlands

11:00-11:20

Film formation and friction in grease lubricated contacts

Yuta KANAZAWA, Richard S SAYLES, Amir KADIRIC

Imperial College London, UK

11:20-11:40

Experimental study on singular EHL behavior of grease at low speeds

Masataka SAKAI<sup>1</sup>, Tsuyoshi KOCHI<sup>1</sup>, Daming DONG<sup>1</sup>, Yoshitsugu KIMURA<sup>2,3</sup><sup>1</sup>Kyodo Yushi CO., LTD, Japan; <sup>2</sup>University of Tokyo, Japan; <sup>3</sup>Kagawa University, Japan

12:00-13:30

Lunch

Room 201B

Track 1: Science of Tribology

Elastohydrodynamic Lubrication II

Chair: Roland LARSSON, Lulea University of Technology, Sweden

13:30-13:50

High pressure and high shear rate contribution on the limiting shear stress of lubricants in EHL

Laetitia MARTINIE<sup>1</sup>, Serigne NDIAYE<sup>1</sup>, Jérémie MARGUERITAT<sup>2</sup>, David PHILIPPON<sup>1</sup>, Philippe VERGNE<sup>1</sup><sup>1</sup>LaMCoS - INSA de Lyon, France; <sup>2</sup>Université de Lyon, France

13:50-14:10

A method for solving the equivalent viscosity of non-Newtonian fluid and its application in thermal EHL considering spinning

Xiaoling LIU, Mingming MA, Peiran YANG

Qingdao University of Technology, China

14:10-14:30

Theoretical modelling of film forming mechanisms under transient conditions: application to deceleration and experimental validation

Juliette CAYER-BARRIOZ, Denis MAZUYER, André ERNESTO

Ecole Centrale de Lyon - LTDS - CNRS, France

14:30-14:50

Measurements of lubricant and surface temperatures within an elastohydrodynamic contact

Jia LU, Thomas REDDYHOFF, Daniele DINI

Imperial College London, UK

14:50-15:10

Boundary slippage induced elastohydrodynamic lubrication under zero entrainment velocity

Yang ZHAO<sup>1,2</sup>, Pat Lam Patrick WONG<sup>2</sup>, Junhong MAO<sup>1</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>City University of Hong Kong, China

15:10-15:30

Understanding EHL friction through nonequilibrium molecular dynamics simulations and tribology experiments

James EWEN<sup>1</sup>, Chiara GATTINONI<sup>3</sup>, Neal MORGAN<sup>2</sup>, Hugh SPIKES<sup>1</sup>, Daniele DINI<sup>1</sup><sup>1</sup>Imperial College London, UK; <sup>2</sup>Shell Global Solutions, UK; <sup>3</sup>ETH Zurich, Switzerland

15:30-16:30

Coffee Break &amp; Poster Time

Room 201B

Track 1: Science of Tribology

Elastohydrodynamic Lubrication III

Chair: Xiaoli WANG, Beijing Institute of Technology, China

16:30-16:50

Effect of groove topography on the contact behavior in EHL and mixed lubrication. Part 1: experimental

Denis MAZUYER<sup>1</sup>, Thomas TOUCHE<sup>1</sup>, Tomasz WOLOSZYNSKI<sup>2</sup>, Pawel PODSIADLO<sup>2</sup>, Gwidon STACHOWIAK<sup>2</sup>, Juliette CAYER-BARRIOZ<sup>1</sup><sup>1</sup>Ecole Centrale de Lyon, France; <sup>2</sup>Curtin University, Australia

16:50-17:10

Effect of groove topography on the contact behavior in EHL and mixed lubrication. Part 2: numerical simulations

Tomasz WOLOSZYNSKI<sup>1</sup>, Thomas TOUCHE<sup>2</sup>, Pawel PODSIADLO<sup>1</sup>, Gwidon STACHOWIAK<sup>1</sup>, Juliette CAYER-BARRIOZ<sup>2</sup>, Denis MAZUYER<sup>2</sup><sup>1</sup>Curtin University, Australia; <sup>2</sup>Ecole Centrale de Lyon, France

17:10-17:30

A thermal and transient lubrication model for EHL contacts

Bilel MEZIANE<sup>1</sup>, Nicolas FILLOT<sup>1</sup>, Guillermo E. MORALES-ESPEJEL<sup>2,1</sup><sup>1</sup>INSA Lyon, France; <sup>2</sup>SKF Engineering and Research Centre, Netherlands

17:30-17:50

A molecular dynamics study of the limiting shear stress phenomenon in an EHD contact

Alejandro PORRAS-VAZQUEZ, Laetitia MARTINIE, Philippe VERGNE, Nicolas FILLOT

Université de Lyon, INSA Lyon, CNRS, LaMCoS UMR5259, France

17:50-18:10

Behaviour of entrapped oil film in point contact EHL

Hiroshi NISHIKAWA<sup>1</sup>, Yuma MITA<sup>1</sup>, Nobuyoshi OHNP<sup>2</sup><sup>1</sup>Kyushu Institute of Technology, Japan; <sup>2</sup>Saga University, Japan

18:10-18:30

Grease distribution under sliding reciprocating motions

Shanshan WANG

Room 201D

Track 2: Wear &amp; Surface Engineering

Wear III

Chair: Ling WANG, University of Southampton, UK

10:10-10:40 Keynote

Design and application of friction pair surface modification coating for remanufacturing

Haidou WANG

Academy of Armored Forces Engineering, China

10:40-11:00

Effects of lay direction and crossing angle on friction and wear behavior of winding hoist rope in ultra-deep coal mine hoist

Xiangdong CHANG<sup>1</sup>, Yuxing PENG<sup>1</sup>, Zhencai ZHU<sup>1</sup>, Xiansheng GONG<sup>2</sup>, Shengyong ZOU<sup>3,4</sup>, Shisheng SUN<sup>1</sup>, Wenxue XU<sup>1</sup><sup>1</sup>China University of Mining and Technology, China; <sup>2</sup>Chongqing University, China; <sup>3</sup>CITIC Heavy Industries Co. Ltd, China; <sup>4</sup>Luoyang Mining Machinery Engineering Design Institute, China

**11:00-11:20**

Study on out-of-roundness wear of wheels of high-speed trains  
Guangxiong CHEN  
*Southwest Jiaotong University, China*

**11:20-11:40**

Dynamic Numerical Model for Adhesive Wear in Heavy-loaded Herringbone Gears with Clearance Grooves  
Hongbing WANG<sup>1</sup>, Changjiang ZHOU<sup>1,2</sup>, Yuying LEI<sup>1</sup>  
<sup>1</sup>Hunan University, China; <sup>2</sup>Central South University, China

**11:40-12:00**

The influence of abrasive debris on the wear of equipment  
Zhihong HU  
*Tsinghua University, China*

**12:00-12:20**

Wear protection in rolling bearings by targeted generation of tribological boundary layers  
Gero BURGHARDT, Georg JACOBS, Andreas STRATMANN  
*RWTH Aachen University, Germany*

**12:00-13:30**

Lunch

**Room 201D****Track 2: Wear & Surface Engineering****Wear IV**Chair: Robert JK WOOD, *University of Southampton, United Kingdom***13:30-13:55 Invited**

Exploring carbon-based nanomaterials for enhancing tribological behaviors and mechanical properties  
Yeau-Ren JENG  
*Chung Cheng University, Taiwan, China*

**13:55-14:15**

Tribo-investigations of "size effect" of particles of mica in PAEK based short glass fiber reinforced solid lubricated composites  
Jitendra Narayan PANDA, Jayashree BIJWE, Steven SHAFFER  
*IIT Delhi, India*

**14:15-14:35**

Numerical investigation on wear and wet-skid resistance of nano-silicon reinforced tread rubber  
Jian WU, Youshan WANG, Chuanbing ZHANG, Benlong SU  
*Harbin Institute of Technology, China*

**14:35-14:55**

Abrasive wear resistance of polymers and polymer compounds  
Helena RONKAINEN, Mikko KARTTUNEN, Jani PELTO, Simo VARJUS, Lauri KILPI  
*VTT Technical Research Centre of Finland, Finland*

**14:55-15:15**

Influence of the type of abrasive particle and abrasive slurry concentration on the micro-abrasive wear behaviour of an iron aluminide alloy  
Felipe CASTILHO<sup>1</sup>, Ronaldo COZZA<sup>1,2</sup>, Gustavo DONATO<sup>1</sup>, Claudio SCHOEN<sup>3</sup>  
<sup>1</sup>University Center of FEI, Brazil; <sup>2</sup>State Center of Technological Education "Paula Souza", Brazil; <sup>3</sup>University of Sao Paulo, Brazil

**15:20-16:30**

Coffee Break &amp; Poster Time

**Room 201D****Track 2: Wear & Surface Engineering****Wear V**Chair: Jian LI, *Wuhan Research Institute of Materials Protection, China***16:30-16:50**

Dry sliding wear and friction behavior of self-lubricating polymer composite bearing materials under extreme operating conditions  
Maria RODIOUCHKINA, Kim BERGLUND, Nazanin EMAMI, Roland LARSSON  
*Luleå University of Technology, Sweden*

**16:50-17:10**

Fast calculation method for predicting the risk of surface initiated damage in rolling bearings  
Bernd VIERNEUSEL  
*Schaeffler Technologies AG Co., KG, Germany*

**17:10-17:30**

Model of contact and wear between high-speed moving parts of piezo-drives  
Yuri KLIGERMAN, Eido ZELIKOV, Haytam KASEM  
*Technion - Israel Institute of Technology, Israel*

**17:30-17:50**

Anti-adhesive properties of hierarchical structures and insulating liquid media  
Weixu YANG, Xiaoli WANG, Xintao SONG  
*Beijing Institute of Technology, China*

**17:50-18:10**

The wear behavior between marine corroded Al/BN seal coating and Ti-alloy blade under high-speed rubbing condition  
Jiaping ZHANG<sup>1,2</sup>, Deli DUAN<sup>1</sup>  
<sup>1</sup>Institute of Metal Research, China; <sup>2</sup>Shenyang Liming Aero-Engine Group Corporation LTD., China

**18:10-18:30**

Localized fretting corrosion behavior of micro-arc oxidation coating on AZ31 alloy in simulated body fluid  
Yanhong GU, Huijuan MA  
*Beijing Institute of Petrochemical Technology, China*

**Room 203A****Track 2: Wear & Surface Engineering****Coatings III**Chair: Huaiyuan WANG, *Northeast Petroleum University, China***10:10-10:35 Invited**

Effect of ceramic counterpart material on wear properties of a-C:H coating under dry condition at various temperatures  
Noritsugu UMEHARA  
*Nagoya University, Japan*

**10:35-10:55**

Control of surface temperature during run-in for low friction of carbon nitride coatings under room temperature in air  
Mamoru MIURA<sup>1</sup>, Naohiro YAMADA<sup>1</sup>, Tomomi WATARI<sup>2</sup>, Takatori TAKENO<sup>1</sup>, Koshi ADACHI<sup>2</sup>  
<sup>1</sup>Tohoku University, Japan; <sup>2</sup>Shimadzu Corporation, Japan



10:55-11:15

DLC deposited onto nitrided gray and nodular cast iron substrates: an unexpected tribological behaviour

Renan GIACOMELLI, Diego SALVARO, Cristiano BINDER, Aloisio N. KLEIN, Jose Daniel DE MELLO  
Universidade Federal de Santa Catarina, Brazil

11:15-11:35

Effects of oxygen and water on friction and wear of DLC slid against pure metals

Keisuke MANABE, Hiroyoshi TANAKA, Joichi SUGIMURA  
Kyushu University, Japan

11:35-11:55

Frictional behavior of oxygen doped carbon films prepared by ion irradiation assisted sputtering deposition

Meiling GUO<sup>1</sup>, Dongfeng DIAO<sup>2</sup>, Lei YANG<sup>3</sup>  
<sup>1</sup>Xi'an University of Technology, China; <sup>2</sup>Shenzhen University, China; <sup>3</sup>Xi'an Jiaotong University, China

11:55-12:15

Investigation on influences of diamond-like carbon coatings and roughness on fretting behaviors of Ti6Al4V material in modular hip implants

Haohao DING, Vincent FRIDRICI, Philippe KAPSA  
Laboratoire de Tribologie et Dynamique des Systemes, France

12:15-12:35

Dependence of tribology behavior of carbon films on orientation of graphene nanocrystallites controlled by directional electron beam irradiation

Wencong CHEN, Dongfeng DIAO  
Institute of Nanosurface Science and Engineering, China

12:35-13:30

Lunch

Room 203A

Track 2: Wear & Surface Engineering  
Coatings IV

Chair: Koshi ADACHI, Tohoku University, Japan

13:30-13:55 **Invited**

Roles of MoS<sub>2</sub>, DLC coatings and graphene in reducing adhesion under different atmospheres and temperatures

Guanhong SUN, Z. YANG, Sukanta BHOWMICK, Ahmet ALPAS  
University of Windsor, Canada

13:55-14:15

Experiment Study on effects of graphene on tribological properties of MoS<sub>2</sub> coating

Huali HAN, Fanming MENG, Chengzhang YANG, Ziqi ZHENG  
Chongqing University, China

14:15-14:35

Preparation and tribological performance of bonded solid lubrication coating used on spherical plain bearings

Ming QIU<sup>1,2</sup>, Rui ZHANG<sup>1</sup>, Yingchun LI<sup>1</sup>, Hui DU<sup>1</sup>, Xiaoxu PANG<sup>1</sup>  
<sup>1</sup>Henan University of Science and Technology, China; <sup>2</sup>Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, China

14:35-14:55

Solid-liquid complex lubrication based on novel graphene-MoS<sub>2</sub> coatings with 3D oil reservoir structure

Jinqing WANG<sup>1,2</sup>, Kaiming HOU<sup>1,2,3</sup>, Shengrong YANG<sup>1,2</sup>  
<sup>1</sup>Lanzhou Institute of Chemical Physics, China; <sup>2</sup>Chinese Academy of Sciences, China; <sup>3</sup>University of Chinese Academy of Sciences, China

14:55-15:15

Frictional behavior and lubricant mechanism of nanostructural Mo-S-C films in different sliding conditions

Jiao XU, Tengfei He, Liqiang CHAI, Qiao LI, Xiaoqin ZHANG, Peng WANG  
Chinese Academy of Sciences, China

15:15-15:35

Tribological properties of Ni-based composite coatings containing silver vanadate at elevated temperatures

Jun WANG, Jianliang LI, Dangsheng XIONG, Xuejun WANG, Hang LI  
Nanjing University of Science and Technology, China

15:35-16:30

Coffee Break &amp; Poster Time

Room 203A

Track 2: Wear & Surface Engineering  
Coatings V

Chair: Fei ZHOU, Nanjing University of Aeronautics and Astronautics, China

16:30-16:50

Effect of self-lubricating coating on the performance of finger seal

Yanchao ZHANG, Chenguang SI, Yahui CUI, Dongya ZHANG, Jianlei WANG  
Xi'an University of Technology, China

16:50-17:10

Friction and wear of Ag-doped nanocomposite coatings in wide temperature range

Andrey BONDAREV, Philipp KIRYUKHANTSEV-KORNEEV, Mehran GOLIZADEH, Dmitry SHTANSKY  
National University of Science and Technology MISiS, Russia

17:10-17:30

Development of a robust and intelligent nickel composite with self-lubrication, wear resistance and health diagnosis via one-pot electrodeposition

Nan ZHOU<sup>1</sup>, Shuncai WANG<sup>1</sup>, Frank WALSH<sup>2</sup>  
<sup>1</sup>National Centre for Advanced Tribology at Southampton, University of Southampton, UK; <sup>2</sup>Research Institute for Industry, University of Southampton, UK

17:30-17:50

New development and in-situ analysis of a multi-hydrophobic coating methodology

Helen WANG<sup>1,3</sup>, Michael FIIEDNER<sup>2</sup>, Thomas OBERBILLING<sup>2</sup>, Wolfgang WEINHOLD<sup>3</sup>  
<sup>1</sup>AMT China Co. Ltd., China; <sup>2</sup>COTEC GmbH, China; <sup>3</sup>Innowep GmbH, Germany

17:50-18:10

A universal model for an elastic-plastic coated spherical contact with moderate to large coating thicknesses

Zhou CHEN, Roman GOLTSBERG, Izhak ETSION  
Technion, Israel



**18:10-18:30**

Effect of silicon content on the microstructure and wear resistance of FeCoCrNiMoSix high entropy alloy coatings

Yanwen TIAN, Hong WU

*Central South University, China***Room 203B****Track 2: Wear & Surface Engineering****Texturing III****Chair: Gachot CARSTEN**, *Vienna University of Technology, Austria***10:10-10:30**

The effect of surface texture on the oil film forming in journal bearings

Jaroslaw SEP<sup>1</sup>, Lidia GALDA<sup>1</sup>, Leszek TOMCZEWSKI<sup>1,2</sup><sup>1</sup>*Rzeszow University of Technology, Poland*; <sup>2</sup>*The Jan Grodek State Vocational Academy, Poland***10:30-10:50**

Visualising cavitation in a piston ring-liner type contact to understand surface texture behaviour

Sorin-Cristian VLADESCU<sup>1</sup>, Khizer TUFIL<sup>2</sup>, Arup GANGOPADHYAY<sup>3</sup>, Tom REDDYHOFF<sup>1</sup><sup>1</sup>*Imperial College London, United Kingdom*; <sup>2</sup>*Ford Motor Company, United Kingdom*; <sup>3</sup>*Ford Motor Company, United States of America***10:50-11:10**

Study on the effects of surface texture on lubrication performance of water lubricated rubber bearing

Jian WANG<sup>1</sup>, Zhenglin LIU<sup>1</sup>, Yangwu OU<sup>1</sup>, Haojiang LIU<sup>2</sup>, Xingxin LIANG<sup>1</sup><sup>1</sup>*Wuhan University of Technology, China*; <sup>2</sup>*The NO.713 Research Institute of CSIC, China***11:10-11:30**

Coupled tribological effects of laser surface texturing and lubrication

Shuwen WANG, Feiyan YAN, Ao CHEN

*University of Shanghai for Science and Technology, China***11:30-11:50**

Multi-scale identification of contact parameters across the 3D texture of the finish by honing

Hassan Zahouani &amp; Mohamed El Mansori

*Laboratory of Tribology and Dynamics of Systems, University of Lyon, France***11:50-12:10**

The use of surface texturing for friction control

Ping LU

*University of Southampton, United Kingdom***12:10-12:30**

Experimental study of oil spreading characteristics on laser textured substrates at high temperature

Rong WANG, Shaoxian BAI

*Zhejiang University of Technology, China***12:30-13:30**

Lunch

**Room 203B****Track 2: Wear & Surface Engineering****Texturing IV****Chair: Kenneth Holmberg VTT**, *Finland***13:30-13:50**Tribological behavior of the textured surfaces lubricated with esterified bio-oil with MoS<sub>2</sub> microsheets

Yufu XU, Jian GENG, Tao YOU, Yubin PENG, Karl DEARN, Xianguo HU

*Hefei University of Technology, China***13:50-14:10**

Computational simulation of frictional temperature rise of textured surfaces under dry sliding condition

Wei WU<sup>1,2</sup>, Guiming CHEN<sup>2</sup>, Tianmin SHAO<sup>1</sup><sup>1</sup>*Tsinghua University, China*; <sup>2</sup>*Xi'an Research Institute of High Technology, China***14:10-14:30**

Optimization of irregular texture shape contour based on Genetic Algorithm under unidirectional sliding

Hui ZHANG<sup>1</sup>, Guangneng DONG<sup>1</sup>, Ligu QIN<sup>1</sup>, Meng HUA<sup>2</sup><sup>1</sup>*Xi'an Jiaotong University, China*; <sup>2</sup>*City University of Hong Kong, China***14:30-14:50**

Friction increasing of bionic convex bumps on flexible surfaces

Xuli ZHU, Nannan LIU, Liang LI, Jiefeng MU, Linjing XIAO

*Shandong University of Science and Technology, China***14:50-15:10**

The effects of surface texture on the start-up behaviors of plain journal bearings

Shuhui CUI, Le GU, Chuanwei ZHANG

*Harbin Institute of Technology, China***15:10-15:30**

Improving the friction-induced vibration performance by using grooved damping component

Dongwei WANG<sup>1</sup>, Jiliang MO<sup>1</sup>, Qi ZHANG<sup>1</sup>, Huajiang OUYANG<sup>2</sup>, Minhao ZHU<sup>1</sup>, Zhongrong ZHOU<sup>1</sup><sup>1</sup>*Southwest Jiaotong University, China*; <sup>2</sup>*University of Liverpool, England***15:30-16:30**

Coffee Break &amp; Poster Time

**Room 203B****Track 2: Wear & Surface Engineering****Texturing V****Chair: Liping WANG**, *Ningbo Institute of material Research, Chinese Academy of Sciences, China***16:30-16:50**

Effect of surface texture on formation of carbon film by adding carbon nanohorns on interface of silicon carbide sliding in water

Xinmei LIU, Hirotuna SATO, Koshi ADACHI

*Tohoku University, Japan***16:50-17:10**

The effect mechanism of groove-textured surfaces in reducing the friction-induced vibration and noise

Jiliang MO<sup>1</sup>, Dongwei WANG<sup>1</sup>, Huajiang OUYANG<sup>2</sup>, Guangxiong CHEN<sup>1</sup>, Minhao ZHU<sup>1</sup>, Zhongrong ZHOU<sup>1</sup><sup>1</sup>*Southwest Jiaotong University, China*; <sup>2</sup>*University of Liverpool, England*

17:10-17:30

Improvement in slip resistance of rubber sole on oil-lubricated surface by controlling height and orientation of tread block

Takeshi YAMAGUCHI, Yu KATSURASHIMA, Kazuo HOKKIRIGAWA

Tohoku University, Japan

17:30-17:50

Thermoelastohydrodynamic behaviour comparisons of different textured gas face seals at low pressure

Shaopeng DING, Shaoxian BAI

Zhejiang University of Technology, China

17:50-18:10

Tribological properties of alloying techniques to deposit coating on laser texturing surface

Yi WAN<sup>1</sup>, Dangsheng XIONG<sup>2</sup>, Jianliang LI<sup>2</sup>

<sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>Nanjing University of Science and Technology, China

18:10-18:30

The effect of tooth topography on the tribo-dynamic characteristics of spur gears

Zhi LI, Jian CHEN, Xiaojun LIU, Kun LIU

Hefei University of Technology, China

### Room 203C

**Track3: Lubrication and Lubricants**  
**Chemistry of lubricants II**

**Chair: Wilfred TYSOE, University of Wisconsin-Milwaukee, USA**

10:10-10:35 **Invited**

The mechanochemistry of ultra low wear fluoropolymers

W Gregory SAWYER<sup>1</sup>, Angela A PITENIS<sup>1</sup>, Kathryn L HARRIS<sup>2</sup>, Brandon A KRI CK<sup>3</sup>

<sup>1</sup>Lulea University of Florida, USA; <sup>2</sup>Kungliga Tekniska Högskolan (KTH), Sweden;

<sup>3</sup>Lehigh University, Bethlehem, USA

10:35-10:55

Tribochemical reactions of alkali metal phosphate with iron oxide surfaces from quantum mechanics molecular dynamics QM/MM Level

Thuy Huong TA, Anh Kiet TIEU, Hongtao ZHU, Haibo YU, Dinh Thi TA, Manh Ha LE

University of Wollongong, Australia

10:55-11:15

Tribological characteristic and mechanism analysis of borate ester as a lubricant additive in different base oils

Guangbin YANG, Shengmao ZHANG, Pingyu ZHANG

Henan University, China

11:15-11:35

Influence of the structure of hydrocarbon radicals on the adsorption parameters for lubricant

Lgor MUKCHORTOV, Elena ZADOROZHNYAYA, Lgor LEVANOVA, Yury ROZHDESTVENSKY

South Ural State University, Russia

11:35-11:55

Lubricant influences on the formation of white etching cracks (WEC)

Christoph MAYER, Balasubramaniam VENGUDUSAMY, Adam ORENDORZ, Stefan GRUNDEI, Claus ENEKES, Reiner SPALLEK

Klüber Lubrication München SE & Co. KG

11:55-12:15

Comparison between Langmuir-Blodgett films made from additive molecules and adsorbed additive layers from the viewpoint of nanotribological property

Koki Shinohara<sup>1</sup>, Tomoko Hirayama<sup>1,2</sup>, Takashi Matsuoka<sup>1</sup>

<sup>1</sup>Doshisha University; <sup>2</sup>JST Presto

12:30-13:30

Lunch

### Room 203C

**Track3: Lubrication and Lubricants**  
**Solid lubricants I**

**Chair: Junyan ZHANG, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China**

13:30-14:00 **Keynote**

In situ created 2D Turbostratic Graphite: A new way to obtain high performance self lubricating composites

José Daniel Biasoli de Mello

Universidade Federal de Uberlândia, Brazil

14:00-14:20

Low friction mechanism of diamond-like carbon in water: a theoretical study

Shandan BAI<sup>1</sup>, Jingxiang XU<sup>2</sup>, Yusuke OOTANI<sup>2</sup>, Yuji HIGUCHI<sup>2</sup>, Nobuki OZAWA<sup>2</sup>, Momoji KUBO<sup>2</sup>

<sup>1</sup>Kyocera Corporation, Japan; <sup>2</sup>Tohoku University, Japan

14:20-14:40

The synthesis of MoS<sub>2</sub> particles with different morphologies for tribological applications

Meirong Yi, Chenhui ZHANG

Tsinghua University, China

14:40-15:00

From nanoscale to macroscale friction reducing enabled by in-suit multilayers graphene formation

Wenbo QIN, Wen YUE, Chengbiao WANG

China University of Geosciences (Beijing), China

15:00-15:20

Study of frictional behaviors of vertically oriented graphene sheets fabricated by electrophoretic deposition

Bin SHEN, Sulin CHEN, Hong HONG

Shanghai Jiao Tong University, China

15:30-16:30

Coffee Break & Poster Time



## Room 203C

**Track3: Lubrication and Lubricants  
Solid Lubricants II**

Chair: Ning REN, Valvoline Co., USA

**16:30-16:55 Invited****Engineering scale superlubricity of carbon films**

Junyan ZHANG

*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China***16:55-17:15****Run-in behavior of DLC film at nano scale**

Pengfei SHI

*Southwest University, China***17:15-17:35****Self-assembled graphene film as low friction solid lubricant in macroscale contact**Pu WU<sup>1</sup>, Xinming LI<sup>2</sup>, Chenhui ZHANG<sup>1</sup>, Xinchun CHEN<sup>1</sup>, Shuyuan LIN<sup>1</sup>, Zefeng CHEN<sup>2</sup>, Hongyan SUN<sup>3,4</sup>, Hengte LIN<sup>3</sup>, Hongwei ZHU<sup>1</sup>, Jianbin LUO<sup>1</sup><sup>1</sup>Tsinghua University, China; <sup>2</sup>The Chinese University of Hong Kong, China;<sup>3</sup>Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China; <sup>4</sup>Hunan University, China**17:35-17:55****Effect of multilayer structure of a C/Si film on its tribological properties in solid-liquid composite lubrication system under high temperature**

Bing LI, Yujuan ZHANG, Shengmao ZHANG, Pingyu ZHANG

*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, China*

## Room 305A

**Track3: Lubrication and Lubricants  
Additives III**

Chair: Hugh SPIKES, Imperial College London, UK

**10:10-10:30****Tribochemistry of molybdenum based additives using Raman microscopy on steel/steel and steel/DLC coatings**Cayetano ESPEJO<sup>1</sup>, Catherine CHARRIN<sup>2</sup>, Benoît THIÉBAUT<sup>2</sup>, Denis LANÇON<sup>2</sup>, Anne NEVILLE<sup>1</sup>, Ardian MORINA<sup>1</sup><sup>1</sup>University of Leeds, UK; <sup>2</sup>TOTAL. Solaize Researcher Center, France**10:30-10:50****Mechanism of fretting wear reduction using magnesium stearate as lubricant additive under oil lubrication**

Taisuke MARUYAMA, Michita HOKAO

*NSK Ltd., Japan***10:50-11:10****The effect of UV irradiation to a-C:H on friction and wear properties under PAO oil lubrication including MoDTC and ZnDTP**

Mohd Taugjik BIN TAIB, Noritsugu UMEHARA, Motoyuki MURASHIMA

*Nagoya University, Japan***11:10-11:30****Effect of water-based lubricants on multi-degradation of austenitic stainless steel**

Amin HOSSEIN ZAVIEH, Nuria ESPALLARGAS

*Norwegian university of science and technology, Norway***11:30-11:50****The tribological properties of sulfur-and-phosphorus-free organic molybdenum compounds as additives in oil**Wenjuan HUAI, Yanxu WANG, Yuanjing DAI, Jiping ZHANG, Chenhui ZHANG  
*Tianjin Research Institute for Advanced Equipment, Tsinghua University, China***11:50-12:10****Effect of graphene as oil additives on the frictional behavior of GCr15 steel during sliding contact**

Lupeng WU, Chuanwei ZHANG, Zhijie XIE, Le GU

*Harbin Institute of Technology, China***12:10-12:30****New sight into the tribological mechanism of cerium oxide nanoparticles**

Lili WU, Shengmao ZHANG, Pingyu ZHANG

*National & Local Joint Engineering Research Center, China***12:30-13:30**

## Lunch

## Room 305A

**Track3: Lubrication and Lubricants  
Additives IV**

Chair: Petr SPERKA, Brno University of Technology

**13:30-13:50****Microstructure and antioxidant behavior of mesoporous silica nanospheres as potential antioxidant of synthetic ester lubricant oil**

Lina HUANG, Shengmao ZHANG, Pingyu ZHANG

*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, China***13:50-14:10****Tribological properties of tungsten disulfide nanoparticles surface-capped by oleylamine and maleic anhydride dodecyl ester as additive in diisooctylsebacate**

Zhengquan JIANG, Shengmao ZHANG, Pingyu ZHANG

*Henan University, China***14:10-14:30****The graphene as friction reduction and antiwear additive in polyphosphate lubricant for elevated rubbing surfaces**

Ning KONG, Shanshan LIU, Hongbo LI, Jie ZHANG

*University of Science and Technology Beijing, China***14:30-14:50****Study of the tribological behavior and the adsorption mechanism of fatty amines and derivatives**Toni MASSOUD<sup>1</sup>, Rafael PEREIRA DE MATOS<sup>1</sup>, Thierry LE MOGNE<sup>1</sup>, Manuel COBIAN<sup>1</sup>, Michel BELIN<sup>1</sup>, Benoît THIÉBAUT<sup>2</sup>, Sophie LOEHLÉ<sup>2</sup>, Franck DAHLEM<sup>1</sup>, Clotilde MINFRAY<sup>1</sup><sup>1</sup>CNRS-UMR 5513, France; <sup>2</sup>Total-Centre de Recherche de Solaize, France**14:50-15:10****Stress-induced reticulation of unsaturated fatty acid fuel additives under boundary lubrication**Jean Michel MARTIN<sup>1</sup>, Maria Isabel DE BAFFOS BOUCHET<sup>1</sup>, Cyrielle FOREST<sup>1</sup>, Jose AVILA<sup>2</sup>, Michaël MAZARIN<sup>3</sup>, Maria Carmen ASENSIO<sup>2</sup><sup>1</sup>University of Lyon, France; <sup>2</sup>University Paris-Saclay, France; <sup>3</sup>TOTAL, France

15:10-15:30

Inorganic nano/submicrospheres grown by in-situ laser irradiation for enhanced tribology performance

Ting LUO, Bingqiang CAO  
University of Jinan, China

15:30-16:30

Coffee Break & Poster Time

Room 305A

Track3: Lubrication and Lubricants  
Additives V

Chair: Fabrice DASSENOY, Ecole Centrale de Lyon, France

16:30-16:50

Friction characteristics of environmentally adapted lubricants in boundary lubricated contacts

Kim BERGLUND, Yijun SHI  
Lulea University of Technology, Sweden

16:50-17:10

Tribological performance of environmentally acceptable lubricants composed of various fatty acids

Szymon BERNAT<sup>1</sup>, Nuria ESPALLARGAS<sup>1</sup>, Sergio ARMADA<sup>2</sup>  
<sup>1</sup>Norwegian University of Science and Technology, Norway; <sup>2</sup>SINTEF, Norway

17:10-17:30

Tribological properties of nitrided steel lubricated with fully formulated oils in boundary lubrication conditions

Hiroto AOTA<sup>1</sup>, Aya SHINGAI<sup>2</sup>, Yukio TAMURA<sup>1</sup>, Hiroshi YAMAMOTO<sup>1</sup>, Shinji TANAKA<sup>2</sup>, Masao KIKUCHI<sup>1,2</sup>, Masabumi MASUKO<sup>2</sup>  
<sup>1</sup>Komatsu.Ltd, Japan; <sup>2</sup>Tokyo Institute of Technology, Japan

17:30-17:50

The oil additives effects on the friction property of rubbers

Ryota ASHIZAWA<sup>1</sup>, Tasuku ONODERA<sup>1</sup>, Yoshie SAKAI<sup>2</sup>, Hiroaki TACHIBANA<sup>2</sup>  
<sup>1</sup>Hitachi, Ltd, Japan; <sup>2</sup>Hitachi Automotive Systems, Ltd., Japan

17:50-18:10

Tribological performance of MoS<sub>2</sub>/CNTs composite as lubricant additive in ester based oil

Jincan YAN, Wei SONG, Jiahua MAI, Hongbing JI  
Sun Yat-sen University, China

18:10-18:30

Improving the performance of water-based lubrication system by ultrathin MoS<sub>2</sub> exfoliated by biological proteins

Lei LIU, Zhengquan LEI, Wei ZOU  
Southeast University, China

Room 305C

Track4: Biotribology & Biomimetics  
Artificial Joints I

Chair: Teruo MURAKAMI, Teikyo University, Japan

10:10-10:35 **Invited**

Ceramic multilayer coating under high demanding activities knee wear simulation

Thomas M. GRUPP, Bernhard FRITZ, Jens SCHWIESAU, Ana Laura Puente REYNA  
Aesculap AG Research and Development, Tuttlingen 78532, Germany

10:35-10:55

Coordinate based methodology for wear and creep assessment of polyethylene tibial knee inserts in total knee replacement

Wei JIANG<sup>1</sup>, Zhongmin JIN<sup>2,3</sup>, Cuicui JI<sup>4</sup>  
<sup>1</sup>Changzhou Institute of Technology, China; <sup>2</sup>University of Leeds, England; <sup>3</sup>Southwest Jiaotong University, China; <sup>4</sup>Hohai University, China

10:55-11:15

Effect of loading conditions on wear of polyethylene total hip joint replacements: A putational formulation

Feng LIU, Lei DONG, Li FENG, Junyuan WANG  
North University of China, China

11:15-11:35

Toward minimizing wear in prosthetic socket by optimizing reliefs areas

Gabi NEHME  
University of Balamand, Lebanon

11:35-11:55

Influence of acetabular cup inclination on wear of UHMWPE liner

Matúš RANUUSA<sup>1</sup>, Martin VRBKA<sup>1</sup>, Jiří GALLO<sup>2</sup>, Ivan KRUPKA<sup>1</sup>, Martin HARTL<sup>1</sup>

<sup>1</sup>Brno University of Technology, Czech; <sup>2</sup>University Hospital Olomouc, Czech

11:55-12:15

Fiber reinforcement promotes biphasic lubrication of PVA hydrogel as an artificial cartilage material

Nobuo SAKAI<sup>1</sup>, Chie HASHIMOTO<sup>1</sup>, Seido YARIMITSU<sup>2</sup>, Yoshinori SAWAE<sup>3</sup>, Teruo MURAKAMI<sup>4</sup>  
<sup>1</sup>Kyushu Institute of Technology, Japan; <sup>2</sup>Tokyo Metropolitan University, Japan; <sup>3</sup>Kyushu University, Japan; <sup>4</sup>Teikyo University, Japan

12:15-13:30

Lunch

Room 305C

Track4: Biotribology & Biomimetics  
Artificial Joints II

Chair: Thomas M. GRUPP, Aesculap AG Research and Development, Tuttlingen 78532, Germany

13:30-14:00 **Keynote**

Biomimetic articular cartilage and biotribology properties

Shirong GE  
China University of Mining & Technology, China

14:00-14:20

Evaluation of friction properties of polyvinyl alcohol/graphene oxide hydrogels as articular cartilage replacement

Yan Brandon SHI, Dangsheng XIONG, Jianliang LI  
Nanjing University of Science and Technology, China

14:20-14:40

Chemical and physical surface modification on polycarbonate urethane to reduce its friction against cartilage to make a durable permanent meniscus

Prashant SHARMA, Irene SCHIAVON, Sara EHSANI MAJD, Hans KAPER  
University of Groningen and University Medical Center Groningen, Holland



**14:40-15:00****"Tribological behaviors of PEEK-coated titanium alloys in contact with ZrO<sub>2</sub> counterbodies**Jian SONG<sup>1</sup>, Yuhong LIU<sup>1</sup>, Zhenhuha LIAO<sup>2</sup>, Yiqin DUAN<sup>1</sup>, Weiqiang LIU<sup>1</sup>, Xiaohong MU<sup>3</sup><sup>1</sup>Tsinghua University, China; <sup>2</sup>Research Institute of Tsinghua University in Shenzhen, China; <sup>3</sup>Dongzhimen Hospital Affiliated to Beijing University of Chinese Medicine, China**15:30-16:30**

Coffee Break &amp; Poster Time

**Room 305C****Track4: Biotribology & Biomimetics  
Artificial Joints III****Chair: Shirong GE, China University of Mining & Technology, China****16:30-16:55 Invited****Superior lubricity of poly(vinyl alcohol) hydrogels as artificial cartilage with adaptive multimode lubrication**Teruo MURAKAMI<sup>1</sup>, Seido YARIMITSU<sup>2</sup>, Nobuo SAKAI<sup>3</sup>, Kazuhiro NAKASHIMA<sup>4</sup>, Tetsuo YAMAGUCHI<sup>4</sup>, Yoshinori SAWAE<sup>4</sup>, Atsushi SUZUKI<sup>5</sup><sup>1</sup>Teikyo University, Japan; <sup>2</sup>Tokyo Metropolitan University, Japan; <sup>3</sup>Kyushu Institute of Technology, Japan; <sup>4</sup>Kyushu University, Japan; <sup>5</sup>Yokohama National University, Japan**16:55-17:15****The effect of synovial fluid composition on CoCrMo wear**Harriet STEVENSON<sup>1</sup>, Matthew JAGGARD<sup>2</sup>, Claire BOULANGE<sup>3</sup>, Pouya AKHBARI<sup>2</sup>, Uddhav VAGHELA, John LINDON<sup>3</sup>, Horace WILLIAMS<sup>2</sup>, Chinmay GUPTA<sup>2</sup>, Philippa CANN<sup>1</sup><sup>1</sup>Imperial College London, Tribology Group, England; <sup>2</sup>Imperial College London, Musculoskeletal Laboratory, England; <sup>3</sup>Imperial College London, Phenome Center, England**17:15-17:35****Could Ti<sub>6</sub>Al<sub>4</sub>V be alternative as a bearing surface articulated with polymer in artificial cervical disc?**Song WANG<sup>1</sup>, Weiqiang LIU<sup>1</sup><sup>1</sup>Research Institute of Tsinghua University in Shenzhen, China; <sup>2</sup>Tsinghua University State Key Laboratory of Tribology, China**17:35-17:55****Study on the tribological behaviors of CoCrMo alloy against different materials for use in artificial cervical disc**Dingding XIANG<sup>1</sup>, Jian SONG<sup>2</sup>, Song WANG<sup>3</sup>, Zhenhua LIAO<sup>4</sup>, Weiqiang LIU<sup>2</sup><sup>1</sup>Tsinghua University State Key Laboratory of Tribology, China; <sup>2</sup>Tsinghua University Department of Mechanical Engineering, China; <sup>3</sup>Tsinghua University Biomechanics and Biotechnology Lab, China; <sup>4</sup>Research Institute of Tsinghua University in Shenzhen, China**17:55-18:15****Effect of corrosion on tribology and protein adsorption properties of a CoCrMo alloy used in artificial joints**

Yu YAN, Zhongwei WANG, Lijie QIAO

University of Science and Technology Beijing, China

**Room 303****Track5: Tribology in Manufacturing  
Metal Forming & Advanced Processing I****Chair: Kun LIU, Hefei University of technology, China****10:10-10:35 Invited****Tribology in rolling technology of steel**

Kiet TIEU

University of Wollongong, Australia

**10:35-11:00 Invited****Tribology in multiscale metal forming**

Kuniaki DOHDA

Northwestern University, USA

**11:00-11:20****Oxidation and wear mechanics of high speed steel measured by a novel high temperature roller-on-disc testing rig**Hongtao ZHU<sup>1</sup>, Qiang ZHU<sup>1,2</sup>, Guanyu DENG<sup>1</sup>, Kiet TIEU<sup>1</sup>, Qiong WU<sup>3</sup>, Qun FAN<sup>3</sup><sup>1</sup>University of Wollongong, Australia; <sup>2</sup>University of New South Wales, Australia; <sup>3</sup>Baosteel, China**11:20-11:40****Analysis of hot rolled surface and metallographic structure of SS41 steel lubricated with water-based nano-TiO<sub>2</sub> fluid**

Yanan MENG, Jianlin SUN, Linghui KONG

University of Science &amp; Technology Beijing, China

**11:40-12:00****Lubricant film thickness measurements in cold rolling using ultrasound**

Andrew HUNTER

University of Sheffield, United Kingdom

**12:00-13:30**

Lunch

**Room 303****Track5: Tribology in Manufacturing  
Metal Forming & Advanced Processing II****Chair: Kuniaki DOHDA, Northwestern University, USA****13:30-13:55 Invited****Direct force measurement in thread rolling operations – experimental and numerical tribological process investigation**

Philipp KRAMER, Peter GROCHE

TU Darmstadt, Germany

**13:55-14:20 Invited****Effect of granular matter property on powder compaction**

Kun LIU

Hefei University of Technology, China

**14:20-14:40****Wear behavior of friction stir processed NAB alloys in marine environment**Ajay Kumar P.<sup>1</sup>, Vishnu NAMBOODIRI<sup>2</sup>, Anirudhan P.<sup>2</sup>, Satish V. KAILAS<sup>1</sup><sup>1</sup>Indian Institute of Science (IISc) Bangalore, India; <sup>2</sup>Department of Mechanical Engineering, Government Engineering College, India

14:40-15:00

Tribological behaviors of porous metal produced by additive manufacturing from boundary to full film lubrication

Yi ZHU, Guoliang LIN, Xubin CHEN, Jun ZOU, Huayang YANG  
*Zhejiang University, China*

15:00-15:20

Optimal design of the ring with boss compression test for high sensitivity to friction

Chengliang HU, Xiping LIAO, Qiang YIN, Zhen ZHAO  
*Shanghai Jiaotong University, China*

15:30-16:30

Coffee Break &amp; Poster Time

**Room 303****Track5: Tribology in Manufacturing  
Micro and Nano Fabrication**Chair: Guoshun PAN, *Tsinghua University, China*

16:30-16:50

A rotational near-field photolithography system for nanopatterning

Jiaxin JI<sup>1,2</sup>, Yonggang MENG<sup>2</sup>, Shayu LI<sup>3</sup><sup>1</sup>China University of Petroleum, China; <sup>2</sup>Tsinghua University, China; <sup>3</sup>Chinese Academy of Sciences, China

16:50-17:10

Friction-induced nanofabrication on UV/Ozone treated Si(100) surface

Linmao QIAN, Hongbo WANG, Shulan JIANG, Bingjun YU  
*Southwest Jiaotong University, China*

17:10-17:30

Effects of surface wettability on the defects controlling in soft lithography of ceramic microparts

Junhu MENG<sup>1</sup>, Bo SU<sup>1</sup>, Lanqing JIAO<sup>1,2</sup><sup>1</sup>Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China; <sup>2</sup>University of Chinese Academy of Sciences, China**Room 305E****Track6: Engine and Transmission Tribology  
Rolling bearings III**Chair: Xiaolan AI, *Timken co., USA*10:10-10:35 **Invited**

Lubrication problem of retainerless rolling element bearings

Pat Lam Patrick WONG  
*City University of Hong Kong, Hong Kong*

10:35-10:55

Non-steady elastohydrodynamic lubrication for the finite line contact: Subsurface stress analysis

Tobias HULTQVIST, Mohammad SHIRZADEGAN, Aleks VRCEK, Pär MARKLUND, Roland LARSSON, Braham PRAKASH  
*Luleå University of Technology, Sweden*

10:55-11:15

Effect of bearings preload of the tribological performance of elastohydrodynamic conjunctions in the automotive manual transmissions

Angeliki Christina LADEROU, Mahdi MOHAMMADPOUR, Stephanos THEODOSSIADES, Homer RAHNEJATL  
*Loughborough University, UK*

11:15-11:35

Numerical simulation of the transonic airflow resistance between rings of the high-speed rolling bearing

Hongbin LIU, Gongping LIU, Yunbin LI, Haiyang WANG  
*Henan University of Science and Technology, China*

11:35-11:55

A numerical approach for lubrication analysis in rolling bearing considering real surface morphology

Shi CHEN<sup>1</sup>, Zhinan ZHANG<sup>1</sup>, Xinsheng WEI<sup>2</sup><sup>1</sup>Shanghai Jiao Tong University, China; <sup>2</sup>Shanghai Aerospace Control Technology Institute, China

11:55-12:15

Advanced calculations of spherical roller bearings (SRB) accounting for roller skewing

Luc HOUPERT  
*The Timken Company, France*

12:15-13:30

Lunch

**Room 305E****Track6: Engine and Transmission Tribology  
Rolling Bearings IV**Chair: Luc HOUPERT, *Timken co., Europe*13:30-13:55 **Invited**

Recent achievements in mixed EHL research

Dong ZHU  
*Sichuan University, China*

13:55-14:15

Contact characteristic analysis of thin wall angular contact ball

Ming QIU<sup>1,2</sup>, Zhenhua NIU<sup>1</sup>, Hui DU<sup>1</sup>, Xiaoxu PANG<sup>1</sup><sup>1</sup>Henan University of Science and Technology, China; <sup>2</sup>Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, China

14:15-14:35

The theoretical analysis and experimental study for ultra-high speed angular contact ball bearing

Dongfeng WANG, Shengchao LIU, Yanjing YIN  
*Luoyang Bearing Science & Technology Co., Ltd., China*

14:35-14:55

Influence of preload on the friction and wear properties of high-speed instrument rotor angular contact ball bearings

Tao ZHANG, Xiaoyang CHEN  
*Shanghai University, China*

14:55-15:15

Frictional work in oscillating bearings – simulation of an angular contact ball bearing under dry conditions and small amplitudes

Fabian SCHWACK, Felix PRIGGE, Gerhard POLL  
*Institute of Machine Design and Tribology, Germany*

15:15-15:35

Effects of rough surfaces in an angular contact ball bearing

Yunlong WANG, Wenzhong WANG, Zhiqiang ZHAO  
*Beijing Institute of Technology, China*

15:35-16:30

Coffee Break &amp; Poster Time

16:30-16:50

Roller end and flange contact modeling for cylindrical rolling element bearings

Xiaolan AI, Jerry RHODES  
*The Timken Company, USA*

Room 305E

Track6: Engine and Transmission Tribology  
Rolling Bearings VChair: Dong ZHU, *Sichuan University, USA*

16:50-17:10

Tribological aspects of rolling bearings lubricated with refrigerant  
Rudolf HAULEITNER<sup>1</sup>, Guillermo E MORALES-ESPEJEL<sup>2,3</sup>, Magnus ARVIDSSON<sup>4</sup><sup>1</sup>SKF Oesterreich AG; <sup>2</sup>SKF Engineering & Research Centre; <sup>3</sup>Université de Lyon; <sup>4</sup>SKF Application Competence Centre

17:10-17:30

Effect of detergent additive and standstill corrosion on rolling contact fatigue

Wen WANG<sup>1</sup>, Bo HAN<sup>3</sup>, Xiaobo ZHOU<sup>2</sup><sup>1</sup>Shanghai University, China; <sup>2</sup>SKF Engineering and Research Centre, China; <sup>3</sup>SKF Global Technical Centre China, China

17:30-17:50

NiTi alloys for aerospace bearing applications

Christopher DELLACORTE  
*NASA, USA*

Room 307

Track6: Engine and Transmission Tribology  
Fluid-film BearingsIIIChair: Federico COLOMBO, *Polytechnic University of Turin, Italy*

10:10-10:30

A thermal elastic-hydrodynamic lubricated analysis of highly loaded journal bearings, with varying bulk modulus, to allow high areas of cavitation to be solved

Benjamin ROTHWELL, Seamus GARVEY, John WEBSTER  
*University of Nottingham, UK*

10:30-10:50

Running-in of journal bearings subjected to non-stationary conditions

Gero BURGHADT, Georg JACOBS, Florian KOENIG, Christopher SOUS  
*RWTH Aachen University, Germany*

10:50-11:10

Static characteristics of a cryogenic hydrostatic journal bearing

Jialei DU, Panyun YAN, Guozhu LIANG  
*Beihang University, China*

11:10-11:30

External magnetic field of journal bearing with twined solenoid

Yanjuan ZHANG<sup>1</sup>, Jianmei WANG<sup>2</sup>, Decai LI<sup>1</sup><sup>1</sup>Beijing Jiaotong University, China; <sup>2</sup>Taiyuan University of Science and Technology, China

11:30-11:50

Load carrying capacity and friction torque in a thrust heterogeneous surface bearing

Evan THOMAS, Romeo GLOVNEA  
*University of Sussex, United Kingdom*

11:50-13:30

Lunch

Room 307

Track6: Engine and Transmission Tribology  
Fluid-film Bearings IVChair: Masaaki MIYATAKE, *Tokyo University of Science, Japan*

13:30-14:00 Keynote

Modelling development &amp; technological improvements of hydrodynamic bearings

Michel FILLON  
*University of Poitiers, France*

14:00-14:20

A new method for calculating the static performance of hydrostatic journal bearing

Peng LIANG<sup>1</sup>, Changhou LU<sup>2</sup><sup>1</sup>Qingdao University of Technology, China; <sup>2</sup>Shandong University, China

14:20-14:40

Behavior of a two lobe journal bearing with a scratched shaft: comparison between numerical results and experimental data

Jean BOUYER<sup>1</sup>, Célia GIRAUDEAU<sup>1,2</sup>, Michel FILLON<sup>1</sup>, Mathieu HÉLÈNE<sup>2</sup>, Jérôme BEAURAIN<sup>2</sup><sup>1</sup>University of Poitiers, France; <sup>2</sup>EDF Lab Paris-Saclay, France

14:40-15:00

Efficient numerical solver of the unsteady thermohydrodynamic Reynolds equation for journal bearings

Silun ZHANG, Mohamed-Amine HASSINI, Mihai ARGHIR  
*EDF R&D, France*

15:00-15:20

Ferro-fluid lubrication of finite journal bearings using Jenkins model

Benyebka Bou-Said  
*INSA Lyon*

15:20-15:40

Comparison between the load carrying capacity of a Rayleigh step and a heterogeneous slip/non-slip surface bearing

Evan THOMAS<sup>1</sup>, Romeo GLOVNEA<sup>1</sup>, Kazuyuki YAGI<sup>2</sup>, Joichi SUGIMURA<sup>2</sup><sup>1</sup>University of Sussex, United Kingdom; <sup>2</sup>Kyushu University, Japan

15:40-16:30

Coffee Break &amp; Poster Time

Room 307

Track6: Engine and Transmission Tribology  
Fluid-film Bearings VChair: T. V. L. N. RAO, *The LNM Institute of Information Technology, India*

16:30-16:50

Research on friction vibration of marine water lubricated rubber bearing

Jun YANG, Zhenglin LIU  
*Wuhan University of Technology, China*

16:50-17:10

Equivalent support position and stiffness of misaligned water-lubricated stern tube bearing

Fangrui LV, Chunxiao JIAO, Zhushi RAO, Na TA  
Shanghai Jiao Tong University, China

17:10-17:30

Study on dynamic characteristics of water lubricated bearings fluid-solid coupling system considering local contact

Wu OUYANG<sup>1,2</sup>, Lei WANG<sup>3</sup>, Yong JIN<sup>1,2</sup>, Zhenglin LIU<sup>1</sup>, Xinping YAN<sup>1,4</sup>  
<sup>1</sup>Wuhan University of Technology, China; <sup>2</sup>Key Laboratory of Marine Power Engineering Technology (Ministry of Communications), China; <sup>3</sup>China Ship Development and Design Center, China; <sup>4</sup>National Engineering Research Center for Water Transport Safety, China

17:30-17:50

Static and dynamic characteristics of a self-controlled water-lubricated hydrostatic thrust bearing using an elastic hinge

Koichi JOTAKI, Kazuki FUKUYAMA, Masaaki MIYATAKE, Shigeka YOSHIMOTO  
Tokyo University of Science, Japan

17:50-18:10

Study on the influencing mechanism of water temperature on the lubrication performance of water lubricated rubber pad

Xingxin LIANG<sup>1</sup>, Xinping YAN<sup>1,2</sup>, Wu OUYANG<sup>1</sup>, Zhenglin LIU<sup>1</sup>, Jian WANG<sup>1</sup>  
<sup>1</sup>Wuhan University of Technology, China; <sup>2</sup>National Engineering Research Center for Water Transportation Safety, China

### Room 308

#### Track7: Industrial Tribo-systems Automotive Tribology I

Chair: Patrick G SWAN, Aswan Consulting Cc, South Africa

10:10-10:35 **Invited**

Drastic reduction in drag force of car brake by Rayleigh-step

Takashi NAKAMURA  
Nagoya Institute of Technology, Japan

10:35-10:55

A bottom-up approach to study metal sulphides in brake friction materials at higher temperatures

Christian WOLTER, Thomas GRADT  
Bundesanstalt für Materialforschung und -prüfung (BAM), Germany

10:55-11:15

Brake squeal: Investigating the links between friction mechanisms and dynamic behavior

Edouard DAVIN<sup>1,2,3</sup>, Anne Lise CRISTOL<sup>1,2,3</sup>, Yannick DESPLANQUES<sup>1,2,3</sup>, Jean Francois BRUNEL<sup>1,3</sup>, Martin DUBOC<sup>4</sup>, Philippe DUFRENOY<sup>1,3</sup>  
<sup>1</sup>Laboratoire de mécanique de Lille, France; <sup>2</sup>Centrale Lille, France; <sup>3</sup>CNRS, France; <sup>4</sup>Arts et Métiers ParisTech - Lille, France

11:15-11:35

Friction induced noise analysis by potential exciting power method for car components applications

Yan-Ming CHEN<sup>1</sup>, David CAZE<sup>1</sup>, Moussa DIABY<sup>2</sup>, Catherine GAERTNER<sup>2</sup>, Dominique PIERRAT<sup>2</sup>  
<sup>1</sup>CETIM, France; <sup>2</sup>PSA, France

11:35-11:55

Characterisation of airborne particles emitted from car brake materials

Oleksii NOSKO<sup>1</sup>, Mattia ALEMANI<sup>2</sup>, Ulf OLOFSSON<sup>3</sup>  
<sup>1</sup>Bialystok University of Technology, Poland; <sup>2</sup>Brembo S.p.A., Italy; <sup>3</sup>KTH Royal Institute of Technology, Sweden

11:55-12:15

Synergetic effects inside a simplified friction material: a PCA approach

Florence VIVIER, Diego PELLERÉ  
ITT Italia Srl, China

12:15-12:35

The influence of lubricant composition on shift performance of manual transmissions

Christoph WINCIERZ, Dmitriy SHAKHVOROSTOV, Anatolij SMIRNOV  
Evonik, Germany

12:35-13:30

Lunch

### Room 308

#### Track7: Industrial Tribo-systems Automotive Tribology II

Chair: Yoshitsugu KIMURA, The University of Tokyo / Kagawa University, Japan

13:30-13:55 **Invited**

Contribution of tribology to the progress in industry in Japan - A brief review of the first half century of tribology

Yoshitsugu KIMURA  
The University of Tokyo / Kagawa University, Japan

13:55-14:15

A method of reducing windage power loss of a high-speed motor using a viscous vacuum pump

Junpei HORIIKE, Masaaki MIYATAKE, Shigeka YOSHIMOTO  
Tokyo University of Science, Japan

14:15-14:35

Study of rubber/road dry friction in rolling sliding and linear sliding conditions

Jonas BOUSMAT<sup>1,2</sup>, Julien SCHEIBERT<sup>1</sup>, Alain LE BOT<sup>1</sup>, Florian BREMOND<sup>2</sup>  
<sup>1</sup>Laboratoire de tribologie et dynamique des systèmes, France; <sup>2</sup>Manufacture Michelin, France

14:35-14:55

Experimental investigation on mechanism of tire wear particle production

Haibo HUANG, Jinpeng LIU  
Ningbo University, China

14:55-15:15

Application of DLC coatings for automotive and industrial components in China to minimize friction and wear

Bo WANG, Simon ZHANG  
Ionbond China, China

15:15-15:35

Applications of rotary tribometer with European urban driving cycles

Deepak Halenahally VEEREGOWDA, Angela Maria TORTORA  
Ducom Instruments Europe B.V, Netherlands



15:35-16:30

Coffee Break &amp; Poster Time

## Room 308

## Track7: Industrial Tribo-systems

## Space and Aerospace

Chair: Qian ZOU, Oakland University, USA

16:30-16:50

Research on the characteristics of rolling-tribology with current of space ultra high power transfer rotary joint of unlike structures

Zili LIU<sup>1</sup>, Yongzhen ZHANG<sup>2</sup>, Chenfei SONG<sup>2</sup>, Li WANG<sup>1</sup>, Xinbin HOU<sup>1</sup><sup>1</sup>Qian Xuesen Laboratory of Space Technology, China; <sup>2</sup>Henan University of Science and Technology, China

16:50-17:10

Long life technologies of oil-lubricated ball bearing for space applications

Kazuhisa KITAMURA<sup>1</sup>, Kazuyoshi YAMAKAWA<sup>1</sup>, Akira KOYAMA<sup>1</sup>, Kazuaki MANIWA<sup>2</sup>, Takashi NOGI<sup>2</sup>, Shingo OBARA<sup>2</sup><sup>1</sup>JTEKT Corporation, Japan; <sup>2</sup>Japan Aerospace Exploration Agency, Japan

17:10-17:30

Investigations of spatial grease tribological behavior for reformulation

Magali BUSQUET<sup>1,2</sup>, David LEVEQUE<sup>1</sup>, Yves BERTHIER<sup>1,4</sup>, Mathieu RENOUF<sup>3,4</sup>, Nathalie BOUSCHARAIN<sup>1</sup>, Jacques SICRE<sup>5</sup><sup>1</sup>Université de Lyon, France; <sup>2</sup>INS, France; <sup>3</sup>Université de Montpellier, France; <sup>4</sup>International Tribology Group, France; <sup>5</sup>CNES, France

17:30-17:50

Ball screw performance and film formation behavior of four multiply alkylated cyclopentane (MAC) base greases for space applications

Toshifumi MAWATARI<sup>1</sup>, Nobuyoshi OHNO<sup>1</sup>, Bo ZHANG<sup>1</sup>, Akira NAKAJIMA<sup>1</sup>, Hiroshi SHIOMI<sup>2</sup>, Shingo OBARA<sup>2</sup><sup>1</sup>Saga University, Japan; <sup>2</sup>Japan Aerospace Exploration Agency, Japan

17:50-18:10

Tribology investigation in open space

Marat BRONOVETS

Institute for Problems in Mechanics of the Russian Academy of Sciences, Russia

## Room 311A

## Track 8: Tribotest and Monitoring

## Condition Monitoring &amp; Data Analysis I

Chair: Xinping YAN, Wuhan University of Technology, China

10:10-10:40 Keynote

How tribology has been helping us to advance and to survive

Gwidon STACHOWIAK

Curtin University, Australia

10:40-11:00

Wear monitoring based on reflected image of a novel on-line visual ferrograph

Bo LI

Xi'an Jiaotong University, China

11:00-11:20

Parameter estimation and residual life prediction for deteriorating lubricating oil based on hidden semi-Markov modeling

Ying DU<sup>1</sup>, Tonghai WU<sup>1</sup>, Viliam MAKIS<sup>2</sup><sup>1</sup>Key Laboratory of Education Ministry for Modern Design and Rotor-Bearing System, Canada; <sup>2</sup>Department of Mechanical and Industrial Engineering, University of Toronto, Canada

11:20-11:40

Three-dimensional feature extraction of wear particle based on multi-objects tracking and recognition

Shuo WANG, Tonghai WU, Lingfeng YANG, Longxin WANG

Xi'an Jiaotong University, China

11:40-12:00

Directional and multi-scale characterization of curvature of DLC-coated and uncoated surfaces

Marcin WOLSKI<sup>1</sup>, Pawel PODSIADLO<sup>1</sup>, Gwidon W. STACHOWIAK<sup>1</sup>, Kenneth HOLMBERG<sup>2</sup>, Anssi LAUKKANEN<sup>2</sup>, Helena RONKAINEN<sup>2</sup>, Mark GEE<sup>3</sup>, Nunn John NUNN<sup>3</sup>, Carsten GACHOT<sup>4</sup>, Lawrence LI<sup>5</sup><sup>1</sup>Curtin University, Australia; <sup>2</sup>VTT Technical Research Centre, Finland;<sup>3</sup>National Physical Laboratory, UK; <sup>4</sup>Saarland University, Germany; <sup>5</sup>City University of Hong Kong, Hong Kong

12:00-12:20

Bearing faults in the wind turbine drivetrain: Comparative study of monitoring with FFT and the Discrete Wavelet Transform

Daniel STRÖMBERGSSON, Pär MARKLUND, Kim BERGLUND

Division of Machine Elements, Luleå University of Technology, Luleå, Sweden

12:30-13:30

Lunch

## Room 311A

## Track 8: Tribotest and Monitoring

## Condition Monitoring &amp; Data Analysis II

Chair: Rob DWYER-JOYCE, University of Sheffield United Kingdom

13:30-14:00 Keynote

Remote fault diagnosis system for marine power machinery system based on tribology

Xinping YAN

Wuhan University of Technology, China

14:00-14:20

Vehicular engine oil drain interval evaluation based on on-board diagnostic data

Lei WEI<sup>1</sup>, Haitao DUAN<sup>1</sup>, Song CHEN<sup>1</sup>, Yongliang JIN<sup>1</sup>, Bingxue CHENG<sup>1</sup>, Dan JIA<sup>1</sup>, Jianfang LIU<sup>1,2</sup>, Jian LI<sup>1</sup><sup>1</sup>Wuhan Research Institute of Materials Protection, China; <sup>2</sup>Wuhan Polytechnic University, China

14:20-14:40

Online characterization of rolling element bearing wear status using oil debris features

Yeping PENG<sup>1</sup>, Tonghai WU<sup>1</sup>, Lingfeng YANG<sup>1</sup>, Ngaiming KWOK<sup>2</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>The University of New South Wales, Australia

**14:40-15:00****A fuzzy clustering-based BP neural network for intelligent wear debris recognition**Tao SHAO, Tonghai WU, Yeping PENG, Shuaiwei GUO  
*Xi'an Jiaotong University, China***15:00-15:20****The Research of engine oil performance evaluation method based on data mining**Minjie CHEN<sup>1,2</sup>, Xincong ZHOU<sup>1</sup>, Fuming KUANG<sup>1</sup>, Kai CHEN<sup>1</sup>  
<sup>1</sup>Wuhan University of Technology, China; <sup>2</sup>Guangzhou Mechanical Engineering Research Institute Co., Ltd, China**15:20-16:30****Coffee Break & Poster Time****Room 311A****Track 8: Tribotest and Monitoring  
Measurement and Instruments I****Chair: Dan GUO, Tsinghua University, China****16:30-16:55 Invited****Curvature analysis of surface topography at different scales and directions**Paweł PODSIADŁO, Marcin WOLSKI, Gwidon STACHOWIAK  
*Curtin University, Australia***16:55-17:15****Acoustic emission modelling of three body abrasion in machinery elements**Surojit PODDAR, Naresh TANDON  
*ITMMEC, Indian Institute of Technology Delhi, India***17:15-17:35****Effects of surface tilt on measurement of friction coefficient by scratch testing**Ming LIU, Chenghui GAO  
*Fuzhou University, China***17:35-17:55****A novel ultrasonic viscometer to measure PAO viscosity in-situ at high shear rates and pressures suitable for use in EHD problems**Michele SCHIRRU, Rob DWYER-JOYCE  
*The University of Sheffield, United Kingdom***17:55-18:15****The dynamic measurement of contact pressure distribution in a wheel-rail interface**Henry BRUNSKILL, Roger LEWIS, Rob DWYER-JOYCE  
*University of Sheffield, United Kingdom***18:15-18:35****Observation of grease behavior in ball bearing using X-ray CT and multi-phase grease simulation**Takashi NODA, Kenichi SHIBASAKI, Shinji MIYATA, Masato TANIGUCHI  
*NSK Ltd, Japan*

**Room 201A****Track1: Science of Tribology  
Tribochemistry I**Chair: Linmao QIAN, *Southwest Jiaotong University, China***10:10-10:35 Invited**

Tribochemistry at sliding interfaces – shear-induced polymerization of adsorbed molecules upon mechanical shear

Seong H. KIM

*Pennsylvania State University, USA***10:35-10:55**

Tribo-mechano-chemistry: lessons learnt from atomic scale modelling of diamond sliding against silica and silicon

Michael MOSELER, Andreas KLEMENZ, Lars PASTEWKA, Gianpietro MORAS  
*Fraunhofer IWM, MicroTribology Centr, Germany***10:55-11:15**

Mechanochemical behaviour of ZDDP

Jie ZHANG, Hugh SPIKES

*Imperial College London, UK***11:15-11:35**

Water-induced mechanochemical reactions and wear of multicomponent silicate glass in humid ambient

Seong H. KIM

*Pennsylvania State University, USA***11:35-11:55**

Effect of interfacial chemical reaction and intermolecular interaction on friction and wear mechanism

Yuliang LI, Wen YUE

*University of Geosciences(Beijing), China***12:00-13:30**

Lunch

**Room 201A****Track1: Science of Tribology  
Tribochemistry II**Chair: Junhong JIA, *Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China***13:30-13:55 Invited**

Quantum chemical molecular dynamics simulations on tribochemical reaction dynamics of diamond-like carbon and molybdenum dithiocarbamate

Momoji KUBO, Hiroki MURABAYASHI, Keiko WATASE, Yoshie OHGOSHI, Miho NAKAMURA, Yusuke OOTANI, Yuji HIGUCHI, Nobuki OZAWA, Koshi ADACHI

*Tohoku University, Japan***13:55-14:15**

Influences of surface temperature and applied pressure on cracking of hydrocarbon chains at boundary lubrication: a molecular dynamics approach

Thi Dinh TA, Anh Kiet TIEU, Hongtao ZHU, Ha Manh LE, Huong Thi Thuy TA  
*University of Wollongong, Australia***14:15-14:35**

Effect of tribochemical reaction on friction interface structure of amorphous silica under humidity: a molecular dynamics simulation study

Jingxiang XU, Naoki TAKAHASHI, Yusuke OOTANI, Yuji HIGUCHI, Nobuki OZAWA, Momoji KUBO

*Tohoku University, Japan***14:35-14:55**

Tight-binding quantum chemical molecular dynamics simulation study on tribological behaviors of diamond-like carbon against aluminum

Yang WANG, Jingxiang XU, Yusuke OOTANI, Yuji HIGUCHI, Nobuki OZAWA, Koshi ADACHI, Momoji KUBO

*Tohoku University, Japan***14:55-15:15**

First-principles molecular dynamics simulations for tribochemical reactions in silicon based ceramics sliding interface

Yusuke OOTANI, Naoki TAKAHASHI, Momoji KUBO

*Tohoku University, Japan***15:15-16:30**

Coffee Break &amp; Poster Time

**Room 201A****Track1: Science of Tribology  
Tribochemistry III**Chair: Momoji KUBO, *Tohoku University, Japan***16:30-16:50**

Frictional properties of model boundary films

Wilfred TYSOE<sup>1</sup>, Dustin OLSON<sup>1</sup>, Hongyu GAO<sup>2</sup>, Chun TANG<sup>2</sup>, Ashlie MARTINI<sup>2</sup><sup>1</sup>University of Wisconsin-Milwaukee, USA; <sup>2</sup>University of California-Merced, USA**16:50-17:10**

The influence of Al-Si alloy on ZDDP tribofilm formation on the counter-surface

Yasunori SHIMIZU<sup>1,2</sup>, Hugh SPIKES<sup>1</sup><sup>1</sup>Imperial College London, UK; <sup>2</sup>Idemitsu Kosan Co., Ltd., Japan**17:10-17:30**

Influence of refrigerant-surface chemistry on lubrication conditions

Stephane TROMP<sup>1</sup>, Laurent JOLY<sup>2</sup>, Manuel COBIAN<sup>3</sup>, Nicolas FILLOT<sup>1</sup><sup>1</sup>LaMCoS - INSA Lyon, France; <sup>2</sup>ILM, France; <sup>3</sup>LTDS, France**17:30-17:50**Electrochemical effect on tribofilm formation during running-in process of ZrO<sub>2</sub> ball/52100 steel plate in ZDDP/propylene carbonate solutions

Hui CAO, Yonggang MENG

*Tsinghua University, China***17:50-18:10**

Molecular dynamics analyses for boundary lubrications of carbon-based materials

Hitoshi WASHIZU<sup>1,2</sup>, Tatsuya MAEDA<sup>1</sup>, Hirotohi AKIYAMA<sup>1</sup>, Masakazu KONISHI<sup>1</sup><sup>1</sup>University of Hyogo, Japan; <sup>2</sup>Kyoto University, Japan

**Room 201B****Track1: Science of Tribology****Hydrodynamic and Mixed Lubrication****Chair: Gwidon STACHOWIAK, Curtin University, Australian****10:10-10:30****Multi-scale modelling of the mixed lubrication**

Noel BRUNETIERE

*University of Poitiers, Ensm***10:30-10:50****Scaling of the dimple influence for parallel surfaces**

Marie-Pierre NOUTARY, Nans BIBOULET, Ton LUBRECHT

*INSA-Lyon, France***10:50-11:10****Squeeze flow of Bingham fluids through reticulated, compressed foams**Petrica TURTOI<sup>1</sup>, Mircea PASCOVICI<sup>2</sup>, Traian CIONE<sup>2</sup><sup>1</sup>Military Equipments and Technologies Research Agency, Romania; <sup>2</sup>University POLITEHNICA of Bucharest, Romania**11:10-11:30****Transition between mixed lubrication and elastohydrodynamic lubrication with randomly rough surfaces**

Julien BONAVENTURE, Juliette CAYER-BARRIOZ, Denis MAZUYER

*Ecole Centrale de Lyon, France***11:30-11:50****Investigating lubrication by mapping the evolution of surface topography**

Deepak HALENAHALLY VEEREGOWDA, Martijn MIDDELKAMP, Fabio ALEMANNI

*Ducom Instruments Europe B.V, Netherlands***12:00-13:30**

Lunch

**Room 201B****Track1: Science of Tribology****Elastohydrodynamic Lubrication IV****Chair: Antonius LUBRECHT, INSA-Lyon, France****13:30-13:50****Friction and lubricant flow inside concentrated EHL contact**

Petr SPERKA, Ivan KRUPKA, Martin HARTL

*Brno University of Technology, Czech Republic***13:50-14:10****Numerical analysis of thermohydrodynamic lubrication of the textured rough surfaces with micro-grooves**

Jinghu Ji, Moyang WANG, Hao FU, Tianyang CHEN, Yonghong FU

*Jiangsu University, China***14:10-14:30****Exploring elasto-hydrodynamic lubrication using a finite volume CFD based method**

Damon LEE, Daniele DINI, Amir KADIRIC

*Imperial College London, UK***14:30-14:50****Towards a new in situ technique for a local measurement of temperature and pressure in elastohydrodynamic contacts using quantum dots**Tarek SEOUDI<sup>1</sup>, Sayed ALBAHRANI<sup>1</sup>, David PHILIPPON<sup>1</sup>, Peter REISS<sup>2</sup>, Jean-Marie BLUET<sup>3</sup>, Philippe VERGNE<sup>1</sup><sup>1</sup>LaMCos-INSAs LYON, France; <sup>2</sup>INAC, SPrAM, CEA Grenoble, France; <sup>3</sup>INL-INSAs Lyon, France**14:50-15:10****Novel approach and new algorithm for the elastic deformation and cavitation in elastohydrodynamic line contacts**

Tomasz WOLOSZYNSKI, Pawel PODSIADLO, Gwidon STACHOWIAK

*Curtin University, Australia***15:10-15:30****Exact and general reduced order finite element modeling of elastohydrodynamic lubrication problems**

Wassim HABCHI, Jimmy S ISSA

*Lebanese American University, Lebanon***15:30-16:30**

Coffee Break &amp; Poster Time

**Room 201B****Track1: Science of Tribology****Elastohydrodynamic Lubrication V****Chair: Pingyu ZHANG, Henan University, CHINA****16:30-16:50****TEHL simulation and measurements under high sliding conditions**Alexander LIEBEL<sup>1</sup>, Milan OMASTA<sup>2</sup>, Petr ŠPERKA<sup>2</sup>, Willy BOIVIN<sup>3</sup>, Vasilios BAKOLAS<sup>1</sup><sup>1</sup>Schaeffler Technologies AG & Co. KG, Germany; <sup>2</sup>Brno University of Technology, Czech Republic; <sup>3</sup>SIGMA-Clermont, France**16:50-17:10****Tribo-dynamics of concentrated point contact lubricated with nano-composite grease**

Jayant SINGH, Deepak KUMAR, N TANDON

*Indian Institute of Technology Delhi, India***17:10-17:30****Investigation of wall slippage by numerical analysis in combination with the test results at high speed**

Yaoguang ZHANG, Wenzhong WANG, Ziqiang ZHAO

*Beijing Institute of Technology, China***17:30-17:50****Investigation of velocity slip and influences in ball-disc system**

Xin ZHAO, Chao WEI, Shihua YUAN

*Beijing Institute of Technology, China***Room 201D****Track 2: Wear & Surface Engineering****Wear VI****Chair: Friedrich FRANEK, AC2T Research GmbH, Austria****10:10-10:40 Keynote****On strategies to reduce wear by using functional coatings and surface micro-structures**

Dae-Eun KIM

*Yonsei University, Korea*

**10:40-11:00****Characterization of the Low Wear on the Top of Asperities**Alexander KOVALEV<sup>1</sup>, Dirk SPALTMAN<sup>2</sup>, Mathias WOYDT<sup>2</sup>, Yonggang MENG<sup>1</sup>  
<sup>1</sup>Tsinghua University, China; <sup>2</sup>BAM - Federal Institute for Materials Research and Testing, Germany**11:00-11:20****Evolution of surface topography under mixed lubrication condition in running-in process**Yazhao ZHANG, Yonggang MENG, Nishiura KENSUKE, Hayashi NORIYUKI  
Tsinghua University, China; Mitsubishi Heavy Industries, China**11:20-11:40****From use wear traces to prehistoric activities: a multiscale analysis of archaeological surfaces**Haris PROCOPIOU<sup>1</sup>, Roberto VARGIOLU<sup>2</sup>, Hassan ZAHOUANI<sup>2</sup>  
<sup>1</sup>University of Paris, France; <sup>2</sup>LTDS- CNRS, France**11:40-12:00****Numerical study on the influence of scratch parameters in single asperity scratch abrasion of steels**Kannaki PONDICHERRY, Timothy GALLE, Xiaojun XU, Jacob SUKUMARAN, Dieter FAUCONNIER, Stijn HERTELÉ, Patrick DE BAETS  
Ghent University, Belgium**12:00-13:30**

Lunch

**Room 201D****Track 2: Wear & Surface Engineering**

Wear VII

**Chair: Nazanin EMAMI, Luleå University of Technology, Sweden****13:30-13:55 Invited****The effect of the interlayer and the composition on the cavitation erosion behavior of DLC films**Jianhua ZHANG  
School of Mechatronic Engineering and Automation, Shanghai University, Shanghai, China**13:55-14:15****Alternative approach to simulate an entire particle erosion experiment**Dirk SPALTMANN, Mathias WOYDT  
Bundesanstalt fuer Materialforschung und -pruefung, Germany**14:15-14:35****Application of hard surface coatings for prevention of micro-pitting failure in transmission components** NicolaDE LAURENTIS, Amir KADIRIC  
Imperial College London, United Kingdom**14:35-14:55****Simulation models for predicting the wear process of coated sphere/flat electrical contacts**Haomiao YUAN, Vitali SCHINOW, Jian SONG  
Ostwestfalen-Lippe University of Applied Sciences, Germany**14:55-15:15****Slurry erosion behavior of microwave derived bi-modular composite coatings**Harpreet Singh GREWAL, Abhishek BABU, Harpreet Singh ARORA  
Shiv Nadar University, India**15:15-16:30**

Coffee Break &amp; Poster Time

**Room 201D****Track 2: Wear & Surface Engineering**

Wear VIII

**Chair: Yongzhen ZHANG, Henan University of Science and Technology, China****16:30-16:50****Wear analysis of cobalt based alloys in nuclear reactor conditions: a combined experimental and numerical investigation**Ruby MCCARRON<sup>1</sup>, David STEWART<sup>2</sup>, Philip SHIPWAY<sup>3</sup>, Daniele DINI<sup>1</sup>  
<sup>1</sup>Imperial College London, United Kingdom; <sup>2</sup>Rolls Royce plc, England; <sup>3</sup>University of Nottingham, England**16:50-17:10****Investigation of micro-wear characteristics of layered coatings**Kyeong-Hee KANG, Dae-Eun KIM  
Yonsei University, Korea**17:10-17:30****Investigation of the temporal development of roughness parameters of real rough surfaces due to wear under mixed-lubricated conditions with the finite-element-method**Stefan REICHERT, Albert ALBERS, Arn JOERGER  
Karlsruher Institute of Technology (KIT), Germany**17:30-17:50****Chemical, morphological and interface stability of Cu-Nb layered nanocomposites subjected to sliding wear**Fuzeng REN<sup>1,2</sup>, Ekiz ELVAN<sup>2</sup>, Aaron DAHLKE<sup>2</sup>, Pascal BELLON<sup>2</sup>, Robert S. AVERBACK<sup>2</sup>, Nathan MARA<sup>3</sup>, Irene BEYERLEIN<sup>3</sup>, M. POURYAZDAN<sup>4</sup>, H. HAHN<sup>4</sup>  
<sup>1</sup>Southern University of Science and Technology, China; <sup>2</sup>University of Illinois at Urbana-Champaign, America; <sup>3</sup>Los Alamos National Laboratory, America; <sup>4</sup>Karlsruhe Institute of Technology, Germany**17:50-18:10****Study on anti-loosening performance of nylon inserted nuts**Jianhua LIU<sup>1</sup>, Huajiang OUYANG<sup>2</sup>, Zhiqiang FENG<sup>3</sup>, Zhenbing CAI<sup>1</sup>, Minhao ZHU<sup>1</sup>  
<sup>1</sup>Southwest Jiaotong University, China; <sup>2</sup>University of Liverpool, England; <sup>3</sup>Université d'Évry-Val d'Essonne, France**Room 203A****Track 2: Wear & Surface Engineering**

Coatings VI

**Chair: Maria Isabel DE BARROS BOUCHET, Laboratoire de Tribologie et Dynamique des Systèmes, Université de Lyon, France****10:10-10:35 Invited****New evaluation method for elastic and viscoelastic materials and coatings**Ralph STENGLER  
President of Hochschule Darmstadt, Germany

**10:35-11:00 Invited****Wear resistance and self-healing superhydrophobic coatings**

Huaiyuan WANG, Zhanjian LIU, Yanji ZHU, Chijia WANG

*Northeast Petroleum University, China***11:00-11:20****Investigation of fracture toughness and sliding properties of CrBC and CrBCN coatings for tribological application**Qianzhi WANG<sup>1</sup>, Fei ZHOU<sup>1</sup>, Qiang MA<sup>1</sup>, Tomas POLCAR<sup>2</sup>, Jiwang YAN<sup>3</sup><sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>University of Southampton, England; <sup>3</sup>Keio University, Japan**11:20-11:40****Comparison of tribological properties of lead and lead-free coatings using ring-on-disk test method**

Mayank ANAND, Rizwan BAJWA, Ignacio TUDELA, Rolandas VERBICKAS, Yi ZHANG

*Daido Metal Co. Ltd - European Technical Centre, United Kingdom***11:40-12:00****Comparison of tribological properties of CrN, CrTiN and CrTiBN coatings sliding against SiC and SUS440C balls in water**Fei ZHOU<sup>1</sup>, Qiang MA<sup>1</sup>, Qianzhi WANG<sup>1</sup>, Kangmin CHEN<sup>1,2</sup>, Zhifeng ZHOU<sup>1,3</sup>, L.K.Y LI<sup>1,3</sup><sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>Jiangsu University, China; <sup>3</sup>City University of HongKong, China**12:00-12:20****Advanced Diamond Surface Technology – Latest Friction Joints Designed for Forthcoming Generations of Light-Weight-Designs**Willibald SPETH<sup>1</sup>, Erhard LEIDICH<sup>2</sup>, Yufeng ZHANG<sup>3</sup><sup>1</sup>Frictins GmbH, Germany; <sup>2</sup>IKAT Technische Universität Chemnitz, Germany;<sup>3</sup>Frictins Shanghai, China**12:30-13:30**

Lunch

**Room 203A****Track 2: Wear & Surface Engineering****Coatings VII****Chair: Stephen HSU, George Washington University, United States****13:30-14:00 Keynote****Contact mechanics of coated surfaces**

Izhak ETSION

*Technion-Israel Institute of Technology, Israel***14:00-14:20****Tribological characterization and wear mechanisms of novel nitride and oxynitride PVD coatings designed for applications at high temperatures**Bin ZHANG<sup>1</sup>, Jiri NOHAVA<sup>1</sup>, Pascal DESSARZIN<sup>2</sup>, Pavla KARVANKOVA<sup>2</sup>, Marcus MORSTEIN<sup>2</sup><sup>1</sup>Anton Paar TriTec SA, Switzerland; <sup>2</sup>PLATIT AG, Switzerland**14:20-14:40****Elevated temperature repetitive micro-scratch testing of hard PVD coatings**Ben BEAKE<sup>1</sup>, German FOX-RABINOVICH<sup>1,2</sup>, Jose ENDRINO<sup>1,3</sup><sup>1</sup>Micro Materials Ltd, United Kingdom; <sup>2</sup>McMaster, Canada; <sup>3</sup>Cranfield University, England**14:40-15:00****300 mm class of filtered cathode vacuum arc (FCVA) system for tribological applications**

Jongkuk KIM, Yong-Jin KANG, Young-Jun JANG

*Korea Institute of Materials Science (KIMS), Korea***15:00-15:20****Interaction of EP additives with W- or Mo- based carbide and nitride coatings and their in-situ related formation of a low friction tribofilm**Bernhard KOHLHAUSER<sup>1</sup>, Manel RODRÍGUEZ RIPOLL<sup>2</sup>, Helmut RIEDL<sup>1</sup>, Carsten GACHOT<sup>1</sup>, Paul Heinz MAYRHOFER<sup>1</sup><sup>1</sup>TU Wien, Austria; <sup>2</sup>AC<sup>2</sup>T Research GmbH, Austria**15:20-15:40****Influence of chemical bonding of PTFE lubricant to a polyamideimide matrix in antifriction coatings**Michaela GEDAN-SMOLKA<sup>1</sup>, Anne MARSCHNER<sup>1</sup>, Klaus KUNZE<sup>2</sup>, Rainer FRANKE<sup>3</sup>, Dieter LEHMANN<sup>1</sup><sup>1</sup>Leibniz-Institut fuer Polymerforschung Dresden, Germany; <sup>2</sup>Institut fuer Leichtbau und Kunststofftechnik at TU Dresden, Germany; <sup>3</sup>Struktur und Werkstoffmechnikforschung at TU Dresden, Germany**15:40-16:30**

Coffee Break &amp; Poster Time

**Room 203A****Track 2: Wear & Surface Engineering****Coatings VIII****Chair: Ralph STENGLER, Hochschule Darmstadt, Germany****16:30-16:55 Invited****The friction and wear characteristics of graphene coating by the CVD process on piston rings under tribo and engine testing conditions**Hakan KALELI<sup>1</sup>, Levent YÜKSEK<sup>1</sup>, Emre ÇITAK<sup>2</sup><sup>1</sup>YILDIZ Technical University, Turkey; <sup>2</sup>GrafenBioTech Nano Teknoloji Mühendislik San. ve Tic. Ltd. Şti, Selçuklu/Konya, Turkey**16:55-17:15****Low friction high electrical conductivity of nitrogen-graphene nanocrystalline embedded carbon films**Pengfei WANG<sup>1</sup>, Weiqiang ZHANG<sup>2</sup>, Dongfeng DIAO<sup>1</sup><sup>1</sup>Shenzhen University, China; <sup>2</sup>Xi'an Jiaotong University, China**17:15-17:35****Size dependence of frictional behavior of graphene nanocrystal carbon films by ion irradiation**

Saizhou QIU, Xue FAN, Cheng CHEN, Dongfeng DIAO

*Shenzhen University, China***17:35-17:55****Graphene-based film on steel surfaces in dry sliding and high load conditions for friction and wear reduction**Abdullah ALAZEMI<sup>1</sup>, Arthur DYSART<sup>1</sup>, Steve SHAFFER<sup>2</sup>, Vilas POL<sup>1</sup>, Farshid SADEGHI<sup>1</sup><sup>1</sup>Purdue University, United States; <sup>2</sup>Bruker Corporation, United States**17:55-18:15****Tribological behavior of Ni/GO nanocomposite coatings**

Hanshan DONG, Shaojun QI, Xiaoying LI

*University of Birmingham, United Kingdom*

**18:15-18:35**

Tribological behavior of a self-lubricated GO/WC-12Co composite coating fabricated by detonation gun spraying

Haoliang TIAN

*Beijing Institute of Aeronautical Materials, China***Room 203C****Track3: Lubrication and Lubricants****Liquid Lubricants I****Chair: Masjuki Bin Hassan HAJI HASSAN, University of Malaya, Malaysia****10:10-10:35 Invited**

Bubble flow adjacent to surfaces: Shape of a thin lubricating film between a sliding bubble and an inclined plane

Roger HORN, Ninghui HAN, Wren GREENE

*Deakin University***10:35-10:55**

Development and stability of surfactantless soybean oil in water emulsion with nanoparticles for lubricating purposes

Buyung KOSASIH, Reza TAHERI, Hongtao ZHU, Kiet TIEU

*University of Wollongong, Australia***10:55-11:15**

In-situ observation of lubricant films in a model rolling element bearing

He LIANG, Amir KADIRIC

*Imperial College London, UK***11:15-11:35**

Effect of perfluoropolyether (PFPE) concentration on the tribological and mechanical properties of filled SU-8/Talc composite

Jitendra Kumar KATIYAR<sup>1</sup>, Sujeet Kumar SINHA<sup>2</sup>, Arvind KUMAR<sup>1</sup><sup>1</sup>Indian Institute of Technology Kanpur, India; <sup>2</sup>Indian Institute of Technology Delhi, India**11:35-11:55**

Preparing for ILSAC GF-6: advantages of full-synthetic motor oils for boosting fuel economy

Boris ZHMUD, Boris TATIEVSKI

<sup>1</sup>BIZOL Lubricants, Germany; <sup>2</sup>Applied Nano Surfaces, UK**11:55-12:15**

Investigation of inorganic alkali polymer glass as a high temperature lubricant in hot rolling process

Shaogang CUI, Anh Kiet TIEU, Hongtao ZHU, Shanhong WAN

*University of Wollongong, Australia***12:30-13:30**

Lunch

**Room 203C****Track3: Lubrication and Lubricants****Rheology of Lubricants II****Chair: Wilfred TYSOE, University of Wisconsin-Milwaukee, USA****13:30-13:55 Invited**

A new method to solve hydrodynamic lubrication problem of non-newtonian fluid

Ping HUANG<sup>1</sup>, Qianqian YANG<sup>2</sup><sup>1</sup>South China University of Technology, China; <sup>2</sup>Sun Yat-sen University, China**13:55-14:15**

Shear thinning and hydrodynamic friction of VM-containing engine oils

Hugh SPIKES<sup>1</sup>, Nigel MARX<sup>1</sup>, Luis FERNÁNDEZ<sup>2</sup>, Francisco BARCELÓ<sup>2</sup><sup>1</sup>Imperial College London, UK; <sup>2</sup>Lubricants Group, Repsol Technology Centre, Spain**14:15-14:35**

Stretching and shear behaviors of several base lubricants

Jie CHENG<sup>1</sup>, Yuzhen ZHAO<sup>2</sup>, Ka MA<sup>2</sup>, Zhanjiang WANG<sup>1</sup>, Qian WANG<sup>1,3</sup><sup>1</sup>Chongqing University, China; <sup>2</sup>Chongqing Branch, Lubricant Co. Ltd. SINOPEC, China; <sup>3</sup>Northwestern University, China**14:35-14:55**

Origin of shear banding of elasto-hydrodynamic lubricants

Luca DI MARE, Benedicte GALMICHE, Janet WONG

*Imperial College London, UK***14:55-15:15**

Fluorescence anisotropy as a tool to probe lubricant rheology

Jonathan DENCH<sup>1</sup>, Neal MORGAN<sup>2</sup>, Janet WONG<sup>1</sup><sup>1</sup>Imperial College London, UK; <sup>2</sup>Shell Global Solutions, UK**15:15-15:35**

Interdependency between rheology and tribology of lubricants

Joerg LAEUGER<sup>1</sup>, Florian RUMMEL<sup>1</sup>, Kartik PONDICHERRY<sup>2</sup><sup>1</sup>Anton Paar Germany, Germany; <sup>2</sup>Anton Paar GmbH, Austria**15:35-16:30**

Coffee Break &amp; Poster Time

**Room 203C****Track3: Lubrication and Lubricants****Liquid Lubricants II****Chair: Roger HORN, Deakin University****16:30-16:55 Invited**

Characterization of lubricants by resonance shear measurement

Kazue KURIHARA

*Tohoku University, Japan***16:55-17:15**

Low friction, lubricity and durability of polymer brushes coatings, characterized thanks to the relaxation tribometer technique

Michel BELIN<sup>1</sup>, Hiroyuki ARAFUNE<sup>2</sup>, Toshio KAMIJO<sup>2</sup>, Takaya SATO, Joel PERRET-LIAUDET<sup>3</sup><sup>1</sup>CNRS, France; <sup>2</sup>Tsuruoka College, Japan; <sup>3</sup>Ecole Centrale de Lyon - LTDS, France**17:15-17:35**

Tribological behaviors of ceramics in aqueous glycerol solutions

Shuai YAN, Bin LIN, Wenbin HU, Anying WANG, Xiaoxue ZHOU, Xiaofeng ZHANG

*Tianjin University, China***17:35-17:55**

The tribological behavior of nano carbon materials in aqueous systems

Xiangqiong (Lydia) ZENG, Hongmei, YANG, Jiusheng LI

*Shanghai Advanced Research Institute, Chinese Academy of Sciences, China.*

17:55-18:15

Water-based lubrication behavior of polyvinyl alcohol on styrene-ethylene-butylene-styrene block copolymers

Qinghua FANG, Feng YE, Xiaoniu YANG

Changchun Institute of Applied Chemistry, Chinese Academy of Science, State Key Laboratory of Polymer Physics and Chemistry, China

18:15-18:35

Fuel economy 0W-20 engine oil for natural aspirated small gasoline engine

Daozheng WAN

Castrol (Shenzhen) Co., Limited Shanghai Pudong Branch, China

### Room 305A

Track3: Lubrication and Lubricants Additives VI

Chair: Feng GUO, Qingdao University of Technology, China

10:10-10:30

Supercritical fluid synthesis of gold nanoparticle-decorated graphene and its tribological properties as oil additive

Yuan MENG, Fenghua SU

South China University of Technology, China

10:30-10:50

Influence of lubricant additives on rolling-contact-fatigue of gears: role of sulphur on hydrogen embrittlement

Clotilde MINFRAY<sup>1</sup>, Benoit L'HOSTIS<sup>1</sup>, Marion FREGONESE<sup>2</sup>, Catherine VERDU<sup>2</sup>, Béatrice VACHER<sup>1</sup>, Thierry LE MOGNE<sup>1</sup>, Benoit TER OVANESSIAN<sup>2</sup>, Frédéric JARNIAS<sup>3</sup>, Alder DA-COSTA D'AMBROS<sup>3</sup>

<sup>1</sup>LTDS, France; <sup>2</sup>MATEIS, France; <sup>3</sup>TOTAL Marketing Services, France

10:50-11:10

Preparation of PEGylated black phosphorus nanoparticles and subsequent application as water-based lubricant additive

Wei WANG, Jianbin LUO, Guoxin XIE

Tsinghua University, China

11:10-11:30

The importance of additive chemistry in generating tribofilms efficient at preventing hydrogen permeation in rolling contacts

Vlad Bogdan NISTE, Hiroyoshi TANAKA, Joichi SUGIMURA

Kyushu University, Japan

11:30-11:50

Novel carbon nanotori additives for lubricants with superior extreme pressure properties

Laura PEÑA-PARÁS<sup>1</sup>, Demófilo MALDONADO-CORTÉS<sup>1</sup>, Oxana KHARISSOVA<sup>2</sup>, José Santiago CRUZ-BAUELOSL<sup>1</sup>, Karla Itzel SALDIVAR<sup>1</sup>, Luisana LUISANA<sup>1</sup>, Patsy ARQUIETA<sup>2</sup>

<sup>1</sup>Universidad de Monterrey, Mexico; <sup>2</sup>Facultad de Ciencias Físico-Matemáticas, México

11:50-12:10

Nanotribology of functionalized silica nanoparticles as water-based lubricant additives

Tianyi SUI, Bin LIN, Shuai YAN

Tianjin University, China

12:10-12:30

Improving drilling efficiency by utilizing sepiolite nanoparticles in drilling fluids

Jamil ABDO, Jan KWAK

Qatar University, Oman

12:30-13:30

Lunch

### Room 305A

Track3: Lubrication and Lubricants Additives VII

Chair: Mark RUTLAND, KTH, Sweden

13:30-13:50

Mechanism of interactions between MoS<sub>2</sub>, nanotubes and conventional oil additives under various contact conditions

Agnieszka TOMALA<sup>1</sup>, Manel RODRÍGUEZ RIPOLL<sup>1</sup>, Maja REMŠKAR<sup>2</sup>, Mitjan KALIN<sup>3</sup>

<sup>1</sup>AC2T research GmbH, Austria; <sup>2</sup>Jožef Stefan Institute, Slovenia; <sup>3</sup>University of Ljubljana, Slovenia

13:50-14:10

The tribological properties of synthetic magnesium silicate hydroxide as additives in lubricating oil

Bin WANG, Qiuying CHANG, Kai GAO

Beijing Jiaotong University, China

14:10-14:30

Friction-reduction and life-extension effects of two types of new additives on multialkylated cyclopentanes under vacuum condition

Songwei ZHANG, Yi LI, Qi DING, Litian HU

Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China

14:30-14:50

Investigation of tribological properties of lubricity additives for chlorinated paraffin replacement

Yixing ZHAO(Philip), Alexandra GOODE

Houghton International Inc., USA

14:50-15:10

An investigation on the lubrication mechanism of MoS<sub>2</sub> nanoparticles in unidirectional and reciprocating point contact: the flow pattern effect around the contact area

Hongxing WU, Guangneng DONG

Xi'an Jiaotong University, China

15:10-15:30

The influence of adsorption and tribo-chemistry study of Cu nano-additives in DLC based solid-liquid synergetic system on friction behavior

Yaohui LIU, Yujuan ZHANG, Shengmao ZHANG, Pingyu ZHANG

National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, China

15:30-16:30

Coffee Break & Poster Time



**Room 305A****Track3: Lubrication and Lubricants****Additives VIII****Chair: Enrico CIULLI**, *University of Pisa, Italy***16:30-16:50****Impacts of polypropylene glycol (PPG) and pH on tribological properties of water based drilling mud**

Huaping XIAO, Shuhai LIU, Yu CHEN

*China University of Petroleum-Beijing, China***16:50-17:10****Tribological evaluation of Calcium-copper-titanate and Cerium oxide nano-additives in paraffin oil**

Harsha ARAKERE PUTTASWAMY, Gupta RAJEEV NAYAN

*Indian Institute of Technology, Banaras Hindu University, India***17:10-17:30****Towards industry application prospect to develop modified graphene oxide with good oil solubility**Zhilin CHENG<sup>1,2</sup>, Wei LI<sup>1</sup>, Peirong WU<sup>1</sup>, Zan LIU<sup>1</sup><sup>1</sup>Yangzhou University, China; <sup>2</sup>China Aviation Union Graphene Technology Co., Ltd., China**17:30-17:50****Multiple ways to synthesis of thermally reduced graphene additives and reaching high-efficiency lubrication**Jun ZHAO<sup>1</sup>, Junyuan MAO<sup>1</sup>, Yingru LI<sup>2</sup>, Wei WANG<sup>1</sup>, Yongfu WANG<sup>3</sup>,Yongyong HE<sup>1</sup>, Jianbin LUO<sup>1</sup><sup>1</sup>Tsinghua University, China; <sup>2</sup>China Academy of Engineering Physics, China;<sup>3</sup>Chinese Academy of Sciences, China**17:50-18:10****Preparation and tribological properties study of CuS nanoparticles as water-based lubricating additives**

Junhua ZHAO, Guangbin YANG, Shengmao ZHANG, Pingyu ZHANG

*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, China***18:10-18:30****The effect of adding additives in biolubricant on physical and tribological properties**

Dedison GASNI, Ismet Hari MULYADI, Jon AFFI

*Andalas University, Indonesia***Room 305C****Track4: Biotribology & Biomimetics****Artificial Joints IV****Chair: Zhongrong ZHOU**, *Tribology Research Institute, Southwest Jiaotong University, Chengdu 610031, China***10:10-10:35 Invited****Contact mechanics and lubrication regime analysis of cervical total disc replacement in conjunction with a multi-body dynamics model of the Human**Hua XIN<sup>1</sup>, Hao DIAO<sup>1</sup>, Peng LIU<sup>2</sup>, Zhongmin JIN<sup>1</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Xi'an Honghui Hospital, China**10:35-10:55****Tribology of surfaces: a study in cartilaginous tissue from synovial joints**

Fausto MOREIRA, Ahmad JABBARZADEH

*The University of Sydney, Australia***10:55-11:15****Observation of lubrication mechanisms within artificial hip joints**David NECAS<sup>1</sup>, Martin VRBKA<sup>1</sup>, Jiří GALLO<sup>2</sup>, Ivan KRUPKA<sup>1</sup>, Martin HART<sup>1</sup><sup>1</sup>Brno University of Technology, Czech; <sup>2</sup>University Hospital Olomouc, Czech**11:15-11:35****Influence of dehydration by pre-loading on tribological property of hydrogel artificial cartilage and articular cartilage**Seido YARIMITSU<sup>1</sup>, Naoya HASHIMOTO<sup>1</sup>, Teruo MURAKAMI<sup>2</sup>, AtsushiSUZUKI<sup>3</sup>, Hiromichi FUJIE<sup>1</sup><sup>1</sup>Tokyo Metropolitan University, Japan; <sup>2</sup>Teikyo University, Japan; <sup>3</sup>Yokohama National University, Japan**11:35-11:55****Tribological properties of graphene oxide sheets as water-based lubricant additives in artificial knee joint**Gangqiang ZHANG<sup>1</sup>, Xiangqiong ZENG<sup>2</sup>, Tianhui REN<sup>1</sup>, Emile Van derHEIDE<sup>3</sup><sup>1</sup>Shanghai Jiao Tong University, China; <sup>2</sup>Chinese Academy of Sciences, China;<sup>3</sup>University of Twente, Holand; <sup>4</sup>TU Delft, Holand**11:55-12:15****Regulation mechanism of biomacromolecules in synovial fluid for superlubricity of Poly (vinylphosphonic acid) (PVPA) coatings on Ti6Al4V**Caixia ZHANG<sup>1</sup>, Zhifeng LIU<sup>1</sup>, Yuhong LIU<sup>2</sup>, Ligang CAI<sup>1</sup>, Shizhu WEN<sup>2</sup><sup>1</sup>Beijing Key Laboratory of Advanced Manufacturing Technology, China; <sup>2</sup>State

Key Laboratory of Tribology, Tsinghua University, China

**12:30-13:30****Lunch****Room 305C****Track4: Biotribology & Biomimetics****Artificial Joints V****Chair: Zhongmin JIN**, *Xi'an Jiaotong University, China; Xi'an Honghui Hospital, China***13:30-13:50****The effect of insert conformity on wear in total knee replacement**Qida ZHANG<sup>1</sup>, Jing ZHANG<sup>1</sup>, Zhenxian CHEN<sup>1</sup>, Zhongmin JIN<sup>1</sup><sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>University of Leeds, England; <sup>3</sup>Southwest

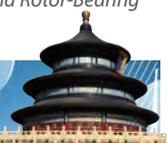
Jiaotong University, China

**13:50-14:10****A simulator for friction and wear testing of artificial hip joints**Zikai HUA<sup>1</sup>, Fei TANG<sup>1</sup>, Pingchuan DOU<sup>1</sup>, Zhongmin JIN<sup>2</sup>, Xiaojing WANG<sup>1</sup><sup>1</sup>Shanghai University, China; <sup>2</sup>University of Leeds, England**14:10-14:30****Modelling of the elasto-hydrodynamic lubrication of knee joint replacements with surface topography**Leiming GAO<sup>1</sup>, Zikai HUA<sup>2</sup>, Robert HEWSON<sup>1</sup>, Michael Skipper Andersen<sup>3</sup>, Zhongmin JIN<sup>4,5</sup><sup>1</sup>Imperial College London, England; <sup>2</sup>Shanghai University, China; <sup>3</sup>AalborgUniversity, Denmark; <sup>4</sup>South West Jiaotong University, China; <sup>5</sup>University of

Leeds, England

**14:30-14:50****Analyzing the lubrication properties of hydrogel capsule over ceramic-on-ceramic artificial hip joint**

Mahshid HAFEZI, Liguo QIN, Guangneng DONG

*Key Laboratory of Education Ministry for Modern Design and Rotor-Bearing System, Theory of Lubrication and Bearing Institute, China*

14:50-15:10

Implementing patient-derived multi-activity inputs in a knee joint simulator

Spencer FULLAM<sup>1</sup>, Gauthier LOUBRIEU<sup>2</sup>, Diego OROZCO<sup>3</sup>, Markus WIMMER<sup>1</sup>  
<sup>1</sup>Rush University Medical Center, America; <sup>2</sup>École centrale de Lyon, France;  
<sup>3</sup>ITESM Campus Guadalajara, Mexico

15:30-16:30

Coffee Break & Poster Time

### Room 305C

#### Track4: Biotribology & Biomimetics Organs&Tissues-I: Tooth

Chair: Jing ZHENG, Tribology Research Institute, Southwest Jiaotong University, China

16:30-17:00 **Keynote**

Bionic design perspectives based on the formation mechanism of dental anti-wear function

Zhongrong ZHOU, Jing ZHENG  
 Tribology Research Institute, Southwest Jiaotong University, China

17:00-17:20

Effect of hydroxyapatite fibres arrangement on mechanical and microtribological behavior of human tooth enamel

Jing XIA, Lei CHEN, Zhongrong ZHOU, Linmao QIAN  
 Southwest Jiaotong University, China

17:20-17:40

Effect of acid-attack on the lubrication performance of salivary pellicle on human tooth enamel

Dongwen LIU, Liang ZHENG, Jing ZHENG, Zhongrong ZHOU  
 Tribology Research Institute, Southwest Jiaotong University, China

17:40-18:00

Tribological effects of different toothpaste additive during tooth brushing on the permanent teeth

Mohamad Ali AHMAD<sup>1</sup>, Salmiah KASOLANG<sup>1</sup>, Azlina Mimi ABU BAKAR<sup>1</sup>, Zakiah MAT RIPEN<sup>2</sup>  
<sup>1</sup>UNIVERSITI TEKNOLOGI MARA, Malaysia; <sup>2</sup>University of Malaya, Malaysia

18:00-18:20

Effects of amelogenin-related amino acids on the remineralization behavior of bovine enamel in CPP-ACP

Liang ZHENG, Wei HAN, Jing ZHENG, Zhongrong ZHOU  
 Tribology Research Institute, Southwest Jiaotong University, China

### Room 303

#### Track5: Tribology in Manufacturing CMP and Surface Processing I

Chair: Xinchun LU, Tsinghua University, China

10:10-10:40 **Keynote**

Tribology in chemical-mechanical polishing

Hong LIANG  
 Texas A&M University, USA

10:40-11:00

Load dependence of frictional forces between single nanoparticles and copper substrate

Yating HUANG<sup>1</sup>, Weiqi WANG<sup>2</sup>, Dan GUO<sup>2</sup>, Xinchun LU<sup>2</sup>  
<sup>1</sup>Beijing Technology and Business University, China; <sup>2</sup>Tsinghua University, China

11:00-11:20

Flatness control in the grinding and polishing process of thick silicon reflection mirror

Bocheng JIANG, Dewen ZHAO, Xinchun LU  
 Tsinghua University, China

11:20-11:40

Defect-free nanofabrication on GaAs surface by tribochemistry material removal

Bingjun YU, Chenning JIN, Xiaoxiao LIU, Linmao QIAN  
 Southwest Jiaotong University, China

11:40-12:00

A novel catalyst (FeIII-based) and its catalytic performance towards the removal rate of sapphire substrate during CMP process

Li XU, Guoshun PAN, Chunli ZHOU, Yan ZHOU, Guihai LUO  
 Research Institute of Tsinghua University in Shenzhen, China

12:30-13:30

Lunch

### Room 303

#### Track5: Tribology in Manufacturing CMP and Surface Processing II

Chair: Hong LIANG, Texas A&M University, USA

13:30-13:55 **Invited**

Research and development of a new CMP tool and its applications

Xinchun LU  
 Tsinghua University, China

13:55-14:15

CMP behavior of Al<sub>2</sub>O<sub>3</sub>/SiO<sub>2</sub> core-shell abrasives on sapphire substrate

Xin WANG, Hong LEI, Yue DONG  
 Shanghai University, China

14:15-14:35

ReaxFF reactive molecular dynamics simulations of Cu chemical mechanical polishing process

Jialin WEN, Tianbao MA, Xinchun LU  
 Tsinghua University, China

14:35-14:55

The numerical analysis of marangoni drying mechanism in post-CMP cleaning

Changkun LI, Dewen ZHAO, Xinchun LU  
 Tsinghua University, China

14:55-15:15

Investigation of minimum depth of material removal in nanoscale machining process using molecular dynamics simulations

Pengzhe ZHU, Tianbao MA, Yuanzhong HU, Hui WANG, Jianbin LUO  
 Tsinghua University, China

15:15-15:35

Mechanochemical surface finishing: process runnability and surface condition monitoring by using angle-resolved light scattering, photothermal analysis and vibration analysis

Boris ZHMUD<sup>1</sup>, Jonas LUNDMARK<sup>1</sup>, Dietmar SCHORR<sup>2</sup>, Boris BRODMANN<sup>3</sup>  
<sup>1</sup>Applied Nano Surfaces AB, Sweden; <sup>2</sup>Steinbeis Transfer Center Tribology, Karlsruhe, Germany; <sup>3</sup>OptoSurf GmbH, Ettlingen, Germany



15:35-16:30

Coffee Break &amp; Poster Time

## Room 303

**Track5: Tribology in Manufacturing  
CMP and Surface Processing III**

Chair: Linmao QIAN, Southwest Jiaotong University, China

16:30-16:50

Nanoparticle impacts on a solid surface in a liquid jet and its effects on the material removal

Xuechu ZHAO, Xuefeng XU

Beijing Forestry University, China

16:50-17:10

Multi-zone pressure control for chemical mechanical planarization system

Hongkai LI, Xinchun LU, Jianbin LUO

Tsinghua University, China

17:10-17:30

Improved fused silica optics surface quality using CMP with colloidal silica

Chunli ZHOU<sup>1,2,3</sup>, Guoshun PAN<sup>1,2,3</sup>, Li XU<sup>1,2,3</sup>, Hua GONG<sup>1,2,3</sup>, Yan ZHOU<sup>1,2,3</sup><sup>1</sup>Research Institute of Tsinghua University in Shenzhen, China;<sup>2</sup>Tsinghua University, China; <sup>3</sup>Guangdong Provincial Key Laboratory of

Optomechanics, China

17:30-17:50

Chemical mechanical polishing (CMP) of SiC wafer utilizing catalyst incorporated pad

Yan ZHOU<sup>1,2,3</sup>, Guoshun PAN<sup>1,2,3</sup>, Chunli ZHOU<sup>1,2,3</sup>, Li XU<sup>1,2,3</sup><sup>1</sup>Tsinghua University, China; <sup>2</sup>Research Institute of Tsinghua Universityin Shenzhen, China; <sup>3</sup>Guangdong Provincial Key Laboratory of

Optomechanics, China

17:50-18:10

Synthesis of sm-doped colloidal SiO<sub>2</sub> composite abrasives and their chemical mechanical polishing performances on sapphire substrates

Tingting LIU, Hong LEI, Tianxian WANG

Shanghai University, China

18:10-18:30

Multiscale friction in bio-composite cutting

Mohamed EL MANSORI, Faissal CHEGDANI, Sabeur MEZGHANI

Arts et Métiers ParisTech, France

## Room 305E

**Track6: Engine and Transmission Tribology  
Engine I**

Chair: Victor WONG, Massachusetts Institute of Technology, USA

10:10-10:35 **Invited**

Tribology in hot steam

Mathias WOYDT<sup>1</sup>, Wäsche R<sup>1</sup>, Brandt G<sup>1</sup>, Yano S<sup>2</sup>, Sasaki S<sup>2</sup>, Ehrke R<sup>1</sup><sup>1</sup>Federal Institute for Materials Research and Testing BAM, Germany; <sup>2</sup>Tokyo

University of Science (TUS), Tokyo, Japan

10:35-10:55

Advanced piston assembly – liner friction evaluation: simulation and measurement

Ming-Tang MA<sup>1,2</sup>, Christoph PRIESTNER<sup>1,2</sup><sup>1</sup>AVL List Technical Center (Shanghai) Co. Ltd, China; <sup>2</sup>AVL List GmbH, Austria

10:55-11:15

A newly developed piston tribo-dynamics model considering deterministic skirt surface grooves

Congcong FANG, Xianghui MENG, Youbai XIE

Shanghai Jiaotong University, China

11:15-11:35

Vibration localization in mechanical models experiencing self-excited vibrations

Antonio PAPANGELO<sup>1</sup>, Aurelien GROLET<sup>3</sup>, Loic SALLES<sup>3</sup>, NorbertHOFFMANN<sup>1,3</sup>, Michele CIAVARELLA<sup>2</sup><sup>1</sup>Hamburg University of Technology, Germany; <sup>2</sup>Polytechnic of Bari, Italy;<sup>3</sup>Imperial College London, UK

11:35-11:55

Tribology study on turbocharger kinematic parts

Shouxing ZHU<sup>1</sup>, Moses ZHAO<sup>1</sup>, Marc WILSON<sup>2</sup>, Marek SLOUKA<sup>3</sup>, MrazekRADIM<sup>3</sup>, Lionel TOUSSAINT<sup>2</sup><sup>1</sup>Honeywell integrated technology company, China; <sup>2</sup>Honeywell TransportationSystems, TLV, France; <sup>3</sup>Honeywell Technology Solution, Czech Republic

11:55-12:15

Study on the friction reduction between piston and cylinder using floating liner engine

Natsuki KANEKO<sup>1</sup>, Hideyuki TABATA<sup>1</sup>, Hideyuki IWASAKI<sup>1</sup>, Yuji MIHARA<sup>1</sup>,Hatsuhiko USAMI<sup>3</sup>, Tomomi HONDA<sup>2</sup><sup>1</sup>Tokyo City University, Japan; <sup>2</sup>Fukui University, Japan; <sup>3</sup>Meijo University, Japan

12:15-13:30

Lunch

## Room 305E

**Track6: Engine and Transmission Tribology  
Engine II**

Chair: Jiujuun XU, Dalian Maritime University, China

13:30-13:50

A numerical model for mechanical interaction of rough surfaces of hydrodynamic tribosystems of piston engines taking into account rheological characteristics of lubricants

Alexei DOIKIN<sup>1</sup>, Konstantin GAVRILOV<sup>1</sup>, Yurii GORITSKIY<sup>2</sup>, Yuliya ISMAILOVA<sup>2</sup><sup>1</sup>Federal State Autonomous Educational Institution of Higher Education "SouthUral State University (national research university)", Russia; <sup>2</sup>National Research

University "Moscow Power Engineering Institute", Russia

13:50-14:10

Development of tribology simulator using FEM and CFD analyses to predict oil behavior around piston ring

Masayuki OCHIAI, Akihiko AZETSU, Kenji YAMAMOTO, Yuki KAWAMOTO,

Ryuichi SASAKI, Shun TAKAHASHI

Tokai University, Japan



**14:10-14:30**

Thin film sensors for measuring oil film condition in engine sliding surfaces

Kouta MIURA, Yuji MIHARA  
Tokyo City University, Japan**14:30-14:50**

Influence of boundary conditions on starvation of piston ring conjunction

Stephen BEWSHER<sup>1</sup>, Mahdi MOHAMMADPOUR<sup>1</sup>, Ramin RAHMANI<sup>1</sup>, Homer RAHNEJAT<sup>1</sup>, Guenter OFFINER<sup>2</sup>  
<sup>1</sup>Loughborough University, UK; <sup>2</sup>AVL List GmbH, Austria**14:50-15:10**

Mixed lubrication modelling of internal combustion engine connecting-rod bearings

Aurelian FATU  
University of Poitiers, France**15:10-16:30**

Coffee Break &amp; Poster Time

**Room 305E****Track6: Engine and Transmission Tribology  
Engine III**

Chair: Mathias WOYDT, Tokyo University of Science (TUS), Tokyo, Japan

**16:30-16:50**

Improving vehicle fuel efficiency through viscosity index improver in engine oils

Frank LAUTERWASSER, Boris EISENBERG, Christoph WINCIERZ  
Evonik, Germany**16:50-17:10**

Influence of antiwear and dispersant lubricant additives on soot wear

Hugh SPIKES<sup>1</sup>, Artemis KONTOU<sup>1</sup>, Mark SOUTHBY<sup>2</sup>, Neal MORGAN<sup>2</sup>  
<sup>1</sup>Imperial College London, UK; <sup>2</sup>Lubricants Discovery Hub, Shell Global Solutions UK, UK**17:10-17:30**

Tribological and tribochemical characteristics of a lubricated DLC/Cast iron system under sliding and rolling contacts

Yasir ALJEBOORI, Shahriar KOSARIEK, Ardian MORINA, Anee NEVILLE  
Leeds University, UK**17:30-17:50**

In-Manufacture running-in of engine components by using the triboconditioning process: synergy with PC-11 and ILSAC GF-6 motor oils

Boris ZHMUD  
Applied Nano Surfaces AB, Sweden**Room 307****Track6: Engine and Transmission Tribology  
Fluid-film bearings VI**

Chair: Wojciech LITWIN, Gdansk University of Technology, Poland

**10:10-10:30**

Study on characteristics of high speed water-lubricated bearings for micro fabrication

Ryosuke MAKINO, Hiroki HOHUKU, Masaaki MIYATAKE, Shigeka YOSHIMOTO  
Tokyo University of Science, Japan**10:30-10:50**

Study on a reduction method of power consumption of water lubricated hydrostatic thrust bearings

Yusuke ASAKAWA, Masaaki MIYATAKE, Shigeka YOSHIMOTO  
Tokyo University of Science, Japan**10:50-11:10**

Hydrodynamic pressure distribution in water-lubricated hydrodynamic bearings - fluid structure interaction simulations and experimental tests

Artur OLSZEWSKI, Michal WODTKE  
Gdansk University of Technology, Poland**11:10-11:30**

The performance analysis of infinite length journal bearing under aqueous solution

Kuankuan LI, Chaohui ZHANG, Jun GU, Zhide LU  
Beijing Jiaotong University, China**11:30-11:50**

Surface profile design and its influence on the start-up and shut-down process for tilting-pad thrust bearing under water lubrication

Zhanchao WANG, Ying LIU  
Tsinghua University, China**11:50-12:10**

An experimental investigation on a water cooled tilting pad thrust bearing

Farooq NAJAR, G A HARMAN  
National Institute of Technology Srinagar, India**12:10-12:30**

Research on water lubricated main shaft bearings in conditions of improper lubrication and cooling conducted on high torque real-life scale bush test rig

Wojciech LITWIN  
Gdansk University of Technology, Poland**12:30-13:30**

Lunch

**Room 307****Track6: Engine and Transmission Tribology  
Sealing I**

Chair: Qingbing DONG, Harbin Engineering University, China

**13:30-13:55 Invited**

Towards the development of tribotronic sealing technology

Ian SHERRINGTON, Wilbert SINZARA, Hadley BROOKS, Ahmed ONSY, Edward SMITH  
Jost Institute for Tribotechnology, United Kingdom**13:55-14:15**

Fretting wear behavior of thermoplastic polyurethane (TPU) for mechanical seal application

Chao WANG<sup>1</sup>, Andreas HAUSBERGER<sup>1</sup>, Gerald PINTER<sup>2</sup>, Thomas SCHWARZ<sup>3</sup>  
<sup>1</sup>Polymer Competence Center Leoben, Austria; <sup>2</sup>University of Leoben, Austria;  
<sup>3</sup>SKF Sealing Solutions Austria GmbH, Austria

**14:15-14:35**

Cavitation in reverse spiral grooves and leak control in mechanical face seals

Xuezhong MA, Xiangkai MENG, Yuming WANG, Yangyang LIANG, Mingxue SHEN, Xudong PENG

*Zhejiang University of Technology, China***14:35-14:55**

Study of mixed lubrication in radial shaft seals with model surface topography

Hiromichi YOSHIMIZU<sup>1</sup>, Shigenobu HONDA<sup>2</sup>, Hiroataka MIZUTA<sup>2</sup>, Joichi SUGIMURA<sup>1</sup><sup>1</sup>Kyushu University, Japan; <sup>2</sup>NOK Corporation**14:55-15:15**

Tribological behavior of HNBR in oil and gas field applications

Winoj BALASOORIYA<sup>1</sup>, Bernd SCHRITTESSER<sup>1</sup>, Chao WANG<sup>1</sup>, Andreas HAUSBERGER<sup>1</sup>, Gerald PINTER<sup>2</sup>, Thomas SCHWARZ<sup>3</sup><sup>1</sup>Polymer competence center Leoben GmbH, Austria; <sup>2</sup>Montanuniversitaet Leoben, Austria; <sup>3</sup>SKF Sealing Solutions Austria GmbH, Austria**15:15-15:35**

A coupling hydrodynamic mechanical seal model with considering the gas-liquid phase flow conditions

Guozhong CHEN, Guoyuan ZHANG, Yi ZHANG

*Xidian University, China***15:35-16:30**

Coffee Break &amp; Poster Time

**Room 307****Track6: Engine and Transmission Tribology Sealing II**Chair: Ian SHERRINGTON, *Jost Institute for Tribotechnology, United Kingdom***16:30-16:50**

Clearance regulation and transient sealing performance analysis of dry gas seal for extreme operating conditions

Yuan CHEN, Xudong PENG, Jinbo JIANG, Jiyun LI

*Zhejiang University of Technology, China***16:50-17:10**

An analysis on the stiffness characteristics of spiral groove dry gas seal influenced by the real gas effect at high pressure

Hengjie XU, Pengyun SONG, Wenyuan MAO, Qiangguo DENG

*Kunming University of Science and Technology, China***17:10-17:30**

Numerical simulation of the dynamic behavior of a contacting mechanical face seal

Jeremy COCHAIN, Noël BRUNETIÈRE

*Pprime Institute, France***17:30-17:50**

Numerical investigation on static and rotordynamic characteristics of convergent-tapered and divergent-tapered hole-pattern damper seals

Dan SUN

*Shenyang Aerospace University, China***17:50-18:10**

EHL simulation of the radial shaft sealing system

Stefan THIELEN, Balázs MAGYAR, Bernd SAUER, Flavien FOKO FOKO

*University of Kaiserslautern, Germany***Room 308****Track7: Industrial Tribo-systems Green Tribology**Chair: Jenfin LIN, *National Cheng Kung University, Taiwan, China***10:10-10:40 Keynote**

Financial Tribology

Patrick G SWAN

*Aswan Consulting Cc, South Africa***10:40-11:10 Keynote**

The challenge in creating sustainable tribological products – 'closing the loop' approach

Satish V. KAILAS

*Indian Institute of Science, India***11:10-11:35 Invited**

50 years of tribology: Malaysian perspective

Haji HASSAN, Masjuki Bin HASSAN

*University of Malaya, Malaysia***11:35-12:00 Invited**

Oil-water separation based on adjusted surface wettability of filters

Jiadao WANG, Chuan DU, Shuai CHEN, Bao WANG, Hao ZHAO

*State Key Laboratory of Tribology, China***12:00-13:30**

Lunch

**Room 308****Track7: Industrial Tribo-systems Railway I**Chair: Georg JACOBS, *RWTH Aachen University, Germany***13:30-14:00 Keynote**

Dynamic behavior of arc during electrical sliding and its directional erosion

Yongzhen ZHANG

*Henan University of Science and Technology, China***14:00-14:20**

A systematic study on the mechanism of friction-induced high-frequency noise

Shuwen WANG, Jie MEI, Linlei ZHOU

*University of Shanghai for Science and Technology, China***14:20-14:40**

Hi-tech: cast rails

Leonid SOSNOVSKIY<sup>1</sup>, Sergei SHERBAKOV<sup>2</sup>, Guozheng KANG<sup>3</sup>, Zefeng WEN<sup>3</sup>, Victor KOMISSAROV<sup>4</sup><sup>1</sup>S&P Group Tribo-Fatigue Ltd, Belarus; <sup>2</sup>Belarusian State University, Belarus;<sup>3</sup>Southwest Jiaotong University, China; <sup>4</sup>Belarusian State University of

Transport, Belarus



**14:40-15:00**

Wheel/rail pair as a tribo-fatigue system and its laboratory models for the tests in the conditions close to operational

Leonid SOSNOVSKIY<sup>1</sup>, Sergei SHERBAKOV<sup>2</sup>, Zili LI<sup>3</sup>, Meysam NAEIMI<sup>3</sup>  
<sup>1</sup>S&P Group Tribo-Fatigue Ltd, Belarus; <sup>2</sup>Belarusian State University, Belarus;  
<sup>3</sup>Delft University of Technology, Netherlands

**15:00-15:20**

Damage evolution of AISi7Mg0.6-T6 for catenary under impact-sliding wear

Deqiang TAN<sup>1</sup>, Jiliang MO<sup>1</sup>, Jinfang PENG<sup>1</sup>, Minhao ZHU<sup>1</sup>, Jian LUO<sup>2</sup>  
<sup>1</sup>Tribology Research Institute, China; <sup>2</sup>The Third Railway Survey and Design Institute Group Corporation, China

**15:30-16:30**

Coffee Break & Poster Time

**Room 308**

**Track 7: Industrial Tribo-systems  
Railway II**

Chair: Satish V. KAILAS, Indian Institute of Science, India

**16:30-16:50**

On wear and damage transitions of two kinds of railway wheel materials in the rolling-sliding contact

Lubing SHI, Wentao ZHU, Lichang GUO, Qiyue LIU, Wenjian WANG  
Tribology Research Institute, Southwest Jiaotong University, China

**16:50-17:10**

Grease selection for railway axlebox bearings

Muhammad Naqeeb BIN YUSOF<sup>1</sup>, Marcel VAN EIJK<sup>1</sup>, Marco VAN ZOELLEN<sup>2</sup>, Pieter BAART<sup>2</sup>, Lieuwe DE VRIES<sup>2</sup>  
<sup>1</sup>SKF Engineering & Research Centre, Netherlands; <sup>2</sup>SKF Global Testing NL, Netherlands

**17:10-17:30 Cancelled**

Identification of dynamic friction models in a customised sliders-disc system

Xiaocui WANG<sup>1</sup>, Jiliang MO<sup>1</sup>, Huajiang OUYANG<sup>2</sup>, Yuhang JIANG<sup>1</sup>, Minhao ZHU<sup>1</sup>, Zhongrong ZHOU<sup>1</sup>  
<sup>1</sup>Southwest Jiaotong University, China; <sup>2</sup>University of Liverpool, UK

**Room 311A**

**Track 8: Tribotest and Monitoring  
Measurement and Instruments II**

Chair: Pawel PODSIADLO, Curtin University, Australia

**10:10-10:35 Invited**

Research progress on full-mode fretting wear test system

Min-Hao ZHU  
Southwest Jiaotong University, China

**10:35-10:55**

Characterization and model of ionic polymer-graphene composite sensor

Qingsong HE<sup>1,2</sup>, David VOKOUN<sup>3</sup>, Min YU<sup>1</sup>, Kwang Jin KIM<sup>2</sup>, Dan LI<sup>4</sup>, Zhendong DAI<sup>1</sup>  
<sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>University of Nevada Las Vegas, United States; <sup>3</sup>Institute of Physics of the Academy of Sciences of the Czech Republic, The Czech Republic; <sup>4</sup>Monash University, Australia

**10:55-11:15**

Non-intrusive measurement of lubricant film thickness distribution of thrust bearings

Pan DOU, Tonghai WU, Kai ZHANG  
Xi'an Jiaotong University, China

**11:15-11:35**

Using ultrasound for measuring friction in-situ in contacts

Xiangwei LI, Rob DWYER-JOYCE  
The University of Sheffield, United Kingdom

**11:35-11:55**

A new simple method to investigate variations in electric conductivity of thin-layer coatings

Knut WANTZEN, Constantino PAVLIDES, Albert ALBERS  
Karlsruhe Institute of Technology (KIT), Germany

**11:55-12:15**

Development of a lubricating film thickness and friction force measuring instrument

Dewen ZHAO<sup>1</sup>, Xinchun LU<sup>1</sup>, Chenhui ZHANG<sup>1</sup>, Jianbin LUO<sup>1</sup>, Juzhen FENG<sup>2</sup>  
<sup>1</sup>Tsinghua University, China; <sup>2</sup>Tianjin Hwatsing Technology Company Limited, China

**12:30-13:30**

Lunch

**Room 311A**

**Track 8: Tribotest and Monitoring  
Measurement and Instruments III**

Chair: Minhao ZHU, Southwest Jiaotong University, China

**13:30-13:55 Invited**

Measuring interfaces and lubricants with small shear ultrasonic frequency shear vibrations

Rob DWYER-JOYCE  
University of Sheffield, United Kingdom

**13:55-14:15**

Assessment method for tribological property of ceramic/stainless steel rubbing pairs in hydrogen peroxide solutions

Fuming KUANG, XinCong ZHOU, Jun WANG, Junqiang FANG  
Wuhan University of Technology, China

**14:15-14:35**

Effect of operating conditions and lubricating oils on fuel consumption and CO<sub>2</sub> emissions by real Taxi experiments

Jianfang LIU<sup>1</sup>, Lei WEI<sup>2</sup>, Xuzheng QIAN<sup>2</sup>, Jian LI<sup>2</sup>  
<sup>1</sup>Wuhan Polytechnic University, China; <sup>2</sup>Wuhan Research Institute of Materials Protection, China

**14:35-14:55**

Research on the relationship between rheological properties and molecular structure

Yong LIANG, Liran MA, Jianbin LUO  
Tsinghua University, China

**14:55-15:15**

New perspectives on micro-abrasion corrosion tests

Jose Daniel BIASOLI DE MELLO, Wilian DA SILVA LABIAPARI, Marcelo BRAGA DOS SANTOS, Henara LILLIAN COSTA  
Universidade Federal de Uberlandia, Brazil



**15:15-15:35****Bearing fatigue tester with optical module for in situ observation**Martin REPKA<sup>1</sup>, Milan OMASTA<sup>3</sup>, Petr SPERKA<sup>3</sup>, Colin MCALEESE<sup>1</sup>, Motohiko KOSHIMA<sup>2</sup>, Osamu ISHIGO<sup>1</sup><sup>1</sup>Daido Metal Co. Ltd. – organizacni slozka, The European Technical Center, Czech Republic; <sup>2</sup>Daido Metal Co. Ltd, Japan; <sup>3</sup>Brno University of Technology, Czech Republic**15:35-16:30**

Coffee Break &amp; Poster Time

**Room 311A****Track 8: Tribotest and Monitoring Measurement and Instruments IV****Chair: Steve SHAFFER, Bruker-TSOM, United States****16:30-16:50****Test method for evaluating tribologically stressed layers on a translatory oscillation tribometer (SRV)**

Gregor PATZER

Optimol Instruments Prüftechnik GmbH, Germany

**16:50-17:10****Full scale test setup for torque and friction measurements of large axial sliding bearings**

Jan DE PAUW, Timothy GALLE, Jonathan VANCOILLIE, Wouter OST, Patrick DE BAETS

Ghent University, Belgium

**17:10-17:30****Development of a specific tribometer for implementation in an environmental-SEM**Sylvie DESCARTES, Philippe STEYER, David PHILLIPPON, José FERREIRA  
INSA Lyon, France**17:30-17:50****Design of high temperature high pressure water/helium tribometer**Manish KUMAR, Narendra Mohan DUBE, Anshuman DUBE, Kushal GAUR  
DUCOM Instruments Pvt. Ltd., India**17:50-18:10****Tribology, the materials characterization tool for energy efficient and durable products & process design**A.Lgartua\*, B. Fernández, E. Fuentes, X. Almandoz, R. Bayón, G. Mendoza, X. Fernández, V. Saenz de Viteri, B. Pinedo, B. Zabala, F. Pagano, J. C. Rodríguez, O. Areitioaurtena, I. Martínez de Alcocer, C. Cerrillo, A. López, A. Alberdi, N. Pacios, R. Gómez, P. Cobo, I. Saenz, C. Sanz, A. Arnaiz, J. Laucirica, J. Barriga, F. Egaña, I. Ruiz de Argandoña, A. Gutierrez, E. Aranzabe, J. Terradillos, R. Emparantza, I. Maurtúa, J. Mabe and A. Aranzabe  
Fundación TEKNIKER (IK4-TEKNIKER), Spain**18:10-18:30****A comparative study on the micro-abrasive wear behavior of tribological systems submitted to conditions of "constant normal force" and "constant pressure"**

Ronaldo COZZA

University Center of FEI – Educational Foundation of Ignatius "Padre Saboia de Medeiros", Brazil

**Room 203B****Track9: Tribology in Future Nanotribology****Chair: Carmine PUTIGNANO, Politecnico di Bari, Italy****10:10-10:35 Invited****In-situ analysis for adsorbed additive layer on metal substrate and its nanotribological properties**

Tomoko HIRAYAMA

Doshisha University, Japan; JST Presto, Japan

**10:35-11:00 Invited****Investigation of wear reduction effect by applying compliant nano-structure through molecular dynamics simulation**Hyun-Joon KIM<sup>1</sup>, Dae-Eun KIM<sup>2</sup><sup>1</sup>Kyunpook National University, Korea; <sup>2</sup>Yonsei University, Korea**11:00-11:25 Invited****GaN: beyond ultralow wear**Guosong Zeng<sup>1</sup>, Xiaofang Yang<sup>2</sup>, Bruce. E. Koel<sup>2</sup>, Nelson Tansu<sup>3</sup>, Brandon A. Krick<sup>1</sup><sup>1</sup>Mechanical Engineering and Mechanics, Lehigh University, USA; <sup>2</sup>Princeton University, USA; <sup>3</sup>Center for Photonics and Nanoelectronics, Electrical and Computer Engineering, Lehigh University, USA**11:25-11:50 Invited****Investigation of the mechanism of water-based superlubricity**

Chenhui ZHANG, Mingming DENG, Jianbin LUO

Tsinghua University, China

**11:50-12:10****Science education for the future of tribology: new educational material to introduce tribology to young generation**

Alan HASE

Saitama Institute of Technology, Japan

**12:10-13:30**

Lunch

**Room 203B****Track9: Tribology in Future Lubrication****Chair: Hyun-Joon KIM, Kyunpook National University, Korea****13:30-13:55 Invited****Lubricant flow in an elastohydrodynamic (EHD) contact**

Janet WONG, Stephen JEFFREYS, Benedicte GALMICHE, Hugh SPIKES

Imperial College London, UK

**13:55-14:20 Invited****Lubrication between viscoelastic solids: theory & experiments**Carmine PUTIGNANO<sup>1</sup>, Nigel MARX<sup>2</sup>, Giuseppe CARBONE<sup>1</sup>, Daniele DINI<sup>2</sup>, Hugh PIKES<sup>2</sup><sup>1</sup>Politecnico di Bari, Italy; <sup>2</sup>Imperial College, UK**14:20-14:45 Invited****Effects of cylinder liner surface grooves with different angle on tribological properties for cylinder liner-piston**

Chengqing YUAN

Wuhan University of Technology, China



**14:45-15:10 Invited**

**Tribo-condition monitoring for optimized performance and longer service life**

Pär MARKLUND

*Luleå University of Technology, Sweden*

**15:10-15:30**

**The optimization of dimple-arrangement for sealing and lubrication characteristics on mechanical seal surface**

Tadatsugu IMURA, Ayano TANISHIMA, Yuta NEGISHI, Yuichiro TOKUNAGA, Hideyuki INOUE

*EAGLE INDUSTRY CO., LTD., Japan*

**15:30-16:30**

Coffee Break & Poster Time

**Room 203B**

**Track9: Tribology in Future**

**Biotribology**

**Chair: Chengqing YUAN, Wuhan University of Technology, China**

**16:30-16:55 Invited**

**Tribological rehydration of cartilage: new insight into how movement helps keep joints moving**

David BURRIS, Axel MOORE, Brian GRAHAM, Chris PRICE

*University of Delaware, USA*

**16:55-17:20 Invited**

**Mucin growth dynamics on living corneal epithelial cell monolayers**

Thomas ANGELINI, Tristan HORMEL, Angela PITENIS, Juan URUEÑA,

Tapomoy BHATTACHARJEE, W. Gregory SAWYER

*University of Florida, USA*

**17:20-17:40**

**Creation of protein film for low friction by surface texture under sliding contact in blood**

Koki KANDA<sup>1</sup>, Kenta SUZUKI<sup>1</sup>, Shinji KOBAYASHI<sup>2</sup>, Hideki KANEBAKO<sup>2</sup>, Koshi ADACHI<sup>1</sup>

*<sup>1</sup>Tohoku University, Japan; <sup>2</sup>Sun Medical Technology Research Corporation, Japan*

**17:40-18:00**

**Wormlike sliding motion of water droplets on the superhydrophobic surfaces with nanowire bundles**

Yupeng LI, Xiaoyu LI, M. IQBAL, Mingkai LEI

*Dalian University of Technology, China*



**Room 201A****Track1: Science of Tribology****Wear Fundamental I**Chair: Nicholas D SPENCER, *ETH Zurich, Switzerland***10:10-10:40 Keynote**

Relationship between stick-slip sliding and surface damage

Jacob ISRAELACHVILI

*UC Santa Barbar, USA***10:40-11:05 Invited**

Atomic removal mechanism on monocrystalline silicon surface

Linmao QIAN, Chen XIAO, Peng ZHANG, Cheng CHEN, Lei CHEN

*Southwest Jiaotong University, China***11:05-11:25**

Study of anti-wear tribofilm evolution using in-situ synchrotron X-ray measurements

Ardian MORINA, Abdel DORGHAM, Anne NEVILLE

*University of Leeds, UK***11:25-11:45**

Friction between fractal rough surfaces along lubricated point contact

William Woei Fong CHONG<sup>1</sup>, Siti Hartini HAMDAN<sup>2</sup><sup>1</sup>*Universiti Teknologi Malaysia, Malaysia;* <sup>2</sup>*University of Southampton Malaysia Campus, Malaysia***11:45-12:05**

Nano-quantum standard of wear

Sergey FEDOROV

*Kaliningrad State Technical University, Russia***12:05-13:30**

Lunch

**Room 201A****Track1: Science of Tribology****Wear Fundamental II**Chair: Zhanjiang WANG, *Southwest Jiaotong University, China***13:30-14:00 Keynote**

Science of degradation with application to wear and fatigue

Michael M KHONSARI

*Louisiana State University, USA***14:00-14:20**

Length-scale-dependent fracture behavior of polymeric materials in sliding wear

Li CHANG, Hongjian WANG

*The University of Sydney, Australia***14:20-14:40**

Improved predictive wear models: integration of mechanical properties evolution induced by friction

Tomasz LISKIEWICZ<sup>1</sup>, Ben BEAKE<sup>2</sup>, Norbert SCHWARZER<sup>3</sup>, Nick BIERWISCH<sup>3</sup><sup>1</sup>*University of Leeds, UK;* <sup>2</sup>*Micro Materials Ltd., UK;* <sup>3</sup>*Saxonian Institute of Surface Mechanics, Germany***14:40-15:00**

Numerical and experimental investigations of the tungsten carbide wear through impact-sliding conditions

Fridrici VINCENT, Gaetan BOUVARD, Gaylord GUILLONNEAU, Philippe

KAPSA, Marieme FALL

*LTDS, France***15:00-15:50**

Coffee Break

**Room 201A****Track1: Science of Tribology****Wear Fundamental III**Chair: Li CHANG, *The University of Sydney, Australia***15:50-16:10**

Mechanical properties and erosion-corrosion behavior of polyetheretherketone (PEEK) /nickel foam co-continuous composites

Xiaoguang YANG<sup>1,2</sup>, Deli DUAN<sup>1</sup>, Shengli JIANG<sup>1</sup>, Shu LI<sup>1</sup>, Huichen ZHANG<sup>2</sup><sup>1</sup>*Institute of Metal Research, Chinese Academy of Sciences, China;*<sup>2</sup>*Transportation Equipment and Ocean Engineering College, China***16:10-16:30**

Fretting wear behavior of the depleted uranium under different atmosphere environment

Zhengyang LI<sup>1</sup>, Zhenbing CAI<sup>1</sup>, Yanping WU<sup>2</sup>, Wenjin YANG<sup>1</sup>, Minhao ZHU<sup>1</sup><sup>1</sup>*Southwest Jiaotong University, China;* <sup>2</sup>*China Academy of Engineering and Physics, China***16:30-16:50**

Solution of temperature distribution under frictional heating with consideration of inhomogeneous inclusions

Yuanqing LIU, Wenzhong WANG, Shengguang ZHANG

*Beijing Institute of Technology, China***16:50-17:10**

Analysis of two fractal surfaces state in micro sliding process with thermo-mechanical coupling

Lianfeng LAI<sup>1,2</sup>, Chenghui GAO<sup>2</sup>, Jianmeng HUANG<sup>2</sup><sup>1</sup>*Ningde Normal University, China;* <sup>2</sup>*Fuzhou university, China***17:10-17:30**

Heat conduction with an inhomogeneity due to distributed frictional heating in a half space

Xiujiang SHI<sup>1,2</sup>, Liqin WANG<sup>1</sup>, Qian WANG<sup>2</sup><sup>1</sup>*Harbin institute of technology, China;* <sup>2</sup>*Northwestern University, China***Room 201B****Track1: Science of Tribology****Nanotribology I**Chair: Irina G. GORYACHEVA, *Institute for Problems in Mechanics, Russian Academy of Science, Russia***10:10-10:35 Invited**

Studies of the dynamic tribological properties of 2D nanomaterials

James BATTEAS, Meagan ELINSKI, Zhuotong LIU, Mealani NEGRITO

*Texas A&M University, USA***10:35-10:55**Ultra-low friction interface detection of twisted multilayer MoS<sub>2</sub> based on phonon vibration

Ke JIN, Dameng LIU, Junyi LI

*Tsinghua University, China***10:55-11:15**

Thickness dependent friction on few-layer TMDs

Liang FANG<sup>1</sup>, Dameng LIU<sup>1</sup>, Yuzheng GUO<sup>2</sup><sup>1</sup>*Tsinghua University, China;* <sup>2</sup>*University of Cambridge, UK*

**11:15-11:35**

**A combined experimental and DFT study of superlubricity of graphene/MoS<sub>2</sub> heterostructure**

Linfeng WANG<sup>1</sup>, Xiang ZHOU<sup>1</sup>, Tianbao MA<sup>1</sup>, Dameng LIU<sup>1</sup>, Lei GAO<sup>1</sup>, Xin LI<sup>2</sup>, Yuanzhong HU<sup>1</sup>, Hui WANG<sup>1</sup>, Yadong DAI<sup>3</sup>, Jianbin LUO<sup>1</sup>

<sup>1</sup>Tsinghua University, China; <sup>2</sup>Beijing Institute of Technology, China; <sup>3</sup>Neotrident Co., Ltd, China

**11:35-11:55**

**Controllable nanotribological properties of graphene nanosheets**

Yitian PENG, Xingzhong ZENG, Haojie LANG

Donghua University, China

**11:55-12:15**

**Some physical phenomena in nanoscale dissipation and friction from theory and simulation**

Erio TOSATTI

SISSA, Italy; ICTP, Italy; CNR-IOM Democritos, Italy

**12:15-13:30**

Lunch

**Room 201B**

**Track1: Science of Tribology**

**Nanotribology II**

**Chair: Xianqiang PEI, INM-Leibniz Institute for New Materials, Germany**

**13:30-13:50**

**How does the molecular organization govern the interfacial friction at nanoscale?**

Alexia CRESPO, Juliette CAYER-BARRIOZ, Denis MAZUYER, Nazario MORGADO

Ecole Centrale de Lyon, France

**13:50-14:10**

**Confinement-induced nano-sandwich of liquid crystal in thin film lubrication**

Liran MA, Ming GAO, Jianbin LUO

Tsinghua University, China

**14:10-14:30**

**Simultaneous in situ measurements of contact state and friction to understand the mechanism of lubrication with nanometer-thick liquid lubricant films**

Hedong ZHANG<sup>1</sup>, Yasunaga MITSUYA<sup>2</sup>, Yusuke TAKEUCHI<sup>1</sup>, Kenji FUKUZAWA<sup>1</sup>, Shintaro ITOH<sup>1</sup>

<sup>1</sup>Nagoya University, Japan; <sup>2</sup>Nagoya Industrial Science Research Institute, Japan

**14:30-14:50**

**Investigation by in situ raman and in situ fluorescence spectroscopies of the friction reduction mechanisms in sphere plane contacts lubricated by dispersion of nanoparticles in low viscosity bases**

Jean-Louis MANSOT, Audrey MOLZA, Yves BERCIION

Université des Antilles, France

**14:50-15:10**

**Interfacial structures and nanotribological behaviors of host-guest assemblies induced by hydrogen bond and van der Waals force**

Hongyu SHI<sup>1</sup>, Yuhong LIU<sup>1</sup>, Qingdao ZENG<sup>2</sup>, Chen WANG<sup>2</sup>, Xinchun LU<sup>1</sup>

<sup>1</sup>Tsinghua University, China; <sup>2</sup>National Center for Nanoscience and Technology, China

**15:30-15:50**

Coffee Break

**Room 201B**

**Track1: Science of Tribology**

**Nanotribology III**

**Chair: Hedong ZHANG, Nagoya University, Japan**

**15:50-16:10**

**Single asperity experiments in understanding macroscopic polymer tribology**

Xian-Qiang PEI, Roland BENNEWITZ

INM-Leibniz Institute for New Materials, Germany

**16:10-16:30**

**Molecular origin of frictional behavior of pressure-driven water flow through graphene nanochannel**

Lei YANG<sup>1</sup>, Dongfeng DIAO<sup>2</sup>

<sup>1</sup>Xi'an Jiaotong University, China; <sup>2</sup>Shenzhen University, China

**16:30-16:50**

**Nano-scale Investigation of frictional characteristics of tribo-films in sliding contacts of representative in-cylinder conditions**

Jamal UMER<sup>1</sup>, Nick MORRIS<sup>1</sup>, Michael LEIGHTON<sup>1</sup>, Ramin RAHMANI<sup>1</sup>, Homer RAHNEJAT<sup>1</sup>, Sebastian HOWELL-SMITH<sup>2</sup>, Sashi BALAKRISHNAN<sup>3</sup>

<sup>1</sup>Loughborough University, UK; <sup>2</sup>Capricorn Automotive, UK; <sup>3</sup>Castrol Technology Centre, UK

**16:50-17:10**

**Frictional properties of nanojunctions including atomically thin sheets**

Wengen QUYANG<sup>1</sup>, Ming MA<sup>2</sup>, Quanshui ZHENG<sup>2</sup>, Michael URBACH<sup>1</sup>

<sup>1</sup>Tel Aviv University, Israel; <sup>2</sup>Tsinghua University, China

**17:10-17:30 Cancelled**

**Effect of groove topography on the contact behavior in EHL and mixed lubrication.**

Denis MAZUYER<sup>1</sup>, Thomas TOUCHE<sup>1</sup>, Tomasz WOLOSZYNSKI<sup>2</sup>, Pawel PODSIADLO<sup>2</sup>, Gwidon STACHOWIAK<sup>2</sup>, Juliette CAYER-BARRIOZ<sup>2</sup>

<sup>1</sup>Ecole Centrale de Lyon, France; <sup>2</sup>Curtin University, Australia

**17:30-17:50**

**Temperature dependency of shear properties of nanometer-thick liquid lubricant films: a molecular dynamics study**

Takayuki KOBAYASHI, Hedong ZHANG, Kenji FUKUZAWA, Shintaro ITOH

Nagoya University, Japan

**17:50-18:10**

**Finite element analysis of AFM-cantilever dynamic interactions with sample**

G BIJU, U B JAYADEEP, M S BOBBI

Indian Institute of Science, India

**Room 303**

**Track1: Science of Tribology**

**Tribophysics I**

**Chair: Liran MA, Tsinghua University, China**

**10:10-10:35 Invited**

**Material complexity and atomic scale models in tribology**

Michael MOSELER

Fraunhofer IWM, Germany



**10:35-10:55**

**Tribo-phase transformation of graphene nanocrystal carbon films studied by in-situ electrical property test**

Xue FAN, Saizhou QIU, Dongfeng DIAO  
*Shenzhen University, China*

**10:55-11:15**

**Magnetic field induced ferromagnetic domain evolution and the influence on dry friction behavior: A first principles study**

Chao SUN, Yongzhen ZHANG, Sanming DU, Hongbiao HAN  
*Henan University of Science & Technology, China*

**11:15-11:35**

**The relationship between friction coefficient and charge density of PDMS sliding against graphene sheets embedded carbon films**

Weiqiang ZHANG<sup>1</sup>, Pengfei WANG<sup>2</sup>, Dongfeng DIAO<sup>2</sup>  
<sup>1</sup>*Xi'an Jiaotong University, China;* <sup>2</sup>*Shenzhen University, China*

**11:35-11:55**

**The study of magnetorheological elastomer's friction performance and mechanism with magnetic field**

Rui LI, Dejun REN<sup>1</sup>, Jiushan LIU<sup>1</sup>, Shiwei CHEN<sup>2</sup>, Xiaojie WANG<sup>1</sup>  
<sup>1</sup>*Chongqing University of Posts and Telecommunications, China;* <sup>2</sup>*Chongqing Univ. Science & Technology, China*

**12:00-13:30**

Lunch

**Room 303**

**Track1: Science of Tribology  
Tribophysics II**

**Chair: Yuanzhong HU, Tsinghua University, China**

**13:30-13:55 Invited**

**From tribology to tribo-fatigue and mechanothermodynamics**

LEONID SOSNOVSKIY<sup>1</sup>, SERGEI SHERBAKOV<sup>2</sup>  
<sup>1</sup>*S&P Group Tribo-Fatigue Ltd, Belarus;* <sup>2</sup>*Belarusian State University, Belarus*

**13:55-14:15**

**Thermodynamic, tribo-fatigue and mechanothermodynamic entropies**

Leonid SOSNOVSKIY<sup>1</sup>, Sergei SHERBAKOV<sup>2</sup>, Michael KHONSARI<sup>3</sup>  
<sup>1</sup>*S&P Group Tribo-Fatigue Ltd, Belarus;* <sup>2</sup>*Belarusian State University, Belarus;* <sup>3</sup>*Louisiana State University, USA*

**14:15-14:35**

**Thermodynamic analysis of tribo-fatigue**

Michael KHONSARI<sup>1</sup>, Mohammad MEHDIZADEH<sup>1</sup>, Steven SHAFFER<sup>1,2</sup>  
<sup>1</sup>*Louisiana State University, USA;* <sup>2</sup>*Bruker Nano Surfaces Division, USA*

**14:35-14:55**

**Entropy generation related to heat conduct and plastic deformation in tribology**

Zhendong DAI, Yi SONG  
*Nanjing University of Aeronautics and Astronautics, China*

**14:55-15:15**

**Non-equilibrium thermodynamics model and experiments on thin-film lubrication: the role of interfacial interaction**

Xiangjun ZHANG, Haoda JING, Yu TIAN, Yonggang MENG  
*Tsinghua University, China*

**15:30-15:50**

Coffee Break

**Room 303**

**Track1: Science of Tribology  
Tribophysics III**

**Chair: Dongfeng DIAO, Shenzhen University, China**

**15:50-16:10**

**Triboemission mechanism and its correlation with tribocharging**

Alessandra CINIERO, Tom REDDYHOFF  
*Imperial College London, UK*

**16:10-16:30**

**Collection and Utilization of Triboelectrification Charge**

Daoai WANG, Feng ZHOU, Weimin LIU  
*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China*

**16:30-16:50**

**A simple way to modulate the discharging induced by triboelectrification**

Na LI<sup>1</sup>, Xuefeng XU<sup>1</sup>, Liran MA<sup>2</sup>, Jianbin LUO<sup>2</sup>  
<sup>1</sup>*Beijing Forestry University, China;* <sup>2</sup>*Tsinghua University, China*

**16:50-17:10**

**Friction contact affected by surface electron of multi-layer graphene: quantum friction**

Xi ZHANG, Dongfeng DIAO  
*Shenzhen University, China*

**17:10-17:30**

**Mechanical states of multielement tribo-Fatigue system**

Sergei SHERBAKOV<sup>1</sup>, Leonid SOSNOVSKIY<sup>2</sup>  
<sup>1</sup>*Belarusian State University, Belarus;* <sup>2</sup>*S&P Group Tribo-Fatigue Ltd, Belarus*

**17:30-17:50**

**Study on interfacial mechanical properties of diffusion bonding of TiAl alloy and TC11 titanium alloy by nanoindentation test**

Haosheng PANG<sup>1</sup>, Chenghui GAO<sup>1</sup>, Ming LIU<sup>1</sup>, Xiaochen WANG<sup>2</sup>, Xuesong FU<sup>2</sup>  
<sup>1</sup>*Fuzhou University, China;* <sup>2</sup>*Dalian University of Technology, China*

**17:50-18:10**

**Triboelectric behavior of Cu rolling electric contact pairs**

Chenfei SONG, Yixiang SUN, Yang YUE, Yongzhen ZHANG  
*Henan University of Science and Technology, China*

**Room 311A**

**Track1: Science of Tribology  
Contact Mechanics I**

**Chair: Valentin POPOV, Berlin University of Technology, Institute of Mechanics, Germany**

**10:10-10:30**

**In situ measurements of the real area of contact: The contact mechanics challenge**

W Gregory SAWYER<sup>1</sup>, Alexander BENNETT<sup>1</sup>, Kathryn HARRIS<sup>1</sup>, Kyle SCHULZE<sup>1</sup>, Juan URUENA<sup>1</sup>, Angela PITENIS<sup>1</sup>, Martin MUSER<sup>2</sup>, Thomas ANGELINI<sup>1</sup>  
<sup>1</sup>*University of Florida, USA;* <sup>2</sup>*Saarland University, Germany*



10:30-10:50

Measurement of the real area of contact using coating technique and SEM

Robert JACKSON, Yang XU, Yan CHEN, Bart PROROK  
Auburn University, USA

10:50-11:10

The effect of velocity on the nominal contact area of elastomeric materials: comparison between theory and experiment

M. Khafidh<sup>1,2</sup>, N.V. Rodriguez<sup>1,2</sup>, M.A. Masen<sup>3</sup>, D.J. Schipper<sup>1</sup>  
<sup>1</sup>University of Twente, The Netherlands; <sup>2</sup>Dutch Polymer Institute, The Netherlands; <sup>3</sup>Imperial College, United Kingdom

11:10-11:30

In-situ measurement of dewetting behavior on rubber-glass interface

Toshiaki NISHI, Kenta MORIYASU, Tsuyoshi NISHIWAKI  
ASICS Corporation, Japan

11:30-11:50

An in-situ optical study of subsurface crack propagation under sliding herzian contact

Haiyang ZHANG, Bo TAO, Jia ZENG, Xiaojun LIU, Kun LIU, Jiabin YE  
HeFei University of Technology, China

11:50-12:10

An efficient model for the contact of multiferroic composite materials

Xin ZHANG<sup>1,2</sup>, Zhanjiang WANG<sup>1</sup>, Huoming SHEN<sup>1</sup>, Qian WANG<sup>2,1</sup>  
<sup>1</sup>Southwest Jiaotong University, China; <sup>2</sup>Northwestern University, China

12:00-13:30

Lunch

**Room 311A**

**Track1: Science of Tribology**  
**Contact Mechanics II**

**Chair: Thomas ANGELINI, University of Florida**

13:30-14:00 **Keynote**

Strength of adhesive contacts: influence of contact geometry and material gradients

Valentin POPOV  
Berlin University of Technology Institute of Mechanics, Germany

14:00-14:20

Influence of vibration on friction: Critical velocity of controllability

Mikhail POPOV  
National Research Tomsk Polytechnic University, Russia; Technische Universität Berlin, Germany; National Research Tomsk State University, Russia

14:20-14:40

Modeling elastic adhesive contact for different forms of molecular interaction potential

Yulia MAKHOVSKAYA  
Ishlinsky Institute for Problems in Mechanics of the Russian Academy of Sciences, Russian

14:40-15:00

A FFT-enhanced boundary element methodology

Carmine PUTIGNANO, Giuseppe CARBONE  
Politecnico di Bari, Italy

15:00-15:20

Modeling approach for contact simulation of real surfaces on the microscale with composite materials

Daniel NADERMANN<sup>1</sup>, Avijit RASTOGI<sup>2</sup>, Hubert SCHWARZE<sup>3</sup>  
<sup>1</sup>Robert Bosch GmbH - Corporate Sector Research, Germany; <sup>2</sup>RWTH Aachen University, Germany; <sup>3</sup>Institute of Tribology and Energy Conversion Machinery at Clausthal University, Germany

15:30-15:50

Coffee Break

**Room 311A**

**Track1: Science of Tribology**  
**Contact Mechanics III**

**Chair: Tom REDDYHOFF, Imperial College of London, UK**

15:50-16:15 **Invited**

Modeling of sliding contact for viscoelastic layer (3-D model of material)

Elena TORSKAYA, Feodor STEPANOV  
Ishlinsky Institute for Problems in Mechanics, Russia

16:15-16:35

Contact of curved surfaces in elastic and plastic deformation

Robert JACKSON  
Auburn University, USA

16:35-16:55

A computational model for evaluating the stressed volume in contact fatigue

Xiaoqing JIN, Xiangning ZHANG, Pu LI  
Chongqing University, China

16:55-17:15

Effects of truncated tails on pull-off of nominally gaussian self-affine rough surfaces

Antonio PAPANGELO<sup>1,2</sup>, Michele CIAVARELLA<sup>1</sup>, Luciano AFFERRANTE<sup>1</sup>  
<sup>1</sup>Polytechnic of Bari, Italy; <sup>2</sup>Hamburg University of Technology, Germany

17:15-17:35

Contact pressure distribution during sliding interaction

Vera DEEVA<sup>1</sup>, Stepan SLOBODYAN<sup>2</sup>  
<sup>1</sup>National Research Tomsk Polytechnic University, Russia; <sup>2</sup>Omsk State Technical University, Russia

17:35-17:55

Molecular dynamics simulations for the bonding preference of hydrocarbon contaminants in hard disk drives

Jingan SONG, Changdong YEO  
Texas Tech University, USA

**Room 201D**

**Track 2: Wear & Surface Engineering**  
**Tribo-Materials I**

**Chair: Junhong JIA, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China**

10:10-10:35 **Invited**

Tribological Performance of Cu-Sn Alloys Manufactured by Advanced Master Forming Technologies

Friedrich FRANEK<sup>1</sup>, Ulrike CIHAK-BAYR<sup>1</sup>, Robin JISA<sup>2</sup>, Andreas PAUSCHITZ<sup>1</sup>  
<sup>1</sup>AC2T Research GmbH, Austria; <sup>2</sup>Österreichische Tribologische Gesellschaft, Austria



**10:35-10:55**Friction and wear properties of A356-TiB<sub>2</sub> cast composites fabricated by flux assisted synthesis

Rajnish TYAGI, Rahul SARASWAT

*Indian Institute of Technology (Banaras Hindu University), India***10:55-11:15**

Friction and wear properties of CrSiCN/SiC tribopairs in water lubrication

Fei ZHOU, Zhiwei WU, Qianzhi WANG

*Nanjing University of Aeronautics and Astronautics, China***11:15-11:35**

Research on preparation and properties of copper-based powder metallurgy brake pads for high-speed train

Tiantian HE, Zhenjun YUAN, Sanming DU, Yongzhen, ZHANG

*Henan University of Science and Technology, China***11:35-11:55**

The mechanisms of strain inducing grain refinement and mixture in worn surface of binary brass

Lin LIU<sup>1</sup>, Pujie ZHAN<sup>1</sup>, Martin DIENWIEBEL<sup>2,3</sup><sup>1</sup>Changzhou University, China; <sup>2</sup>Karlsruhe Institute for Technology, Germany;<sup>3</sup>Fraunhofer Institute for Mechanics of Materials, Germany**11:55-12:15**

Microstructure and tribological behavior of in situ Zr-based bulk metallic glass composites

Hong WU, Yanwen TIAN, Han ZENG, Yong LIU

*Central South University, China***12:15-12:35**Fabrication and high-temperature tribological properties of self-lubricating NiCr-SrCrO<sub>4</sub> composites

Jiahu OUYANG, Fan LIU, Zhanguo LIU, Yaming WANG, Yujin WANG

*Harbin Institute of Technology, China***12:35-13:30**

Lunch

**Room 201D****Track 2: Wear & Surface Engineering****Tribo-Materials II****Chair: Ming QIU, Henan University of Science and Technology, China****13:30-14:00 Keynote**

Polymer tribology fundamentals and applications

Nikolai MYSHKIN

*Metal-Polymer Research Institute of Belarus National Academy of Sciences, Belarus***14:00-14:20**

High performance hybrid polymer composites for tribological applications

Nazanin EMAMI, A. JAIN

*Luleå University of Technology, Sweden***14:20-14:40**

Preparation of polyimide/UHMWPE blends and their tribological properties in high-speed dry sliding

Song CHEN, Haitao DUAN, Lei WEI, Bingxue CHENG, Jian LI, Kali GU

*Wuhan Research Institute of Materials Protection, China***14:40-15:00**

Clarification of reactive extruding mechanism and tribological behavior on carbodiimide added fiber reinforced PA resin material

Takeshi KUNISHIMA, Takanori KUROKAWA, Hirokazu ARAI

*JTEKT CORPORATION, Japan***15:00-15:20**A comparative study of tribological performance of PEEK composites filled by  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> and  $\alpha$ -FeOOH nanoparticles under water lubrication conditionsChuanping GAO<sup>1,2</sup>, Pingyu ZHANG<sup>1</sup>, Qihua WANG<sup>2</sup>, Shengmao ZHANG<sup>1</sup>, Ga ZHANG<sup>2</sup><sup>1</sup>Henan University, China; <sup>2</sup>State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China**15:20-15:50**

Coffee Break

**Room 201D****Track 2: Wear & Surface Engineering****Tribo-materials III****Chair: Pingping YAO, Central South University, China****15:50-16:15 Invited**

Multiscale design of wear resistant polymer composites

Sergey PANIN<sup>1</sup>, B.A. LYUKSHIN<sup>1,2</sup>, P.A. LYUKSHIN<sup>1</sup>, L.A. KORNIENKO<sup>1</sup>, S.A.BOCHKAREVAL<sup>1</sup>, N.Yu. GRISHAEVA<sup>1,2</sup>, V.O. ALEXENKO<sup>1,2</sup>, Nguyen Duc ANH<sup>3</sup>, Huan QITAO<sup>3</sup><sup>1</sup>ISPM SB RAS, Russia; <sup>2</sup>Tomsk State University of Control Systems and Radioelectronics, Russia; <sup>3</sup>National Research Tomsk Polytechnic University, Russia**16:15-16:35**

Effect of hygrothermal aging on wear mechanism and friction behavior of PTFE composites

Nazanin EMAMI, M.R. HOMAYOUN

*Luleå University of Technology, Sweden***16:35-16:55**

Effects of graphene on tribological performance of resin matrix composites

Kaikui ZHENG, Chenghui GAO, Fushan HE, Lei WANG

*Fuzhou University, China***16:55-17:15**

Effect of cenospheres on mechanical properties of epoxy resin composites

Ping CHEN

*University of Science and Technology Beijing, China***17:15-17:35**

Tribological behavior of carbon filled hybrid UHMWPE composites in water

Hari Shankar VADIVEL, Arash GOLCHIN, Nazanin EMAMI

*Luleå University of technology, Sweden***17:35-17:55**

Impact of metallic counterpart materials on tribofilm formation and tribological mechanisms of polymer composites

Huimin QI, Gen LIU, Ga ZHANG, Tingmei WANG, Qihua WANG

*Lanzhou Institute of Chemical Physics, China*

17:55-18:15

Silver nanosheet coated copper nanowire/epoxy resin nanocomposites with enhanced electrical conductivity and wear resistance

Ningning ZENG

*Henan University, China***Room 203A****Track 2: Wear & Surface Engineering Coatings IX**Chair: Roman GOLTSBERG, *Technion, Israel*

10:10-10:30

Sliding wear behavior of thermal sprayed Al<sub>2</sub>O<sub>3</sub>-Y<sub>2</sub>O<sub>3</sub> composite coatings under severe conditions

Jian RONG, Kai YANG

*Chinese Academy of Sciences, China*

10:30-10:50

Microstructure and properties of TiC/Fe non-skid coating by plasma transferred arc cladding

Deqiang CHEN, Yongzhen ZHANG, Yongping NIU, Bao SHANGGUAN

*Henan University of Science and Technology, China*

10:50-11:10

Thermal arc spray aluminium coating analysis as a sacrificial anode for cathodic protection

Nor Hayati SAAD, Muhamad Hafiz ABD MALEK, Abdul Rahim M SAHAB

*Universiti Teknologi MARA, Malaysia*

11:10-11:30

Tribological performances of Al<sub>2</sub>O<sub>3</sub>/YAG amorphous ceramic coating fabricated by atmospheric plasma spraying

Kai KANG, Jian RONG, Jinxing NI, Yin ZHUANG, Shunyan TAO, Chuanxian DING

*Chinese Academy of Sciences, China*

11:30-11:50

Effect of Fe content on the microstructure and properties of plasma spraying and remelting NiCrBSi coatings

Jingbai CHEN<sup>1</sup>, Lining WAN<sup>1</sup>, Yanchun DONG<sup>1,2</sup><sup>1</sup>Hebei University of Technology, China; <sup>2</sup>University of Alberta, Canada

11:50-12:10

Plasma Sprayed Fe-based Amorphous Alloy Superhydrophobic Coating

Xin JIN

*China University of Mining and Technology, China*

12:20-13:30

Lunch

**Room 203A****Track 2: Wear & Surface Engineering Coatings X**Chair: Ahmet ALPAS, *University of Windsor, Canada*

13:30-13:50

Structure and tribological properties of multicomponent CrTiAlCN coatings in ambient environment

Fei ZHOU<sup>1</sup>, Haotian FANG<sup>1</sup>, Qianzhi WANG<sup>1</sup>, Kangmin CHEN<sup>1,2</sup>, Zhifeng ZHOU<sup>1,3</sup>, L.K.Y LI<sup>1,3</sup><sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>Jiangsu University, China; <sup>3</sup>City University of HongKong, China

13:50-14:10

Effects of blade material characteristic on high-speed rubbing behaviour between Al-hBN abradable seal coatings and blades

Weihai XUE, Siyang GAO, Deli DUAN, Peng WANG, Shu LI

*Chinese academy of sciences, China*

14:10-14:30

Tribological behaviors between aluminum-based seal coatings and titanium boride-coated blades under high-speed rubbing condition

Siyang GAO, Weihai XUE, Deli DUAN, Sihan HOU, Shu LI

*Chinese Academy of Sciences, China*

14:30-14:50

Effect of Ta addition on the properties of TiAlTaN coating

Hongfei SHANG, Tianmin SHAO

*Tsinghua University, China*

14:50-15:10

Nano-impact testing to compare the fatigue performance of multilayered coatings

Mayank ANAND<sup>1</sup>, Richard COOK<sup>2</sup>, Ignacio TUDELA<sup>1</sup>, Rolandas VERBICKAS<sup>1</sup>, Yi ZHANG<sup>1</sup><sup>1</sup>Daido Metal Co. Ltd - European Technical Centre, United Kingdom; <sup>2</sup>National Centre for Advanced Tribology at Southampton (nCATS), England

15:10-15:30

Analysis of three-dimensional thermo-mechanical contact of multilayered materials

Haibo ZHANG, Wenzhong WANG, Ziqiang ZHAO

*Beijing Institute of Technology, China*

15:30-15:50

Coffee Break

**Room 203A****Track 2: Wear & Surface Engineering Coatings XI**Chair: Wen YUE, *China University of Geosciences (Beijing), China*

15:50-16:10

Tribocorrosion behavior of Al<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub> multilayer thin films produced by atomic layer depositionPolyana ALVES RAD<sup>1,2</sup>, Giorgio ERNESTO TESTONI<sup>1,2</sup>, Rodrigo SÁVIO PESSOA<sup>1,2</sup>, Homero SANTIAGO MACIEL<sup>1,2</sup>, Luis AUGUSTO SOUSA MARQUES DA ROCHA<sup>3,4</sup>, Lucia VIEIRA<sup>1,2</sup><sup>1</sup>Instituto Tecnológico de Aeronáutica, Brasil; <sup>2</sup>Universidade do vale do Paraíba Brazil; <sup>3</sup>UNESP Univ. Estadual Paulista, Brazil; <sup>4</sup>Centre for Mechanical and Materials Technologies, Portugal

16:10-16:30

Tribocorrosion behavior of DLC film on metal alloys

Lucia VIEIRA, L.O PAULA, P. A RAD<sup>1</sup>*Instituto Tecnológico de Aeronáutica, Brazil*

16:30-16:50

Stress evolution in DLC and Cr monolayer and DLC /Cr multilayer films with variable layer thickness

Junjun WANG<sup>1,2</sup>, Haoran HE<sup>1</sup>, Weijiu HUANG<sup>1,2</sup>, Linqing WANG<sup>1</sup><sup>1</sup>Chongqing University of Technology, China; <sup>2</sup>Chongqing Collaborative Innovation Center for Brake Tribological Materials, China

**16:50-17:10**

Numerical analysis of exponential type hard gradient coating in elastic line contact

Tingjian WANG<sup>1,2</sup>, Guoen MA<sup>2</sup>, Xinxin MA<sup>2,3</sup>, Yanshuang WANG<sup>1</sup>, Liqin WANG<sup>2,3</sup>

<sup>1</sup>Tianjin University of Technology and Education, China; <sup>2</sup>AECC Harbin Bearing, China; <sup>3</sup>Harbin Institute of Technology, China

**17:10-17:30**

Molecular dynamics simulation of nanoscratching on different interface Cu/Ni multilayer films

Rui LI, Teng LIU, Xi LI, Xiang CHEN

Chongqing University of Posts and Telecommunications, China

**17:30-17:50**

Tribological properties of silver containing at elevated temperatures and wear resistance by laminar coating

Ameet KUMAR, Jianliang LI

Nanjing University of Science and Technology, China

**Room 203C**

**Track3: Lubrication and Lubricants**  
**Liquid Lubricants-III**

**Chair: Stephen HSU, George Washington University, USA**

**10:10-10:40 Keynote**

Lubrication next 50 years

Roland LARSSON

Lulea University of Technology, Sweden

**10:40-11:00**

Advanced fuel efficient low viscosity lubricants

Stephen HSU<sup>1</sup>, Xiangyu GE<sup>1</sup>, Gefei WU<sup>1,2</sup>

<sup>1</sup>George Washington University, USA; <sup>2</sup>Valvoline LLC, USA

**11:00-11:20**

Measurement of shape of nm-sliding gaps by using ellipsometric microscopy

Kenji FUKUZAWA, Yusuke SASAO, Shintaro ITOH, Hedong ZHANG

Nagoya University, Japan

**11:20-11:40**

In situ micro-FTIR spectroscopic observation on shear-induced molecular orientation of carboxylic acids

Renguo LU<sup>1</sup>, Shigeyuki MORI<sup>2</sup>, Hiroshi TANI<sup>1</sup>, Norio TAGAWA<sup>1</sup>, Shinji KOGANEZA WA<sup>1</sup>

<sup>1</sup>Kansai University, Japan; <sup>2</sup>Iwate University, Japan

**11:40-12:00**

Migration of liquid lubricants on a radial grooved surface

Qingwen DAI<sup>1</sup>, M. KHONSARI<sup>2</sup>, Wei HUANG<sup>1</sup>, Xiaolei WANG<sup>1</sup>

<sup>1</sup>Nanjing University of Aeronautics and Astronautics, China; <sup>2</sup>Louisiana State University, USA

**12:00-12:20**

How to effectively improve the tribological performance of liquid lubricant under space environment: from onefold lubrication to synergistic lubrication

Xiaoqiang FAN

Southwest Jiaotong University, China

**12:20-13:30**

Lunch

**Room 203C**

**Track3: Lubrication and Lubricants**  
**Liquid Lubricants IV**

**Chair: Masabumi MASUKO, Tokyo Institute of Technology, Japan**

**13:30-14:00 Keynote**

Friction Characteristic and Tribofilm Formation of Zinc dialkyldithiophosphate-formulated Lubricating Oils

Masabumi MASUKO

Tokyo Institute of Technology, Japan

**14:00-14:25 Invited**

Inkjet based droplet on demand lubrication system for EHL contacts

C.H. VENNER

University of Twente, Netherland

**14:25-14:45**

Novel injectable biolubricants mimicking supramolecular complex effectively restore the lubrication of cartilage by assembling behavior

Renjian XIE<sup>1</sup>, Hang YAO<sup>1,2</sup>, Sa LIU<sup>1,2</sup>, Li REN<sup>1,2</sup>, Yingjun WANG<sup>1,2</sup>, Dongan WANG<sup>3</sup>

<sup>1</sup>South China University of Technology; <sup>2</sup>National Engineering Research Center for Tissue Restoration and Reconstruction; <sup>3</sup>Nanyang Technological University, Singapore

**14:45-15:05**

Anti-spreading behavior of 1,3-diketone oils for precision lubrication

Ke LI, Xiping YAN, Deshuang LIU

Wuhan University of Technology, China

**15:05-15:25**

Lubrication with aqueous solution of polyoxyethylene with castor oil

Chaohui ZHANG, Kuankuan LI, Jianguo HE, Zhide LU

Beijing Jiaotong University, China

**15:30-15:50**

Coffee Break

**Room 203C**

**Track3: Lubrication and Lubricants**  
**Grease**

**Chair: Chenhui ZHANG, Tsinghua University, China**

**15:50-16:10**

The effect of lubricant composition upon film thickness in grease-lubricated EHD contacts subjected to vibrations

Xingnan ZHANG, Romeo GLOVNEA

University of Sussex, UK

**16:10-16:30**

The influence of mechanical degradation on grease life

Hong CHEN, Jianping LIU

Shandong University of Technology, China

**16:30-16:50**

Grease performance in blade bearings for wind turbine applications – experimental results of scaled tests

Fabian SCHWACK<sup>1</sup>, Norbert BADER<sup>1</sup>, Fabian HALMOS<sup>2</sup>, Gerhard POLL<sup>1</sup>

<sup>1</sup>Institute of Machine Design and Tribology, Germany; <sup>2</sup>IMO GmbH & Co. KG, Germany



**16:50-17:10****Behaviour of grease-lubricated EHD contacts under variable loading**

Romeo GLOVNEA, Xingnan ZHANG

*University of Sussex, UK***17:10-17:30****Experimental study on flow properties of greases with different thickeners**Wataru MORI<sup>1</sup>, Joichi SUGIMURA<sup>1</sup>, Hiroyoshi TANAKA<sup>1</sup>, Kazumi SAKAI<sup>2</sup>, Yuji SHITARA<sup>2</sup><sup>1</sup>*Kyushu University, Japan;* <sup>2</sup>*JX Nippon Oil & Energy Corporation, Japan***17:30-17:50****Visualization of the grease flow velocity distribution in a rotating bearing using fluorescent particles**

Tomohiko HARUYAMA, Naoki SAWADA, Kouta NANRI

*Jtekt Corporation, Japan***17:50-18:10****Study into structural impact of novel calcium complex grease delivering high temperature performance**

Kazuya WATANABE, Keji TANAKA, Eiji NAGATOMI

*Showa Shell Sekiyu K.K., Japan***Room 305A****Track3: Lubrication and Lubricants****Ionic Liquids****Chair: Lei LIU, Southeast University, China****10:10-10:30****Nanotribology study of ionic liquids as lubricant additives for alumina surfaces**

Hua LI, Stephen COWIE, Rob ATKIN

*University of Newcastle, Australia***10:30-10:50****Study of the tribological properties of in situ synthesized ionic liquids as lubricants additives in mild wear**Shuyan YANG<sup>1</sup>, Janet WONG<sup>2</sup>, Feng ZHOU<sup>3</sup>, Feng GUO<sup>1</sup><sup>1</sup>*Qingdao University of Technology, China;* <sup>2</sup>*Imperial College London, UK;*<sup>3</sup>*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China***10:50-11:10****Tribotronic control of friction in oil-based lubricants with ionic liquid additives**Peter COOPER<sup>1</sup>, Hua LI<sup>1</sup>, Mark W RUTLAND<sup>2</sup>, Grant B WEBBER<sup>1</sup>, Rob ATKIN<sup>1</sup><sup>1</sup>*University of Newcastle, Australia;* <sup>2</sup>*KTH Royal Institute of Technology, Sweden***11:10-11:30****Tribological property of cyano-based ionic liquids under various environment**Shouhei KAWADA<sup>1</sup>, Watanabe SEIYA<sup>1</sup>, Shinya SASAKI<sup>2</sup><sup>1</sup>*Graduate School of Tokyo University of Science, Japan;* <sup>2</sup>*Tokyo University of Science, Japan***11:30-11:50****Novel green lubricants: strengthened lignin-amino acid bio-ionic liquids interaction via reciprocal hydrogen bonding**Liwen MU<sup>1,2</sup>, Jiahua ZHU<sup>2</sup>, Yijun SHI<sup>1</sup><sup>1</sup>*Lulea University of Technology, Sweden;* <sup>2</sup>*The university of Akron, USA***11:50-12:10****Ionic liquids from 2-mercaptobenzothiazole: noncorrosive lubricants for steel/bronze contact**Yi LI<sup>1,2</sup>, Songwei ZHANG<sup>1</sup>, Litian HU<sup>2</sup><sup>1</sup>*Lanzhou Institute of Chemical physics, Chinese Academy of Sciences, China;*<sup>2</sup>*University of Chinese Academy of Sciences, China***12:10-12:30****Solvent-free ionic nanofluids with excellent lubricating performance**

Yuxia GUO

*Lanzhou Institute of Chemical physics, Chinese academy of sciences, China***12:30-13:30****Lunch****Room 305C****Track4: Biotribology & Biomimetics****Organs & Tissues-II: Skin****Chair: Hongyu ZHANG, Tsinghua University, Chair****10:10-10:40 Keynote****Perception and skin tribology: psychophysics and nanophysics**

Mark RUTLAND

*Department of Chemistry, Surface and Corrosion Science, Royal Institute of Technology, Sweden***10:40-11:05 Invited****Tribological interaction between the textile fabric and human skin**

Hassan ZAHOUANI, Mehdi DJEGHLOUL, Roberto VARGIOLU, Cyril PAILLER-MATTEI

*Laboratoire de Tribologie et Dynamique des SYstèmes - Université de Lyon - ENISE - ECL - ENTPE, France***11:05-11:25****Factors affecting friction behavior between laparoscopic grasper and large intestine**

Qingyuan YU, Chengmo CAI, Wei LI, Zhongrong ZHOU

*Tribology Research Institute, Southwest Jiaotong University, China***11:25-11:45****Skin tribology: the abrasion of calluses**Hassan ZAHOUANI<sup>1</sup>, Roberto VARGIOLU<sup>1</sup>, Cyril PAILLER-MATTEI<sup>1</sup>, Sylvain DELIGNY<sup>3</sup><sup>1</sup>*University of Lyon, France;* <sup>2</sup>*LTDS- UMR CNRS 5513, France;* <sup>3</sup>*BABYLIS France***11:45-13:30****Lunch****Room 305C****Track4: Biotribology & Biomimetics****Organs & Tissues III****Chair: Hassan ZAHOUANI, Laboratoire de Tribologie et Dynamique des SYstèmes - Université de Lyon - ENISE - ECL - ENTPE, France****13:30-13:50****The Tribology of Hair and its Control**

Mark RUTLAND

*Department of Chemistry, Surface and Corrosion Science, Royal Institute of Technology, Sweden*

**13:50-14:10**

Study on the frictional performance of surgical needle/suture interacting with soft tissue by using a newly developed penetration friction apparatus (PFA)

Gangqiang ZHANG<sup>1,2,3</sup>, Tianhui REN<sup>3</sup>, Walter LELLE<sup>2</sup>, Erik DE VRIES<sup>2</sup>, Xiangqiong ZENG<sup>1,2</sup>, Emile van der HEIDE<sup>2,4</sup>

<sup>1</sup>Chinese Academy of Sciences, China; <sup>2</sup>University of Twente, Holand; <sup>3</sup>Shanghai Jiao Tong University, China; <sup>4</sup>TU Delft, Holand

**14:10-14:30**

Investigation on the mouth-feel and frictional behavior of typical drinks under the oral environment

Shanhua QIAN, Di WANG  
Jiangnan University, China

**14:30-14:50**

Development of an ex vivo tongue-enamel friction model to mimic dry mouth and to compare saliva substitutes

Jeroen VINKE<sup>1</sup>, Hans J. KAPER<sup>1</sup>, Arjan VISSINK<sup>2</sup>, Prashant K. SHARMA<sup>1</sup>

<sup>1</sup>Department of Biomedical Engineering, University of Groningen and University Medical Center Groningen, Holand; <sup>2</sup>Department of Oral Maxillofacial Surgery, University of Groningen and University Medical Center Groningen, Holand

**14:50-15:10**

Applying Tribology to Understand Food Oral Processing

Kartik PONDICHERRY, Charlotte REPPICH, Florian RUMMEL  
Anton Paar GmbH, Austria

**15:10-15:30**

Friction behavior of esophageal internal surface under different liquid mediums

Chengxiong LIN, Wei LI  
Tribology Research Institute, Southwest Jiaotong University, China

**15:30-15:50**

Coffee Break

**Room 305C**

**Track4: Biotribology & Biomimetics  
Organs & Tissues IV**

**Chair: Mark RUTLAND**, Department of Chemistry, Surface and Corrosion Science, Royal Institute of Technology, Sweden

**15:50-16:10**

Study on tactile perception evoked by skin friction

Si CHEN<sup>1</sup>, Shirong GE<sup>2</sup>  
<sup>1</sup>Jiangsu University, China; <sup>2</sup>China University of Mining and Technology, China

**16:10-16:30**

The friction effects in the stick slip phenomena of the human skin

Andrei TUDOR, Kussay SUBHI, Andrei CALIN, Haider WAHAD, Nicolae STOICA  
The Polytechnic University of Bucharest, Romania

**16:30-16:50**

Development of low friction facial tissue paper

Kei SHIBATA<sup>1</sup>, Shohei MATSUMURA<sup>1</sup>, Naoki YAMAI<sup>1</sup>, Takeshi YAMAGUCHI<sup>1</sup>, Hidenori OROZU<sup>2</sup>, Shuta ASUI<sup>2</sup>, Kazuo HOKKIRIGAWA<sup>1</sup>  
<sup>1</sup>Tohoku University, Japan; <sup>2</sup>Daio Paper Corporation, Japan

**16:50-17:10**

Friction behaviour and tactile stimulation: friction and touch and feel of writing

Marc MASEN, Aham ROCHAS  
Imperial College London, England

**17:10-17:30**

Tactile friction of Fischer - Tropsch wax emulsion with liquid crystal structure

Ye WANG  
Shanghai Advanced Research Institute, Chinese Academy of Sciences, China

**17:30-17:50**

Friction characteristics of a finger pad slid on the solid surfaces coated with organic molecular layer with different pattern intervals and width

Yimeng LIU, Rina YANAGISAWA, Saiko AOKI  
Tokyo Institute of Technology, Japan

**17:50-18:10**

Adhesion anisotropy and controllability of attachment between grooved adhesion surfaces

Zheyu LIU, Dashuai TAO, Hongyu LU, Yonggang MENG, Yu TIAN  
The State Key Laboratory of Tribology, Tsinghua University, China

**Room 305E**

**Track6: Engine and Transmission Tribology  
Engine IV**

**Chair: Bin ZHAO**, Harbin Engineering University

**10:10-10:30**

Enhanced piston-liner friction reduction through surface texturing

Tom REDDYHOFF, Sorin VLADESCU  
Imperial College London, UK

**10:30-10:50**

Friction control by surface texture in tribosystem with Al-alloy and cast iron in MoDTC oil

Masahiro TAGO, Daiki SUZUKI, Koshi ADACHI  
Tohoku University, Japan

**10:50-11:10**

Cooperative control of friction and oil consumption by combining surface roughness and micro-textures on cylinder bore

Bo XU, Bifeng YIN, Huiqin ZHOU  
Jiangsu University, China

**11:10-11:30**

Impact of honing, engine oil and crankshaft offset on the friction of the piston assembly of a diesel engine

Dirk BARTEL, Matthias SCHORGEL  
Otto von Guericke University Magdeburg, Germany

**11:30-11:50**

The effect tappet geometry on cam tappet durability

Quanbao ZHOU  
Changan UK R&D Centre, UK

**11:50-12:10**

A combined experimental and modelling investigation of laser micro-textured surfaces with focus on piston ring - cylinder liner contacts

Francisco PROFITO<sup>1,2</sup>, Sorin-Cristian VLĂDESCU<sup>2</sup>, Thomas REDDYHOFF<sup>2</sup>, Daniele DINI<sup>2</sup>

<sup>1</sup>Polytechnic School of the University of São Paulo, Brazil; <sup>2</sup>Imperial College London, UK

**12:10-13:30**

Lunch

**Room 305E****Track6: Engine and Transmission Tribology****Engine V**

Chair: Quanbao ZHOU, Changan UK R&D Centre, UK

**13:30-13:50**

EHL simulation of the timing chain drive

Stefan THIELEN, Balázs MAGYAR, Markus LÖWENSTEIN, Andre BECKER, Bernd SAUER

University of Kaiserslautern, Germany

**13:50-14:10**

Effect of film strength on roller slip in engine valve train

Riaz MUFTI, Muhammad KHURRAM, Usman BHUTTA, Naqash AFZAL, Usman ABDULLAH, Samiur RAHMAN, Fazal BADSHAH, Zafar RANA

National University of Sciences and Technology, Pakistan

**14:10-14:30**

Experimental and analytical wear investigations of chain joint wear

Andre BECKER, Bernd SAUER

University of Kaiserslautern, Germany

**14:30-14:50**

Research trend of engine tribology by Japanese university cooperation

Yuji MIHARA<sup>1</sup>, Hatsuhiko USAMI<sup>2</sup>, Masabumi MASUKO<sup>3</sup>, Kazuyuki YAGI<sup>4</sup>, Masayuki OCHIAI<sup>5</sup>, Yasuhiro DAISHO<sup>6</sup>

<sup>1</sup>Tokyo City University, Japan; <sup>2</sup>Meijo University, Japan; <sup>3</sup>Tokyo Institute of Technology, Japan; <sup>4</sup>Kyushu University, Japan; <sup>5</sup>Tokai University, Japan;

<sup>6</sup>Waseda University, Japan

**14:50-15:10**

Application of big data base and cloud computing in engine component tribology

Chao ZHANG

Shanghai University, China

**15:10-15:30**

Numerical analysis of the lubrication performance of piston ring-cylinder liner tribo-systems of low speed 2-stroke diesel engine

Tongyang LI, Xiqun LU, Fuzhan HUANG, Xiuyi LV, Shuaiyu ZHOU

Harbin Engineering University, China

**15:30-15:50**

Coffee Break

**Room 305E****Track6: Engine and Transmission Tribology****Gas Bearings**

Chair: Pyung HWANG, Yeungnam University, Korea

**15:50-16:10**

Balance mechanism and characteristic analysis of the gas thrust bearing for the micro-gravity platform

Yi ZHANG, Guoyuan ZHANG, Guozhong CHEN

Xidian University, China

**16:10-16:30**

Dynamic model of a gas thrust bearing: experimental tests and numerical model

Colombo FEDERICO

Politecnico di Torino, Italy

**16:30-16:50**

Modeling of a multi-layer foil gas thrust bearing and its load carrying mechanism study

Jianjun DU, Changlin LI

Harbin Institute of Technology, China

**16:50-17:10**

Analysis of tilt stiffness and damping coefficients of partial arc annular-thrust aerostatic porous journal bearings

Pyung HWANG<sup>1</sup>, Polina V. KHAN<sup>2</sup>

<sup>1</sup>Yeungnam University, South Korea; <sup>2</sup>Melentiev Energy Systems Institute, South Korea

**17:10-17:30**

Static and dynamic characteristics of downsized aerostatic circular thrust bearing with multiple feed holes

Akihito KONDO<sup>1</sup>, Masaaki MIYATAKE<sup>1</sup>, Shigeka YOSHIMOTO<sup>1</sup>, Tadeusz STOLARSKI<sup>2</sup>

<sup>1</sup>Tokyo University of Science, Japan; <sup>2</sup>Brunel University London, UK

**17:30-17:50**

A novel non-contact squeeze film air journal bearing based on near field acoustic levitation

Minghui SHI, Tao GONG, Kai FENG

State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, China

**17:50-18:10**

Performance measurement of gas foil bearing with high structural stiffness and damping under varying bearing loads on a rotordynamic test rig

Tao ZHANG, Xueyuan ZHAO, Kai FENG

State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, China

**Room 307****Track6: Engine and Transmission Tribology****Sealing III**

Chair: Jean BOUYER, Institut Pprime, University of Poitiers, France

**10:10-10:30**

Effect of the circumferential distance between seal fingers on the formation of hydrodynamic film in finger seal

Zengfeng GAO, Tong ZHAO, Yanchao ZHANG, Yahui CUI, Kai LIU

Xi'an University of Technology, China

**10:30-10:50**

Influence of wall slip effect on leakage rate of hydrodynamic pressure finger seal

Yanchao ZHANG, Pengfei DU, Tong ZHAO, Yahui CUI, Kai LIU

Xi'an University Of Technology, China



**10:50-11:10****TEHD analysis of a mechanical seals with tilted surface**

Xiao YANG, Xudong PENG, Xiangkai MENG, Yuming WANG

*Zhejiang University of Technology, China***11:10-11:30****Theoretical and experimental research of steady performance of a through-slot combined groove dry gas seal**

Jinbo JIANG, Cong ZONG, Xudong PENG, Yuan CHEN, Jiyun LI

*Zhejiang University of Technology, China***11:30-11:50****Thermo-elastohydrodynamic lubrication simulation of X-ring hydraulic seals**

Bingqing WANG, Xudong PENG, Xiangkai MENG, Jiyun LI

*Zhejiang University of Technology, China***11:50-12:10****Experimental and theoretical analysis of small diameter brush seals**

Mihai ARGHIR, Lilas DEVILLE

*Université de Poitiers, France***12:10-13:30****Lunch****Room 307****Track6: Engine and Transmission Tribology  
Sealing IV****Chair: Dr. Noel BRUNETIERE, Institut Pprime, University of Poitiers, France****13:30-13:50****Experimental study of friction in pneumatic seals**Abdelhak AZZI<sup>1</sup>, Abdelghani MAOUI<sup>2</sup>, Didier FRIBOURG<sup>2</sup>, Aurelian FATU<sup>1</sup>,  
Dominique SOUCHET<sup>1</sup><sup>1</sup>University of Poitiers, France; <sup>2</sup>CETIM Pôle Technologies de l'Étanchéité, France**13:50-14:10****Performance characteristics of viscoseals in laminar flow regime**

Mohamed JARRAY, Dominique SOUCHET, Aurelian FATU

*University of Poitiers, France***14:10-14:30****Effects of subsea operating conditions on mechanical face seal performance**Shifeng WU<sup>1</sup>, Ray CLARK<sup>1</sup>, Henri AZIBERT<sup>2</sup><sup>1</sup>A. W. Chesterton Co. USA; <sup>2</sup>Fluid Sealing Association, USA**Room 307****Track6: Engine and Transmission Tribology  
Tribology Materials I****Chair: Simon TUNG, TUNG Innovation Technology Consulting, Inc.****15:50-16:10****Friction and wear behaviors of the modified nylon self-lubricating rod end spherical plain bearings**Ming QIU<sup>1,2</sup>, Dawei ZHOU<sup>1</sup>, Xia LIANG<sup>1</sup>, Xiaoxu PANG<sup>1</sup><sup>1</sup>Henan University of Science and Technology China; <sup>2</sup>Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, China**16:10-16:30****Tribological compatibility of some selected Pb-free engine bearing materials with different engine oil formulations**

Daniel Woldegebriel GEBRETSADIK, Jens HARDELL, Braham PRAKASH

*Luleå University of Technology, Sweden***16:30-16:50****Study on tribological properties of novel biomimetic material for water-lubricated stern tube bearing under the simulated marine environment**

Zhiwei GUO, Chengqing YUAN, Song JIANG, Zongrong YANG

*Wuhan University of Technology, China***16:50-17:10****Development of fluid for chain type CVT**Toshiaki IWAI<sup>1</sup>, Mitsugu KUDO<sup>1</sup>, Keiichi NARITA<sup>1</sup>, Masato OGAWA<sup>2</sup><sup>1</sup>Idemitsu Kosan, Japan; <sup>2</sup>Subaru, Japan**17:10-17:30****Tribological behaviors of porous polyimide containing lubrication oil**Gang ZHOU<sup>1,2</sup>, Fengbin LIU<sup>3</sup>, Shaohua ZHANG<sup>1,2</sup>, Ani ZHANG<sup>1,2</sup>, Tao ZHANG<sup>1,2</sup><sup>1</sup>Beijing Institute of Control Engineering, China; <sup>2</sup>Beijing Key Laboratory of Long-

life Technology of Precise Rotation and Transmission Mechanisms, China;

<sup>3</sup>North China University of Technology, China**17:30-17:50****Tribological performance of high performance polymers in dry conditions**Janet WONG<sup>1</sup>, Annelise JEAN-FULCRAND<sup>1</sup>, Marc MASEN<sup>1</sup>, Tim BREMNER<sup>1,2</sup><sup>1</sup>Imperial College London, UK; <sup>2</sup>Hoerbiger Corporation of America, Inc., USA**17:50-18:10****Preparation and performances of oil solubility BaSO<sub>4</sub>@SiO<sub>2</sub> nanoparticles as additive in oil-based drilling fluid**

Lu CUI, Shengmao ZHANG, Pingyu ZHANG

*Henan University, China***Room 308****Track7: Industrial Tribo-systems  
Energy Equipment I****Chair: Yongzhen ZHANG, Henan University Of Science And Technology, China****14:00-14:20****Investigation of grease behavior on the metal seal surface under high pressure gas tight condition by in-situ observations**

Keita INOSE, Masaaki SUGINO, Kunio GOTO

*Nippon Steel & Sumitomo Metal Corporation, Japan***14:20-14:40****Sliding friction behaviors of shale rock-silica contacts under guar gum aqueous solution lubrication in hydraulic fracturing**

Huijie ZHANG, Shuhai LIU, Huaping XIAO

*China University of Petroleum-Beijing, China***14:40-15:00****Friction and wear during wellbore sands cleanout process**

Yanbao GUO, Liu YANG, Deguo WANG, Shuhai LIU

*China University of Petroleum, China*

15:00-15:20

Evolution of contact between rubber and rigid pipe during experiment of pipe-laying operation

Yongjie ZHOU, Deguo WANG, Yanbao GUO, Shuhai LIU  
*China University of Petroleum, China*

15:20-15:50

Coffee Break

## Room 308

Track7: Industrial Tribo-systems  
Energy Equipment II

Chair: Wei CHEN, Xi'an Jiaotong University, China

15:50-16:10

Measurement of roller load and lubricant film thickness in a wind turbine high-speed shaft bearing in the field

Gary NICHOLAS, Rob DWYER JOYCE  
*The University of Sheffield, United Kingdom*

16:10-16:30

Cool Tribology: polymer and composites in low temperature sliding

Iestyn STEAD<sup>1</sup>, David ECKOLD<sup>1</sup>, Henry CLARKE<sup>2</sup>, Daniel FENNELL<sup>2</sup>, Athanasios TSOLAKIS<sup>1</sup>, Karl DEARN<sup>1</sup>  
<sup>1</sup>University of Birmingham, United Kingdom; <sup>2</sup>Dearman Engine Company, United Kingdom

16:30-16:50

Reproduction of white etching crack under rolling contact loading on thrust bearing and two-disc test rigs

Francisco GUTIERREZ GUZMAN, Georg JACOBS, Gero BURGHARDT  
*RWTH Aachen University, Germany*

16:50-17:10

Flow-induced vibration simulation of steam generator U-tubes based on OpenFOAM

Xiao YE, Run DU, Xiaoyu ZHANG, Pingdi REN  
*Southwest Jiaotong University, China*

## Room 305A

Track7: Industrial Tribo-systems  
Heavy Machinery I

Chair: Wei PU, Sichuan University, China

13:30-13:50

A combined numerical and experimental investigation of disengaged wet clutch system power loss

Michael LEIGHTON<sup>1</sup>, James DAVIES<sup>1</sup>, Nicholas MORRIS<sup>1</sup>, Gareth TRIMMER<sup>2</sup>, Paul KING<sup>1</sup>, Homer RAHNEJAT<sup>1</sup>  
<sup>1</sup>Loughborough University, United Kingdom; <sup>2</sup>J. C. Bamford Excavators, United Kingdom

13:50-14:10

Development of analysis method to estimate dynamic characteristics of tilting pad journal bearing

Tomoaki YAMASHITA, Makoto HEMMI  
*Hitachi, Ltd., Research & Development Group, Japan*

14:10-14:30

Measurement of lubrication film thickness of tilting-pad thrust bearing by ultrasonic methods

Kai ZHANG, Pan DOU, Tonghai WU  
*Xi'an Jiaotong University, China*

14:30-14:50

Dynamic analysis of a multi-fulcrum slender shafting

Zhiqiang ZHANG, Liqin WANG, Chuanwei ZHANG  
*Harbin Institute of Technology, China*

14:50-15:10

Research on dynamic frictional contact behavior of friction hoist's liner under different working conditions

Cunao Feng, Dekun ZHANG, Yongbo GUO, Yuan LIU  
*China University of Mining and Technology, China*

15:10-15:30

Experimental study on tribological property of braking mechanism for anti-skid device of friction hoist

Qian WANG<sup>1</sup>, Xiaofang XING<sup>1</sup>, Xingming XIAO<sup>1,2</sup>, Chuanhui HUANG<sup>1</sup>  
<sup>1</sup>Xuzhou University of Technology, China; <sup>2</sup>China University of Mining and Technology, China

15:30-15:50

Coffee Break

## Room 305A

Track7: Industrial Tribo-systems  
Heavy Machinery II

Chair: Jiadao WANG, State Key Laboratory of Tribology, China

15:50-16:10

Friction-induced deformation of small caliber projectile during engraving process

Bin WU, Bangjun LIU, Jing ZHENG, Zhiqiang ZOU, Liming HU, Kun JIANG, Xiaolei CHEN, Kaishuan ZHANG, Ronggang CHEN  
*Army Academy Officer, China*

16:10-16:30

Tribological behaviour of coated spur gear pairs with tooth surface roughness

Huaiju LIU<sup>1</sup>, Heli LIU<sup>1</sup>, Caichao ZHU<sup>1</sup>, Ye ZHOU<sup>1</sup>, Jinyuan TANG<sup>2</sup>  
<sup>1</sup>Chongqing University, China; <sup>2</sup>Central South University, China

16:30-16:50

Dynamic internal contact and slip characteristics of bent hoisting rope during lifting

Jun ZHANG, Dagang WANG, Dekun ZHANG, Shirong GE  
*China University of Mining and Technology, China*

16:50-17:10

Dynamic characteristics of mine hoist braking torque during emergency braking in km deep mine

Dagang WANG, Jun ZHANG, Dekun ZHANG, Shirong GE  
*China University of Mining and Technology, China*

17:10-17:30

Viscoelastic behavior of conveyor belts and roller bearings seismic isolators

Nicola MENGA, Luciano AFFERRANTE, Giuseppe CARBONE, Giuseppe P. DEMELIO  
*Politecnico di Bari, Italy*



**17:30-17:50****Sliding friction and wear of liner and grinding ball in iron ore ball mill under different conditions**

Yuxing PENG<sup>1,2</sup>, Xu NI<sup>1,2</sup>, Zhencai ZHU<sup>1,2</sup>, Shengyong ZOU<sup>4,3</sup>, Tongqing LI<sup>1,2</sup>, Songyong LIU<sup>1,2</sup>, Lala ZHAO<sup>1,2</sup>, Jie XU<sup>5</sup>

<sup>1</sup>China University of Mining and Technology, China; <sup>2</sup>China University of Mining and Technology, China; <sup>3</sup>Luoyang Mining Machinery Engineering Design Institute Co. Ltd, China; <sup>4</sup>State Key Laboratory of Mining Heavy Equipment, China; <sup>5</sup>China University of Mining and Technology, China

**Room 203B****Track9: Tribology in future****Wear and Friction Control**

Chair: David BURRIS, University of Delaware, USA

**10:10-10:35 Invited****Emergence of surface roughness in plastic deformation**

Lars PASTEWKA, Adam HINKLE, Richard JANA

Karlsruhe Institute of Technology

**10:35-11:00 Invited****Examples of third body formation in sliding metal surfaces**

Martin DIENWIEBEL

Karlsruhe Institute of Technology, Germany; Fraunhofer Institute for Mechanics of Materials, Germany

**11:00-11:20****Measurements of 3D friction forces and of surface potential-controlled friction**

Kai KRISTIANSEN<sup>1</sup>, Xavier BANQUY<sup>2</sup>, Hongbo ZENG<sup>3</sup>, Suzanne GIASSEON<sup>2</sup>, Markus VALTINER<sup>4</sup>, Jacob ISRAELACHVILI<sup>1</sup>

<sup>1</sup>University of California Santa Barbara, USA; <sup>2</sup>Universite de Montreal, Canada; <sup>3</sup>University of Alberta, Canada; <sup>4</sup>Max-Planck-Institut fur Eisenforschung, Germany

**11:20-11:40****Multi-objective design optimization for zero-leakage and low-friction mechanical seals with surface texturing**

Yuichiro TOKUNAGA<sup>1</sup>, Hideyuki INOUE<sup>1</sup>, Joichi SUGIMURA<sup>2</sup>

<sup>1</sup>Kyushu University, Japan; <sup>2</sup>Kyushu University, Japan

**11:40-12:00****A review on adhesion of wheel/rail interface**

Wenjian WANG, Lubing SHI, Yi ZHU, Qiyue LIU

Zhejiang University, China

**12:00-13:30**

Lunch

**Room 203B****Track9: Tribology in future****Carbon-based Materials**

Chair: Lars PASTEWKA, Karlsruhe Institute of Technology

**13:30-13:55 Invited****Hard yet tough carbon-based coatings towards high-tech applications**

Liping WANG<sup>1,2</sup>

<sup>1</sup>Key Laboratory of Marine Materials and Related Technologies, China; <sup>2</sup>Key Laboratory of Marine Materials and Protective, China

**13:55-14:20 Invited****Wear resistance of graphene: Interior vs. step edge**

Qunyang LI<sup>1</sup>, Yizhou QI<sup>1</sup>, Jun LIU<sup>2</sup>, Quanzhou YAO<sup>1</sup>, Ji ZHANG<sup>1</sup>, Yalin DONG<sup>2</sup>

<sup>1</sup>Tsinghua University, China; <sup>2</sup>University of Akron, USA

**14:20-14:45 Invited****Enhancement of friction-reducing effects of functionalized polymethacrylate-series polymer additives by combination with DLC coatings under elevated oil temperature condition**

Saiko AOKI, Daiki INOUE

Tokyo institute of technology, Japan

**14:45-15:05****Effect of UV/ozone treatment on the tribological properties of carbon microelectromechanical systems structures**

Shulan JIANG, Fangshang ZHONG, Linmao QIAN

Southwest Jiaotong University, China

**15:30-15:50**

Coffee Break

**Room 203B****Track9: Tribology in Future****Tribo-materials**

Chair: Yitian PENG, Donghua University, China

**15:50-16:10****Effects of moisture, oxygen and temperature on friction mechanism of MoS<sub>2</sub>: A molecular dynamics simulation**

Nian YIN<sup>1</sup>, Zhinan ZHANG<sup>1</sup>, Shuaihang PAN<sup>2</sup>, Sulin CHEN<sup>1</sup>, Bin SHEN<sup>1</sup>

<sup>1</sup>Shanghai Jiao Tong University, China; <sup>2</sup>University of California-Los Angeles, USA

**16:10-16:30****Microstructure and wear behavior of functionally graded Al-Si composite prepared by selective laser melting**

Nan KANG<sup>1</sup>, Zhongming REN<sup>2</sup>, Pierre CODDET<sup>1</sup>, Hanlin LIAO<sup>1</sup>, Christian CODDET<sup>1</sup>

<sup>1</sup>Université de Bourgogne, France; <sup>2</sup>Shanghai University, China

**16:30-16:50****Towards understanding of mechanical mixing using multilayer model alloys**

Martin DIENWIEBEL, Ebru CIHAN

Karlsruhe Institute of Technology, Germany

**16:50-17:10****Anisotropic flat nanoparticles with different sides sticky/slippy for self forming coatings**

Pavlo RUDENKO

TriboTEX, USA



## Room 201A

Track1: Science of Tribology  
Superlubricity I

Chair: Jean Miche MARTIN, *Laboratory of Tribology and System Dynamics LTDS, France*

08:30-08:55 **Invited**

Direct measurement of graphite-water interfacial energy

Quanshui ZHENG

*Tsinghua University, China*

## 08:55-09:15

Effect of sliding velocity on superlubricity degradation of DLC film

Yunhai LIU<sup>1</sup>, Lei CHEN<sup>1</sup>, Zhongyue CAO<sup>2</sup>, Bin ZHANG<sup>2</sup>, Junyan ZHANG<sup>1</sup>, Linmao QIAN<sup>1</sup>

<sup>1</sup>*Southwest Jiaotong University, China;* <sup>2</sup>*Lanzhou Institute of Chemical Physics, China*

## 09:15-09:35

Tribochemistry and superlubricity of tetrahedral amorphous carbon

Stefan MAKOWSKI<sup>1</sup>, Schaller Frank SCHALLER<sup>1</sup>, Volker WEHNACHT<sup>1</sup>, Michael BECKER<sup>2</sup>, Andreas LESON<sup>1</sup>

<sup>1</sup>*Fraunhofer Institute for Material and Beam Technology, Germany;*

<sup>2</sup>*Fraunhofer USA, Center for Coatings and Diamond Technologies, United States*

## 09:35-09:55

Anisotropy of peeling and superlubricity at graphene-formed interfaces – toward control of atomic-scale real contact area

Naruo SASAKI<sup>1</sup>, Takeshi NARTIA<sup>1</sup>, Shuya OHMUKI<sup>1</sup>, Kouji MIURA<sup>2</sup>

<sup>1</sup>*The University of Electro-Communications, Japan;* <sup>2</sup>*Aichi University of Education, Japan*

## 09:55-10:15

Atomic-scale analysis of tribo-induced interfacial nanostructures in superlubric amorphous carbon films

Xinchun CHEN<sup>1</sup>, Chenhui ZHANG<sup>1</sup>, Takahisa KATO<sup>2</sup>, Xin-an YANG<sup>3</sup>, Sudong WU<sup>4</sup>, Rong WANG<sup>1</sup>, Masataka NOSAKA<sup>2</sup>, Jianbin LUO<sup>1</sup>

<sup>1</sup>*Tsinghua University, China;* <sup>2</sup>*The University of Tokyo, Japan;* <sup>3</sup>*Institute of Physics, Chinese Academy of Sciences, China;* <sup>4</sup>*Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, China*

## 10:15-10:35

Coffee Break

## Room 201A

Track1: Science of Tribology  
Superlubricity II

Chair: Quanshui ZHENG, *Tsinghua University, China*

## 10:35-10:55

New insight into origin of macro-superlubricity of polyethylenimine / molybdenum disulphide films in dry environments

Prabakaran SARAVANAN, Joichi SUGIMURA, Tanaka HOROYOSHI

*International Institute for Carbon-Neutral Energy Research (I2CNER), Japan*

## 10:55-11:15

Superlubricity of segregated polymer brushes in water

Troels RON, Seunghwan LEE, Irakli JAVAKHISHVILI

*Technical University of Denmark, Denmark*

## 11:15-11:35

The effect of contact area on the ultra-low friction between the carbon nanotube and substrate

Kai ZHANG, Ming MA, Yingying ZHANG, Wen WANG, Songlin SHI, Quanshui ZHENG

*Tsinghua University, China*

## 12:00-13:30

Lunch

## Room 201A

Track1: Science of Tribology  
Superlubricity III

Chair: Tianbao MA, *Tsinghua University, China*

13:30-13:55 **Invited**

Impact of superlubricity on the Stribeck curve

Jean Miche MARTIN<sup>1</sup>, Qunfeng ZENG<sup>2</sup>, Maria Isabel DE BARROS BOUCHET<sup>1</sup>, Makoto KANO<sup>3</sup>

<sup>1</sup>*Laboratory of Tribology and System Dynamics LTDS, France;* <sup>2</sup>*Xi'an Jiaotong University, China;* <sup>3</sup>*Kanagawa Industrial Technology center, Japan*

## 13:55-14:15

Superlubricity achieved by aqueous hydroxyethyl cellulose in surface contact

Huichen ZHANG, Dezun SHENG, Xuelian QI

*Dalian Maritime University, China*

## 14:15-14:35

Ultralow friction of steel surfaces induced by a tribochemical running-in process using 1,3-Diketone lubricants

Shumin ZHANG<sup>1</sup>, Ke LI<sup>2,3</sup>, Deshuang LIU<sup>2,3</sup>, Chenhui ZHANG<sup>1</sup>, Xinpeng YAN<sup>2,3</sup>, Jianbin LUO<sup>1</sup>

<sup>1</sup>*State Key Laboratory of Tribology, China;* <sup>2</sup>*National Engineering Research Center for Water Transport Safety, China;* <sup>3</sup>*Intelligent Transport Systems Research Center, China*

## 14:35-14:55

AFM studies on the liquid superlubricity between silica surfaces achieved with surfactant micelles

Jinjin LI

*State Key Laboratory of Tribology, China*

## 14:55-15:15

Graphene nanoribbons and polymeric chains sliding on Au(111)

Ernst MEYER<sup>1</sup>, Remy PAWLAK<sup>1</sup>, Sara FREUND<sup>1</sup>, Urs GYSIN<sup>1</sup>, Thilo GLATZEL<sup>1</sup>, Alexis BARATOFF<sup>1</sup>, Res JOEHR<sup>1</sup>, Shigeki KAWAI<sup>2</sup>

<sup>1</sup>*University of Basel, Switzerland;* <sup>2</sup>*National Institute for Material Science (NIMS), Japan*

## 15:15-15:35

Critical length limiting superlow friction

Ming MA<sup>1</sup>, Andrea BENASSI<sup>2</sup>, Andrea VANOSSO<sup>3,4</sup>, Michael URBAKH<sup>5</sup>

<sup>1</sup>*Tsinghua University, China;* <sup>2</sup>*Empa, Swiss Federal Laboratories for Materials Science and Technology, Switzerland;* <sup>3</sup>*CNR-IOM Democritos National Simulation Center, Italy;* <sup>4</sup>*International School for Advanced Studies (SISSA), Italy;* <sup>5</sup>*Tel Aviv University, Israel*



**Room 201B****Track1: Science of Tribology  
Nanotribology IV**

Chair: Ming MA, Tsinghua University, China

**8:30-8:50**

Single asperity sliding: a multi-scale coupling analysis between discrete dislocation plasticity and crystal plasticity finite element method

Yilun XU, Diniele DINI, Daniel BALINT

Imperial College London, UK

**8:50-9:10**

Numerical simulation of shearing liquid bridge

Kentaro TANAKA, Katsumi IWAMOTO

Tokyo University of Marine Science and Technology, Japan

**9:10-9:30**

Exploring nano-scale friction involving textured surfaces via molecular dynamics simulations

Hualong YU<sup>1</sup>, Xia HU<sup>2</sup>, Chengjiao YU<sup>3</sup>, Qian WANG<sup>4</sup><sup>1</sup>China University of Petroleum-Beijing at Karamay, China; <sup>2</sup>KaramayVocational and Technical College, China; <sup>3</sup>Baker Hughes Inc, US;<sup>4</sup>Northwestern University, China**Room 311A****Track1: Science of Tribology  
Contact Mechanics IV**

Chair: Patrick WONG, City University of Hong Kong, China

**8:30-8:50**

Coating-substrate system with imperfect bonding interface: coupled dislocation-like and force-like conditions

Zhanjiang WANG<sup>1</sup>, Hao YU<sup>2</sup>, Qian WANG<sup>3,1</sup><sup>1</sup>Southwest Jiaotong University, China; <sup>2</sup>Chongqing University, China;<sup>3</sup>Northwestern University, China**8:50-9:10**

Elasto-plastic contact of materials containing double-layered inhomogeneities

Mengqi ZHANG<sup>1,2</sup>, Ning ZHAO<sup>1</sup>, Qinghua ZHOU<sup>3</sup>, Zhanjiang WANG<sup>4</sup>,  
Xiaoqing JIN<sup>4</sup>, Leon KEER<sup>2</sup>, Peter GLAWS<sup>5</sup>, Phil HEGEDUS<sup>5</sup>, Qian WANG<sup>2</sup><sup>1</sup>Northwestern Polytechnical University, China; <sup>2</sup>Northwestern University, China; <sup>3</sup>Sichuan University, China; <sup>4</sup>Chongqing University, China; <sup>5</sup>TimkenSteel, USA**9:10-9:30**

An explicit matrix solution for a three-dimensional elastic wedge under surface loadings

Wen WANG<sup>1</sup>, Zhiming ZHANG<sup>1</sup>, Liang GUO<sup>2</sup>, Patrick WONG<sup>2</sup><sup>1</sup>Shanghai University, China; <sup>2</sup>City University of Hong Kong, Hong Kong, China**9:30-9:50**

A numerical contact solver for adhesive contact between viscoelastic materials

Hualong YU<sup>1</sup>, Xia HU<sup>2</sup>, Qian WANG<sup>3</sup><sup>1</sup>China University of Petroleum-Beijing at Karamay, China; <sup>2</sup>KaramayVocational and Technical College, China; <sup>3</sup>Northwestern University, China**10:10-10:30**

Coffee Break

**Room 311A****Track1: Science of Tribology  
Contact Mechanics V**

Chair: Robert JACKSON, Auburn University, USA

**10:30-10:50**

Contact formation on soft patterned substrates: scale similarities in wetting and adhesion behaviours

Vincent LE HOUEROU<sup>1</sup>, Valentin HISLER<sup>1,2</sup>, Christian GAUTHIER<sup>1</sup>, Michel NARDIN<sup>2</sup>, Laurent VONNA<sup>2</sup><sup>1</sup>Institut Charles Sadron (I.C.S.), CNRS UPR 022 - Strasbourg, France; <sup>2</sup>Institut de Science des Matériaux de Mulhouse (IS2M) - CNRS UMR 7361, Mulhouse**10:50-11:10**

Analysis of heat partition and bulk temperature jump in sliding contact problem

Yuwei LIU<sup>1,3,2</sup>, Yong Hoon JIANG<sup>1,3,2</sup>, Ames Richard BARBER<sup>1,3,2</sup><sup>1</sup>China University of Mining & Technology, China; <sup>2</sup>University of Michigan, USA;<sup>3</sup>Yonsei University, South Korea**11:10-11:30**

Clumping criteria of vertical nanofibers on surfaces

Ming ZHOU

Guangxi University of Science and Technology, China

**11:30-11:50**

Peeling of elastic thin films from substrates of soft material

Nicola MENGA, Luciano AFFERRANTE, Giuseppe CARBONE, Giuseppe P. DEMELIO

Politecnico di Bari, Italy

**11:50-12:10**

Modeling and analysis of rough surface with arbitrary geometrical shape based on fractal theory

Yuchen DAI, Jianmeng HUANG

Fuzhou University, China

**Room 201D****Track 2: Wear & Surface Engineering  
Tribo-materials IV**

Chair: Nikolai MYSHKIN, Metal-Polymer Research Institute of Belarus National Academy of Sciences, Belarus

**8:30-8:50**

Design and Performances of Adaptive Lubricating Composites in a Wide Temperature Ranges

Junhong JIA, Gewen YI, Xiaochun FENG, Eryong LIU

Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China

**8:50-9:10**

Effect of Preparation Technology on Arc Erosion Resistance of MgO/Cu Contact Materials

Xiuhua GUO

Henan University of Science and Technology, China

**9:10-9:30**Spark Plasma Sintered WC-Ni-Cr Based Self-lubricating Composites with Addition of WS<sub>2</sub> Solid Lubricant

Bin WU

Tsinghua University, China



9:30-9:50

Dry sliding wear behavior of tri-ceramic reinforced copper based hybrid composites

Rekesh Kumar GAUTAM, Manvandra Kumar SINGH

Indian Institute of Technology (Banaras Hindu University) Varanasi, India

9:50-10:10

Successes in Synthesis of New Green Tribology Materials

Vladimir LEVCHENKO<sup>1</sup>, Vladimir MATVEENKO<sup>1</sup>, Iliya BUYANOVSKII<sup>2</sup>, Andrey BOLSHAKOV<sup>2</sup>

<sup>1</sup>Lomonosov Moscow State University, Russia; <sup>2</sup>Blagonravov Institute of Machine Science, Russia

10:10-10:30

Tribology of hard reinforced particles cold-sprayed coatings

Sylvie DESCARTES<sup>1</sup>, Richard CHROMIK<sup>2</sup>, Yinyin ZHANG<sup>3</sup>, Michael SHOCKLEY<sup>3</sup>

<sup>1</sup>INSA Lyon - LaMCoS, France; <sup>2</sup>McGill University, Canada; <sup>3</sup>NRC, Canada

10:30-10:50

Coffee Break

#### Room 201D

Track 2: Wear & Surface Engineering

Tribo-materials V

Chair: Sergey PANIN, ISPM SB RAS, Russia

10:50-11:10

High temperature tribological behaviors of microarc oxidation coatings on Ti-35Nb-9Zr alloy

Lin CHEN, Yao QU, Kejian WEI, Xiaoyue JIN, Bin LIAO, Wenbin XUE

Beijing Normal University, China

11:10-11:30

Impact of Fe-intermetallic compounds on the hardness and wear resistance performance of laser alloyed AISI 1015 steel

Olawale FATOBA<sup>1</sup>, Elizabeth MAKHATHA<sup>1</sup>, Esther AKINLABI<sup>1</sup>, Patricia POPOOLA<sup>2</sup>

<sup>1</sup>University of Johannesburg, South Africa; <sup>2</sup>Tshwane University of Technology, South Africa

11:30-11:50

Effect of in-situ modification on the tribological properties of synthetic magnesium silicate hydroxide as lubricant additives

Kai GAO, Qiying CHANG, Bin WANG

Beijing Jiaotong University, China

11:50-12:10

Improved tribological behaviors of graphene/polytetrafluoroethylene composite

Xiao WANG, Junwei WU, Luhai ZHOU, Xicheng WEI

Shanghai University, China

12:10-12:30

Fabrication, Microstructure and High Temperature Tribological Properties of Hot-pressed hBN-SiC-ZrO<sub>2</sub> Ceramics in Sliding against Different Metallic Counterfaces

Jiahu OUYANG, Heng WEN, Lei CHEN, Zhanguo LIU, Yujin WANG

Harbin Institute of Technology, China

12:10-13:30

Lunch

#### Room 201D

Track 2: Wear & Surface Engineering

Heat Treatment I

Chair: Xiqun LU, Harbin Engineering University, China

13:30-13:50

Sliding and impact wear resistance of tool steel after deep cryogenic treatment

Bojan PODGOMIK, Marko SEDLAČEK, Ana KRAČUN, Fevzi KAFEXHIU

Institute of Metals and Technology, Slovenia

13:50-14:10

Study on properties of Ti13Nb13Zr after carburizing

Junyang WANG, Xu RAO, Yong LUO

China University of Mining and Technology, China

14:10-14:30

Improving the wear resistance of CrWMn by deep cryogenic treatment

Kaixuan GU, Jianpeng ZHENG, Jia GUO, Yuan ZHOU, Junjie WANG

CAS, China

14:30-14:50

Two phase ratio recovery for deteriorated duplex stainless steel by laser surface treatment

Yang SONG<sup>1,2</sup>, Peng WEN<sup>1,2</sup>, Haiyan ZHAO<sup>1,2</sup>

<sup>1</sup>Tsinghua University, China; <sup>2</sup>Ministry of Education, China

14:50-15:10

Approach to controllable tribological properties of sintered polycrystalline diamond compact through annealing treatment

Wen YUE<sup>1,2</sup>, Jiansheng LI<sup>1</sup>, Wenbo QIN<sup>1</sup>, Chengbiao WANG<sup>1,2</sup>

<sup>1</sup>School of Engineering and Technology, China; <sup>2</sup>Key Laboratory on Deep Geo-drilling Technology of the Ministry of Land and Resources, China

15:10-15:30

Tribological properties of TC4 titanium alloy treated by plasma nitriding at different temperatures

Yungang YUAN

China University of Geosciences, China

15:30-15:50

Coffee Break

#### Room 203A

Track 2: Wear & Surface Engineering

Surface Modification I

Chair: Ali ERDEMIR, Agonne National Lab. USA

8:30-9:00 Keynote

Surface and Interface design for friction control

Stephen HSU

George Washington University, USA

9:00-9:20

Friction properties of nanostripe inducing structures in vacuum environment

Yasuhisa ANDO, Shunsuke ABE, Masatoshi SAITO

Tokyo University of Agriculture and Technology, Japan



**9:20-9:40**

A key technology for reducing frictional run-in period of amorphous carbon film

Cheng CHEN<sup>1</sup>, Peidong XUE<sup>1,2</sup>, Dongfeng DIAO<sup>1</sup>

<sup>1</sup>Shenzhen University, China; <sup>2</sup>Xi'an Jiaotong University, China

**9:40-10:00**

Effect of irradiation on the frictional performance of sintering materials

Wenkai ZHENG<sup>1</sup>, Ying LIU<sup>1</sup>, Yuming WANG<sup>1</sup>, Guoping WU<sup>2</sup>, Mingjie QI<sup>2</sup>

<sup>1</sup>Tsinghua University, China; <sup>2</sup>Ningbo Vulcan Mechanical Seal Manufacturing Co. Ltd., China

**10:00-10:20**

Microstructure and tribological properties of Ti ion implanted cronidur 30 bearing steel

Jie JIN, Tianmin SHAO

State Key Laboratory of Tribology, Tsinghua University, China

**10:20-10:40**

Coffee Break

**Room 203A**

**Track 2: Wear & Surface Engineering**

**Surface Modification II**

**Chair: Yasuhisa ANDO, Tokyo University of Agriculture and Technology, Japan**

**10:40-11:05 Invited**

Effect of surface modification on surface properties and tribological behaviours of titanium alloys

Yong LUO

China University of Mining and Technology, China

**11:05-11:25**

Characteristic of modified spiral bearing and its seals effect through geometries and dimension modification

Norliza MARUSMAN<sup>1</sup>, Mohd Danial IBRAHIM<sup>1</sup>, Yuta SUNAMI<sup>2</sup>, Aidil Azli ALIAS<sup>1</sup>, Siti Nur Azizah AMRAN<sup>1</sup>, Saad Salahuddin MUSA<sup>1</sup>, Mohd Rahmat A RAHMAN<sup>1</sup>, Yana Shaheera YUNOS<sup>1</sup>, Muhammad Zaidi MOHTAR<sup>1</sup>, Lee Kwang WONG<sup>1</sup>

<sup>1</sup>Universiti Malaysia Sarawak, Malaysia; <sup>2</sup>Tokai University, Japan

**11:25-11:45**

Enhanced wear resistance of mechanically modified tin plating

Jian SONG<sup>1</sup>, Stephan HANSMANN<sup>2</sup>, Christian KOCH<sup>1</sup>, Haomiao YUAN<sup>1</sup>, Vitali SCHINOW<sup>1</sup>

<sup>1</sup>Ostwestfalen-Lippe University of Applied Sciences, Germany; <sup>2</sup>Gebr. Kemper GmbH + Co. KG, Germany

**11:45-12:05**

Characterization of N+C, Ti+N and Ti+C ion implantation into Ti6Al4V alloy

Xingguo FENG

Lanzhou Institute of Physics, China

**12:05-12:25**

Tribological evaluation of new surface modifications for cold rolling mill rolls

Jose Lucio GONCALVES JUNIOR<sup>1,2</sup>, Jose Daniel Biasoli DE MELLO<sup>1,3</sup>, Henara Lillian COSTA<sup>1,4</sup>

<sup>1</sup>Federal University of Uberlandia, Brazil; <sup>2</sup>Federal University of Goias, Brazil;

<sup>3</sup>Federal University of Santa Catarina, Brazil; <sup>4</sup>Federal University of Rio Grande, Brazil

**12:30-13:30**

Lunch

**Room 203A**

**Track 2: Wear & Surface Engineering**

**Surface Modification III**

**Chair: Yong LUO, China University of Mining and Technology, China**

**13:30-13:50**

Tribological investigations on tailored formed axial bearing washers

Gerhard POLL<sup>1</sup>, Florian PAPE<sup>1</sup>, Timm COORS<sup>1</sup>, Alexander BARROI<sup>2</sup>, Jörg HERMSDORF<sup>2</sup>, Stefan KAIERLE<sup>2</sup>, Tim MATTHIAS<sup>1</sup>, Christian BONK<sup>1</sup>, Anna CHUGREEVA<sup>1</sup>, Anas BOUGUECHA<sup>1</sup>, Bernd-Arno BEHRENS<sup>1</sup>, Ludger OVERMEYER<sup>2</sup>

<sup>1</sup>Leibniz Universitaet Hannover, Germany; <sup>2</sup>Laser Zentrum Hannover e.V., Germany

**13:50-14:10**

Residual stresses induced by cavitation peening

Emmanuel SONDE<sup>1,2</sup>, Thibaut CHAISE<sup>1</sup>, Daniel NELIAS<sup>1</sup>, Cyril MAUGER<sup>1</sup>, Nicolas BOISSON<sup>1</sup>

<sup>1</sup>Univ Lyon, France; <sup>2</sup>AREVA NP Lyon, France

**14:10-14:30**

Effects of UV radiation on the friction behavior of thermoplastic polyurethanes

Géraldine THEILER, Volker WACHTENDORF, Anna ELERT, Steffen WEIDNER  
Bundesanstalt für Materialforschung und -prüfung, Germany

**14:30-14:50**

Surface modification of hybrid-fabric composites with amino silane and polydopamine for enhanced mechanical and tribological behaviors

Junya YUAN, Zhaozhu ZHANG

University of Chinese Academy of Sciences, China

**14:50-15:10**

Tribological performance of surface engineered low-cost beta titanium alloy

Xiaoying LI, Eleanor REDMORE, Hanshan DONG

University of Birmingham, United Kingdom

**15:10-15:30**

The wear characteristic and deformation mechanism of QT500-7 nodular cast iron performed by atmospheric plasma beam shock peening

Wei DAI, Zhizhen ZHENG, Jianjun LI

Huazhong University of Science and Technology

**15:30-15:50**

Coffee Break



**Room 203B****Track 2: Wear & Surface Engineering****Tribo-corrosion I**

Chair: Minhao ZHU, Southwest Jiaotong University, China

**8:30-8:50****Abrasion-corrosion of PTA inconel 625 deposits**Henara COSTA<sup>1,2</sup>, Regina GARCIA<sup>2</sup><sup>1</sup>Universidade Federal do Rio Grande, Brazil; <sup>2</sup>Universidade Federal de Uberlandia, Brazil**8:50-9:10****Enhanced cavitation erosion-corrosion resistance of friction stir processed high entropy alloy**Harpreet Singh GREWAL<sup>1</sup>, Rakesh NAIR<sup>1</sup>, Sundeep MUKHERJEE<sup>2</sup>, Harpreet Singh ARORA<sup>1</sup><sup>1</sup>Shiv Nadar University, India; <sup>2</sup>University of North Texas, USA**9:10-9:30****Tribocorrosion study of tin bronze in contact with bearing steel in synthetic sea water**

Elina HUTTUNEN-SAARIVIRTA, L. KILPI, L. CARPEN, H. RONKAINEN

VTT Technical Research Centre of Finland Ltd, Finland

**9:30-9:50****Effects of particle angularity on three-body abrasion-corrosion of high-Cr white cast irons**

Mobin SALASI, Grazyna STACHOWIAK, Gwidon STACHOWIAK

Curtin University, Australia

**9:50-10:10****Study on Impact-fretting Wear of 304 Austenitic Stainless Steel**

Yoshiki SATO, Yuta NAKAGAWA, Bo ZHANG

Saga University, Japan

**10:10-10:30**

Coffee Break

**Room 203B****Track 2: Wear & Surface Engineering****Tribo-corrosion II**

Chair: Guoxin XIE, Tsinghua University, China

**10:30-11:50****Comparison of Two- and Three-body Abrasion-corrosion of 316L Stainless Steel**

Grazyna STACHOWIAK, Mobin SALASI, Gwidon STACHOWIAK

Curtin University, Australia

**10:50-11:10****Study of the tribocorrosion behaviours of albumin on a cobalt-based alloy using SKPFM and AFM**

Yu YAN, Zhongwei WANG, Lijie QIAO

University of Science and Technology Beijing, China

**11:50-13:30**

Lunch

**Room 203B****Track 2: Wear & Surface Engineering****Tribo-corrosion III**

Chair: Yu YAN, Beijing University of Science and Technology, China

**13:30-13:50****Influence of corrosion inhibitor content in sliding CO<sub>2</sub> corrosion on wear and coefficient of friction for steel tubings**Andreas TRAUSMUTH<sup>1</sup>, Manel RODRIGUEZ RIPOLL<sup>1</sup>, Gerald ZEHETHOFER<sup>2</sup>, Ronald SCHÖNGRUNDNER<sup>3</sup>, Ewald BADISCH<sup>1</sup><sup>1</sup>AC2T research GmbH, Austria; <sup>2</sup>OMV Exploration & Production GmbH, Austria; <sup>3</sup>voestalpine Tubulars GmbH&Co KG, 8652 Kindberg-Aumühl, Austria**13:50-14:10****Seawater induced tribo-corrosion of marine alloys**

Robert WOOD

University of Southampton, United Kingdom

**14:10-14:30****Study on erosion-corrosion behavior of metal foam/polyurethane co-continuous composite**

Junxiang WANG, Deli DUAN, Shengli JIANG, Sihan HOU, Shu LI

Institute of Metal Research, Chinese Academy of Sciences, China

**14:30-14:50****Tribocorrosion behavior of 410SS in artificial seawater: effect of applied potentia**Beibei ZHANG<sup>1,2</sup>, Jianzhang WANG<sup>1</sup>, Yue ZHANG<sup>1,2</sup>, Gaofeng HAN<sup>1,2</sup>, Fengyuan YAN<sup>1</sup><sup>1</sup>Lanzhou Institute of Chemical Physics, China; <sup>2</sup>University of Chinese Academy of Sciences, China**14:50-15:10****Tribocorrosion of zinc-doped TiO<sub>2</sub> nanotubular anodic films**Luís ROCHA<sup>1,2,5</sup>, Sofia ALVES<sup>2,3</sup>, André ROSSI<sup>4</sup>, Paulo FILLO<sup>1,5</sup>, Jean-Pierre CELIS<sup>6</sup>, Tolou SHOKUHFA<sup>3,7</sup><sup>1</sup>Universidade Estadual Paulista, Brazil; <sup>2</sup>Center of MicroElectroMechanical Systems, Portugal; <sup>3</sup>US Branch of the Institute of Biomaterials, USA; <sup>4</sup>Brazilian Center for Research in Physics, Brazil; <sup>5</sup>Brazilian Branch of the Institute of Biomaterials, Brazil; <sup>6</sup>KU Leuven, Belgium; <sup>7</sup>University of Illinois at Chicago, USA**15:10-15:50**

Coffee Break

**Room 203B****Track 2: Wear & Surface Engineering****Surface Exploration I**

Chair: Xinchun CHEN, Tsinghua University, China

**15:30-15:55 Invited****Stress control based design of coating/substrate systems**

Tianmin SHAO, Xiao HUANG, Hongfei SHANG, Zhe GENG

Tsinghua University, China

**15:55-16:15****The preparation and elastic properties of core-shell structured polystyrene/SiO<sub>2</sub> composite nanoparticle**

Xu CAO, Dan GUO, Guoshun PAN

Tsinghua University, China



**16:15-16:35****Computation of rough engineering surfaces**Szerena Krisztina UJVARI<sup>1</sup>, Ivana RISTIC<sup>1</sup>, Andras VERNES<sup>1,2</sup>, Carsten GACHOT<sup>1,3</sup><sup>1</sup>AC2T research GmbH, Austria; <sup>2</sup>Technische Universität Wien, Austria**16:35-16:55****A mixed lubrication analysis of a thrust washer bearing with fractal rough surfaces**Xiaohan ZHANG<sup>1</sup>, Yang XU<sup>1</sup>, Robert JACKSON<sup>1</sup>, Timothy PARSONS<sup>2</sup>, Jianpeng FENG<sup>2</sup><sup>1</sup>Auburn University, USA; <sup>2</sup>Oiles America Corporation, USA**16:55-17:15****Hot nano-indentation modeling of high temperature Ni alloys under Helium environment**

Ali BEHESHTI, Sepehr SALARI

Lamar University, USA

**17:15-17:35****Wetting behavior of an underwater oil droplet on structured surfaces: a comparison between theoretical, experimental and simulation study**Shuai CHEN<sup>1</sup>, Jiadao WANG<sup>2</sup>, Gang ZHANG<sup>1</sup>, Yongwei ZHANG<sup>1</sup><sup>1</sup>A\*Star, Singapore; <sup>2</sup>Tsinghua University, China**17:35-17:55****Capturing molecular interactions in lubricants and fluid/solid interfaces**

James EWEN, David M. HEYES, Daniele DINI

Imperial College London, UK

**Room 305C****Track4: Biotribology & Biomimetics  
BioSurface & Contact I****Chair: Bharat BHUSHAN, The Ohio State University, America****08:30-09:00 Keynote****Understanding how medical implant materials interact with their environment in tribological contacts**

Anne NEVILLE

University of Leeds, England

**09:00-09:20****In vitro hydrogel friction on mucin-producing corneal cells**

Angela A. PITENIS, Juan Manuel URUENA, Tristan T. HORMEL, Tapomoy BHATTACHARJEE, Kyle D. SCHULZE, Thomas E. ANGELINI, W. Gregory SAWYER

University of Florida, America

**09:20-09:40****Catheter friction and testing rig in urethra model**

Troels RON, Seunghwan LEE

Technical University of Denmark, Denmark

**09:40-10:00****The potential role of tribocorrosion on in-Stent restenosis**

Emily CLARK, Karen PORTER, Michael BRYANT

University of Leeds, England

**10:00-10:20**

Coffee Break

**Room 305C****Track4: Biotribology & Biomimetics  
BioSurface & Contact II****Chair: Anne NEVILLE, University of Leeds, England****10:20-10:50 Keynote****Bioinspired mechanically durable superhydrophilic/phobic surfaces**

Bharat BHUSHAN

The Ohio State University, America

**10:50-11:10****Friction measurements with chocolate in a simulated tongue-palate contact.**

Philippa CANN, Marc MASEN

Imperial College London, England

**11:10-11:30****Biolubrication and its modulation: Taking saliva as an example**

Hongping WAN, Deepak H. VEEREGOWDA, H. C. VAN DER MEI, H.J.

BUSSCHER, Herrmann ANDREAS, K. Sharma PRASHANT

University of Groningen and the University Medical Center Groningen; Zernike Institute for Advanced Materials; University of Groningen

**11:30-11:50****Wedged anisotropic dry adhesive fabricated with ultra-precision diamond cutting**Dashuai TAO<sup>1</sup>, Xing GAO<sup>1</sup>, Hongyu LU<sup>1</sup>, Zheyu LIU<sup>1</sup>, Yong LI<sup>1</sup>, Hao TONG<sup>1</sup>, Yonggang MENG<sup>1</sup>, Noshir PSEIKA<sup>1,2</sup>, Yu TIAN<sup>1</sup><sup>1</sup>Tsinghua University, China; <sup>2</sup>Tulane University, America**11:50-12:10****Bionic frictional driving dominated by intermolecular adhesion**

Keju JI, Feiqian GUO, Guiyun MENG, Zhendong DAI

Nanjing University of Aeronautics and Astronautics, China

**12:20-13:30**

Lunch

**Room 305C****Track4: Biotribology & Biomimetics  
Biomaterials I****Chair: Feng ZHOU, Lanzhou Institute of Chemical Physics, China****13:30-13:50****Composite hydrogel: A new tool for reproducing the mechanical behaviour of soft human tissues**Zhengchu TAN<sup>1</sup>, Antonio FORTE<sup>1</sup>, Cristian FERDINANDO PARISI<sup>2</sup>, Rodriguez Y BAENA<sup>3</sup>, Daniele DINI<sup>1</sup><sup>1</sup>Imperial College London, Enaland; <sup>2</sup>Tissue Engineering and Biophotonics Division, King's College London, Enaland; <sup>3</sup>Mechatronics in Medicine, Mechanical Engineering, Imperial College, England**13:50-14:10 Cancelled****Highly efficient moisture-enabled power-generation device from flexible carbon dot gel film**

Ming ZHOU

State Key Laboratory of Tribology, China



**14:10-14:30****Multistage composite structure hydrogel with high strength and low friction**Jin ZHAO, Yuhong LIU, Pengxiao LIU  
*Tsinghua University, China***14:30-14:50****Tribological properties of surface texturing padded with hydrogel**Junde GUO<sup>1</sup>, Yu LI<sup>2</sup>, Guangneng DONG<sup>1</sup><sup>1</sup>*Xi'an Jiaotong University, China;* <sup>2</sup>*Department of Applied Chemistry, School of Science Xi'an Jiaotong University, China***14:50-15:10****Nanoporous substrate-infiltrated hydrogels: a bioinspired solution for high load bearing, tunable friction and under water adhesion**Michele SCARAGGI<sup>1,4</sup>, Shuanhong MA<sup>2,3</sup>, Feng ZHOU<sup>2</sup>, Daniele DINI<sup>4</sup><sup>1</sup>*Università del Salento, Italia;* <sup>2</sup>*Lanzhou Institute of Chemical Physics, China;*<sup>3</sup>*University of the Chinese Academy of Sciences, China;* <sup>4</sup>*Imperial College London, England***15:10-15:30****Growing polymer brushes from a hydrogel surface: a step towards imitating articular cartilage**

Joydeb MANDAL

*ETH Zurich, Switzerland***15:30-15:50****Coffee Break****Room 305C****Track4: Biotribology & Biomimetics  
Biomaterials II****Chair: Ming ZHOU, State Key Laboratory of Tribology, China****15:50-16:15 Invited****Induction of long-lived room-temperature phosphorescence of N-doped grapheme quantum dots by water in hydrogen bonded matrices**  
Ming ZHOU, Qijun LI*State Key Laboratory of Tribology, Tsinghua University, China***16:15-16:35****Mathematical interpretation of ""cross-shear"" wear for UHMWPE**Aiguo WANG<sup>1</sup>, Shirong GE<sup>2</sup><sup>1</sup>*Trauson Medical Instrument (China) Company, China;* <sup>2</sup>*China University of Mining & Technology, China***16:35-16:55****AFM study of Nanomechanics of liposomes on titanium alloy**

Yiqin DUAN, Yuhong LIU, Hongyu SHI, Jian SONG, Shizhu WEN

*State Key Laboratory of Tribology, China***16:55-17:15****Lubrication by polymer brushes and friction control**

Feng ZHOU

*Lanzhou Institute of Chemical Physics, China***17:15-17:35****Cartilaginous tissue formation by cultured chondrocytes under traction loading**

Yoshinori SAWAE, Keisuke FUKUDA, Yoshifumi SHIGYO, Hideaki ARIURA,

Takehiro MORITA, Tetsuo YAMAGUCHI

*Kyushu University, Japan***17:35-17:55****Temperature measurement during drilling of acrylic composite materials for development of bone biomodels**Yuta MURAMOTO<sup>1</sup>, Vincent FRIDRICI<sup>2</sup>, Philippe KAPSA<sup>3</sup>, Gaëtan BOUVARD<sup>2</sup>, Makoto OHTA<sup>3</sup><sup>1</sup>*Graduate School of Biomedical Engineering, Tohoku University, Japan;*<sup>2</sup>*Laboratoire de Tribologie et Dynamique des Systèmes UMR CNRS 5513 ECL-ENISE, Ecole Centrale de Lyon – Université de Lyon, France;* <sup>3</sup>*Institute of Fluid Science, Tohoku University, Japan***17:55-18:15****Frictional behaviors of wound dressings**Xiangqiong ZENG<sup>1</sup>, Lin LIN<sup>2</sup>, Jiusheng LI<sup>2</sup><sup>1</sup>*Advanced Lubricating Materials Laboratory, Shanghai Advanced Research Institute, Chinese Academy of Sciences, China;* <sup>2</sup>*Shanghai Advanced Research Institute, Chinese Academy of Sciences, China***Room 305E****Track6: Engine and Transmission Tribology  
Gears I****Chair: Thomas LOHNER, Technical University of Munich, Germany****8:30-8:50****Effect of running-in-load and speed-on surface characteristics of honed gears**

Dinesh MALLIPEDDI, Mats NORELL, Mario SOSA, Lars NYBORG

*Chalmers University of Technology, Sweden***8:50-9:10****Micropitting damage in gear teeth contacts: influencing factors and mechanisms of their action**Amir KADIRIC<sup>1</sup>, Pawel RYCERZ<sup>1</sup>, Guillermo MORALES<sup>2</sup><sup>1</sup>*Imperial College London, UK;* <sup>2</sup>*SKF Engineering and Research Centre, Netherlands***9:10-9:30****In-situ testing of wear and fatigue on gear segments**Florian GRÜN<sup>1</sup>, Tobias KOBLMILLER<sup>1</sup>, István GÓDOR<sup>1</sup>, Werner SCHADLER<sup>2</sup><sup>1</sup>*Montanuniversität Leoben, Austria;* <sup>2</sup>*MAHLE Filtersysteme Austria, Austria***9:30-9:50****The tribology of PEEK gear contact simulated using the TE 77 EP - gear dynamic contact**

Zainab SHUKUR, K. D DEARN, S. N KUKUREKA

*University of Birmingham, UK***9:50-10:10****At the 'PEEK' of gear performance: the evolution of the wear of PEEK and PMC gears at high temperatures**

Karl DEARN, S KONO, A B CROPPER

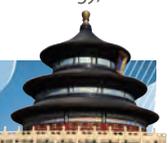
*University of Birmingham, UK***10:10-10:30****Coffee Break****Room 305E****Track6: Engine and Transmission Tribology  
Gears II****Chair: Karsten Stahl, Technical Univ. of Munich, Germany**

**10:30-10:50****TEHL simulation on the influence of lubricants on the frictional losses of DLC coated gears**Andreas ZIEGLTRUM, Thomas LOHNER, Karsten STAHL  
*Technical University of Munich, Germany***10:50-11:10****Numerical modeling and validation of oil distribution and churning losses in gearboxes**Hua LIU, Thomas JURKSCHAT, Thomas LOHNER, Karsten STAHL  
*Technical University of Munich, Germany***11:10-11:30****A test procedure to investigate lubricant-surface combination for high performance racing transmissions**Edward HUMPHREY, Nick MORRIS, Ramin RAHMANI, Homer RAHNEJAT  
*Loughborough University, UK***11:30-11:50****Thermal modelling of mixed non-newtonian thermo-elastohydrodynamics contact in dry sump lubrication system**Ehsan FATOUREHCHI, Mahdi MOHAMMADPOUR, Ramin RAHMANI, Stephanos THEODOSSIADES, Homer RAHNEJAT  
*Loughborough University, UK***11:50-12:10****Non-newtonian thermal elastohydrodynamic lubrication in point contact for modified double helical gears**Lijun PAN<sup>1</sup>, Changjiang ZHOU<sup>1,2</sup>, Xu HAN<sup>1</sup>  
<sup>1</sup>Hunan University, China; <sup>2</sup>Central South University, China**12:10-12:30****Tangential and normal oil film stiffness and damping for modified spur gears in non-newtonian transient thermal elastohydrodynamic lubrication**Zeliang XIAO<sup>1</sup>, Changjiang ZHOU<sup>1,2</sup>, Siyu CHEN<sup>2</sup>  
<sup>1</sup>Hunan University, China; <sup>2</sup>Central South University, China**12:30-13:30**

Lunch

**Room 305E****Track6: Engine and Transmission Tribology Gears III****Chair: Marian SZCZEREK, National Research Institute, Poland****13:30-13:50****Friction, wear and lubrication of coated spiral bevel gears**Remigiusz MICHALCZEWSKI, Marek KALBARCZYK, Waldemar TUSZYNSKI, Anita MANKOWSKA-SNOPCZNSKA, Edyta OSUCH-SLOMKA, Marian SZCZEREK, Elzbieta ROGOS  
*National Research Institute (ITeE-PIB), Poland***13:50-14:10****Friction reduction in gearboxes by plastic deformation (PD) additives**Thomas LOHNER, Karsten STAHL  
*Technical University of Munich, Germany***14:10-14:30****The dynamic performance analysis of gear train with one way meshing sliding**Heyun BAO, Rupeng ZHU, Fengxia LU, Guanghu JIN  
*Nanjing University of Aeronautics and Astronautics, China***14:30-14:50****Influence of textured teeth faces on the vibration behavior of meshed spur gears**N. GUPTA, N. TANDON, R. K. PANDEY  
*Indian Institute of Technology Delhi, India***14:50-15:10****Investigation of power loss and contact conditions of a DLC coated helical gear pair considering limiting shear stress behavior of the lubricant**Ronny BEILICKE, Lars BOBACH, Dirk BARTEL  
*Otto von Guericke University Magdeburg, Germany***15:10-15:30****Lubricated tooth contact analysis of hypoid gears**Gajarajan SIVAYOGAN<sup>1</sup>, Mahdi MOHAMMADPOUR<sup>1</sup>, Ramin RAHMANI<sup>1</sup>, Homer RAHNEJAT<sup>1</sup>, Guenter OFFNER<sup>2</sup>, Martin SOPOUCH<sup>2</sup>  
<sup>1</sup>University of Loughborough, UK; <sup>2</sup>AVL List GmbH, Austria**15:30-15:50**

Coffee Break

**Room 305E****Track6: Engine and Transmission Tribology Gears IV****Chair: Zainab SHUKUR, University of Birmingham, UK****15:50-16:10****Influence of lubricant on shift performance of manual transmissions**Dmitriy SHAKHVOROSTOV, Anatolij SMIRNOV, Christoph WINCIERZ  
*Evonik Resource Efficiency GmbH, Germany***16:10-16:30****On friction-drive model of metal belt continuously variable transmission under slip control situation**Yuanqiang TAN, Shiping YANG, Jingang LIU, Xiaoru ZHANG  
*Huaqiao University, China***16:30-16:50****Efficiency optimization and investigation of the lubricant distribution in a high-speed gearbox as part of the speed2E project**Alexander FRIEDL  
*University of Hanover, Germany***16:50-17:10****Gear durability performance derived from anti-wear additives applied to continuously variable transmission fluids**Keiichi NARITA  
*Idemitsu Kosan Co., Ltd., Japan***17:10-17:30****The selection of thin coatings and gear oils to improve the durability of planetary gears in mining conveyors**Marian SZCZEREK<sup>1</sup>, Remigiusz MICHALCZEWSKI<sup>1</sup>, Witold PIEKOSZEWSKI<sup>1</sup>, Andrzej WIECZOREK<sup>1,2</sup>, Jan WULCZYNSKI<sup>1</sup>  
<sup>1</sup>National Research Institute, Poland; <sup>2</sup>Silesian University of Technology, Poland

**17:30-17:50**

Design optimization research on double helical gear of high efficiency  
Fengxia LU, Weiping LIU, Rupeng ZHU, Heyun BAO, Guanghu JIN  
*Nanjing University of Aeronautics and Astronautics, China*

**17:50-18:10**

Effective stiffness of an assembled shaft with a regularized coulomb law  
Jean-louis LIGIER, Mathieu BENOIT  
*HEIG-VD, Switzerland*

**Room 307**

**Track6: Engine and Transmission Tribology  
Tribology Materials II**

**Chair: Guoxin XIE, Tsinghua University, China**

**8:30-9:00 Keynote**

Insights of engine friction reduction and wear control technology and future trends for improving energy sustainability and environmental opportunity  
Simon TUNG  
*Tung Innovation Technology Consulting, Inc, USA*

**9:00-9:20**

Synthesis and tribological properties of spark plasma sintering NiCr-Cr<sub>2</sub>AlC composites at elevated temperature  
Yufeng LI, Xinliang LI, Hong YIN  
*Harbin Institute of Technology Shenzhen Graduate School, China*

**9:20-9:40**

Thermal response of M50 steel tribopairs in sliding-rolling contacts under mixture lubrication  
Kun SHU, Le GU, Chuanwei ZHANG  
*Harbin Institute of Technology, China*

**9:40-10:00**

Fetting fatigue crack formation in Ni-base single-crystal superalloys: in-situ SEM experiment and crystal plasticity analysis  
Qinan HAN<sup>1,2</sup>, Wenhui QIU<sup>1</sup>, Yibo SHANG<sup>1</sup>, Huiji SHI<sup>1</sup>  
<sup>1</sup>*Tsinghua University, China; <sup>2</sup>Aircraft Strength Research Institute of China, China*

**10:00-10:20**

Coffee Break

**Room 307**

**Track6: Engine and Transmission Tribology  
Tribology Materials III**

**Chair: David ECKOLD, University of Birmingham, United Kingdom**

**10:20-10:40**

Tribological behaviour of short carbon fibre reinforced PEEK under diesel lubrication  
Daniel NADERMANN<sup>1</sup>, Philipp DIETRICH<sup>1,2</sup>, Gregor KORN<sup>1</sup>, Huber SCHWARZE<sup>3</sup>  
<sup>1</sup>*Robert Bosch GmbH - Corporate Sector Research, Germany; <sup>2</sup>Aalen University of applied Sciences, Germany; <sup>3</sup>Clausthal University, Germany*

**10:40-11:00**

Printing the spine: PEEK as a bearing material  
David ECKOLD, Karl DEARN, Duncan SHEPHERD  
*University of Birmingham, United Kingdom*

**11:00-11:20**

Friction of hybrid filled PEEK composites sliding against WC-Ni under water lubrication in start-up period  
Gaolong ZHANG<sup>1</sup>, Ying LIU<sup>1</sup>, Yuechang WANG<sup>1</sup>, Xiangfeng LIU<sup>1</sup>, Ga ZHANG<sup>2</sup>, Yuming WANG<sup>1</sup>  
<sup>1</sup>*Tsinghua University, China; <sup>2</sup>State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, Chinese Academy of Science, China*

**11:20-11:40**

The tribological performance of polytetrafluoroethylene and polyimide composites in adverse operating conditions  
Fuzhi SONG, Zenghui YANG, Yong SUN, Qihua WANG, Tingmei WANG  
*Lanzhou Institute of Chemical Physics of the Chinese Academy of Sciences, China*

**11:40-12:00**

Friction of short-cut aramid fiber reinforced elastomer: the effect of fiber orientation  
M. Khafidh<sup>1,2</sup>, D.J. Schipper<sup>1</sup>, M.A. Masen<sup>3</sup>, N. Vleugels<sup>1,2</sup>, J.W.M. Noordermeer<sup>1</sup>  
<sup>1</sup>*University of Twente, The Netherlands; <sup>2</sup>Dutch Polymer Institute, The Netherlands; <sup>3</sup>Imperial College, United Kingdom*

**12:20-13:30**

Lunch

**Room 308**

**Track7: Industrial Tribo-systems  
Tribology of Machine Elements**

**Chair: Jian LI, Wuhan Research Institute of Materials Protection, China**

**8:30-9:00 Keynote**

Tribological Behavior and Thermoelastic Instability Arising in Ball-Screw-Like Specimens Operating in Dry Contacts and with Grease Lubrications  
Jenfin LIN  
*Cheng Kung University, Taiwan, China*

**9:00-9:25 Invited**

The research of contact force model in multibody systems with clearance joints  
Wei CHEN, Fang YANG  
*Xi'an Jiaotong University, China*

**9:25-9:45**

Geometrical analysis of the roller screw mechanism  
Sebastian SANDU<sup>1,2</sup>, Nans BIBOULET<sup>1</sup>, Daniel NELIAS<sup>1</sup>, Folly ABEVI<sup>2</sup>  
<sup>1</sup>*University of Lyon, France; <sup>2</sup>SKF Transrol, France*

**9:45-10:05**

Research on tribological performance of surface-textured steel alloy for the retainer in EHAP  
Yuan CHEN, Junhui ZHANG, Bing XU, Min HU  
*The State Key Laboratory of Fluid Power and Mechatronic Systems, China*

**10:05-10:30**

Coffee Break



# ***POSTER** TIME*



**PS1- Science of Tribology & Lubrication and Lubricants & Tribology in Manufacturing**

Time: 15:30 - 16:30, 19 September

Venue: Lounge Area, 2<sup>nd</sup> Floor

- 1 **Temperature of sliding contact between wire rope and friction lining**  
Wan MA, A.A. LUBRECHT  
*Jiangsu Normal university, China; LaMCoS, INSA-LYON, UK*
- 2 **A model of rubber friction considering the viscoelasticity of rubber materials**  
Guangyu LEE, Xiangjun ZHANG, Robert WITTENBRINK, Jennifer ZHANG, Yonggang MENG  
*State Key Laboratory of Tribology, China; Exxon Mobil, USA*
- 3 **Friction and wear behaviors of Ni-based solid-lubricating composites under high temperature coupled with vacuum environment**  
Jun CHENG, Jun YANG, Weimin LIU  
*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, China*
- 4 **Friction behaviour and material characterisation of vulcanizates**  
Dong WANG, Jem RONGONG, Matt CARRE, Lewis ROGER  
*Sheffield University, UK*
- 5 **An original tribometer coupling a free-oscillation dynamic tribotest with a conventional linear reciprocating tribometer**  
Amal HRIOUECH, Michel BELIN, Joel PERRET-LIAUDET, Maria-Isabel DE BARROS, Moussa DIABY  
*Ecole Centrale de Lyon, Universit&#233;, de Lyon, France; Psa, Centre technique de Velizy, UK*
- 6 **Molecular dynamics simulation of friction mechanisms of amorphous polyethylene**  
Shengpeng ZHAN, Haitao DUAN, Jian LI  
*Wuhan Research Institute of Materials Protection, State Key Laboratory of Special Surface Protection Materials and Application, China*
- 7 **Numerical simulation of the dynamic process of friction and wear of PTFE sliding against 45 steel by the discrete element method**  
Ting XIE, Ya DING, Bang XIAO, Chenglong WANG  
*Hefei University of Technology, China*
- 8 **Winding-in impact friction characteristics of wire rope in winding hoist**  
Yuxing PENG, Shisheng SUN, Zhencai ZHU, Xiansheng GONG, Dagang WANG  
*School of Mechanical and Electrical Engineering, China University of Mining and Technology, China; Jiangsu Key Laboratory of Mine Mechanical and Electrical Equipment, China; China University of Mining and Technology, China; College of Mechanical Engineering, Chongqing University, China*
- 9 **Thermal analysis of pad-disc contact in the high-speed train braking based on ANSYS**  
Mingli ZHOU, Yongzhen ZHANG  
*Henan University of Science and Technology, China*
- 10 **Harmonic and transient responses of damping bearing with different constraining layer**  
Li HUANG, Jin YONG  
*Wuhan University of Technology, China*
- 11 **Tribological properties of the in-situ synthesized Grapheme/ Nickel Composites**  
Jinlong JIANG, Kaichen HE, Jinfang DU, Xianjuan PANG  
*Lanzhou University of Technology, China; Henan University of Science and Technology, China*
- 12 **Analysis of statics of clamp band systems for spacecraft**  
Xiaodong GUO, Junsen HOU, Xuefeng TAN, Jieliang ZHAO, Shaoze YAN  
*Tsinghua University, China*
- 13 **Effects of surface defect on grease lubricated EHL point contact**  
Chaolin PENG, Haiyan TANG, Xinglin LI  
*Chang'an University, China; Kunming University of Science and Technology, China; Hangzhou Bearing Test & Research Center, China*
- 14 **Friction coefficient and friction reduction of rolling-sliding contact in mixed EHL**  
Yali ZHANG, Zhiqiang WANG, Na QIN, Xiaogang ZHANG, Tonghai WU  
*Southwest Jiaotong University, China; School of Mechanical & Manufacturing Engineering, UNSW Australia, Australia; Xi'an Jiaotong University, China*
- 15 **3D rough surface contacts with lubricant using the hybrid simulation method**  
Jie ZHANG, Kiet TIEU, Guillaume MICHAL, Hongtao ZHU  
*School of Mechanical, materials and Mechatronic Engineering, University of Wollongong, Australia*
- 16 **Film forming properties under unsteady thin film lubrication**  
Weiwei WANG, Zhijun YAN, Jiujuan XU  
*Dalian Maritime University, China*
- 17 **Analytical solution of elastic fluid dynamic lubrication**  
Yi LOU, Huran LIU  
*zhejiang University of science and technology, China*
- 18 **The test of high pure lubrication oil film by the principal of back cone**  
Yi LOU, Huran LIU  
*zhejiang University of science and technology, China*
- 19 **A contact angle hysteresis model based on the fractal structure of triple line**  
Shuai WU, Ming MA  
*Tsinghua University, China*
- 20 **Research on friction and wear properties of finger seal materials**  
Hua SU, Shan SUN  
*Northwestern Polytechnical University, China*
- 21 **Dry tribological behaviour of nanocrystalline metals and alloys**  
Licai FU, Jun YANG, Weimin LIU  
*Hunan University, China; Lanzhou Institute of Chemical Physics, China*
- 22 **A surface energy based wear model for tribological polymers**  
Bo TAO, Jia ZENG, Xiaojun LIU, Kun LIU, Jiabin YE  
*Institute of Tribology, School of Mechanical Engineering, Hefei University of Technology, China*
- 23 **Surface energy and wear: an adhesive wear model**  
Bo TAO, Jia ZENG, Xiaojun LIU, Kun LIU, Jiabin YE  
*Institute of Tribology, School of Mechanical Engineering, Hefei University of Technology, China*
- 24 **Wear behavior of Al<sub>2</sub>O<sub>3</sub>-Nb composites manufactured by SPS**  
Aline Luísa BANDEIRA DOTTA, Ana Julia TERTULIANO, Izabel Fernanda MACHADO, Maria Cristina MORE FARIAS  
*Universidade de Caxias do Sul, Brazil; University of Sao Paulo, Brazil*



- 25 **Microstructure and tribological properties of 316L liquid phase sintered stainless steel with boron addition**  
Francisco LANFERDINI SERAFINI, Marcelle PERUZZO, Tanara DARIVA BEUX, Michell Felipe CANO ORDONEZ, Aline Luísa BANDEIRA DOTTA, Maria Cristina MORE FARIAS  
*Universidade de Caxias do Sul, Brazil; University of Sao Paulo, Brazil*
- 26 **Effect of swelling on tensile properties and abrasion resistance of nitrile rubber with different acrylonitrile contents under water conditions**  
Shuyuan SONG, Shijie WANG, Xiaoren LV  
*Shenyang University of Technology, China*
- 27 **Test on wear rule of casing in deep wells and extended reach wells**  
Erguo LIANG, Zhongmin WANG, Lei FU, Zifeng LI  
*Tianjin University of Technology and Education, China; College of Vehicles and Energy, Yanshan University, Qinhuangdao 066004, China*
- 28 **Structure and function of PTFE/PEEK transfer film: molecular simulation and experimental investigations**  
Tasuku ONODERA, Jun NUNOSHIGE, Kenji KAWASAKI, Koshi ADACHI, Kazue KURIHARA, Momoji KUBO  
*Hitachi, Japan; Graduate School of Engineering, Tohoku University, Japan; WPI Advanced Institute for Materials Research, Tohoku University, Japan; Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan; Institute for Materials Research, Tohoku University, Japan*
- 29 **Computational multiscale modeling of the bipolar electrochemical process on the example of potential-controlled dodecyl sulfate ion adsorption at the aqueous solution – stainless steel interface**  
Johannes Laurin HÖRMANN, Yonggang MENG  
*State Key Laboratory of Tribology, Tsinghua University, China; Technische Universität Berlin, Germany*
- 30 **Tribochemical reaction dynamics of carbon nitride thin films by tight-binding quantum chemical molecular dynamics simulations**  
Miho NAKAMURA, Seiichiro SATO, Yusuke OOTANI, Yuji HIGUCHI, Nobuki OZAWA, Koshi ADACHI, Momoji KUBO  
*Tohoku University, Japan*
- 31 **Tribological properties and electrical characteristics of triboelectric nanogenerator**  
Yanqiang HU  
*Beijing Institute of Technology, Beijing, China*
- 32 **Effect of an electric field on friction of silicon rubber against copper in the glycerol**  
Marek GLOGOWSKI, Juliusz B GAJEWSKI  
*Wroclaw University of Science and Technology, Poland*
- 33 **Behaviour of soft nanoadditives under shear flow**  
Yingying GUO, Luca DI MARE, Janet WONG  
*Imperial College London, UK*
- 34 **Triboelectrification of Al<sub>2</sub>O<sub>3</sub>/PTFE composites sliding against 45 steel**  
Ting XIE, Bang XIAO, Ya DING, Chenglong WANG  
*Hefei University of Technology, Anhui, China*
- 35 **Rubber-ice friction mechanisms at the mesoscale**  
Sylvain HEMETTE, Juliette CAYER-BARRIOZ, Denis MAZUYER  
*Ecole Centrale de Lyon, Laboratoire de Tribologie et Dynamique des Systèmes, France; Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan*
- 36 **On the thermodynamics of running-in**  
Hisham ABDEL-AAL  
*Drexel University, USA*
- 37 **Investigation on impact resistance of CFRP laminate under cycling low kinetic energy**  
Yang SUN, Zhen-bing CAI, Song-bo WU, Min-hao ZHU  
*Southwest Jiaotong University, China*
- 38 **Polytetrafluoroethylene self-assembly coating used in industrial flue gas filtration material**  
Chuan DU, Jiadao WANG, Xiaohong LIU, Tengfei WU  
*Tsinghua University, China; Tianjin Research Institute for Advanced Equipment, China*
- 39 **Sliding friction of fully hydrogenated DLC surfaces using molecular dynamics**  
Hirotoshi AKIYAMA, Hitoshi WASHIZU  
*University of Hyogo, Japan*
- 40 **Nano-scale wear characteristics of polymeric materials**  
Dong-gap SHIN, Dae-Eun KIM  
*Department of Mechanical Engineering, Yonsei University, Korea*
- 41 **Quantum chemical calculations, synthesis, physicochemical properties and nanotribology of copper and argentine clusters**  
Andrey KUZCHAROV, Aleksey MILOV, Yulia GERASINA  
*Don State Technical University, Russia; Southern Research Center of the Russian Academy of Sciences, Russia*
- 42 **Molecular dynamics simulation of wetting behavior of a droplet on carbon-nanotubes**  
Awais MAHMOOD, Jiadao WANG, Shuai CHEN  
*Tsinghua University, China; Institute of High Performance Computing, Singapore*
- 43 **Numerical experiments on the dynamics of sheared and pulled-off single asperity and the origin of sliding friction**  
Ryosuke MINAMI, Hiroshi MATSUKAWA  
*Aoyama Gakuin University, Japan*
- 44 **Understanding of effects of defect in graphite on tribological properties**  
Tianying DUAN, Wen YUE, Qunyang LI  
*China University of Geosciences, Beijing, China; Tsinghua University, Beijing, China*
- 45 **The influence of surface chemistry and nanoscopic roughness on the frictional properties of MoS<sub>2</sub> nanosheets**  
Zhuotong LIU, James BATTEAS  
*Texas A&M University, USA*
- 46 **How interface interaction influences tribology behavior of two layers graphene with hydroxyls**  
Rui LI, Yang CHENG, Chao WU  
*University of Science and Technology Beijing, China*
- 47 **Tribological properties and synergistic effects between stearic acid-modified nano-TiO<sub>2</sub> particles and sulfurized isobutene**  
Jiawei SHEN  
*Shanghai Advanced Research Institute, Chinese Academy of Sciences, China*
- 48 **Nanosliding of a Si<sub>3</sub>N<sub>4</sub> tip on an oscillating substrate**  
Masaru SUZUKI, Tatsuro SUZUKI, Junko TANIGUCHI, Naruo SASAKI, Makoto ISHIKAWA, Kouji MIURA  
*University of Electro-Communications, Japan; Aichi University of Education, Japan*



- 49 **Nanotribological behavior of nanopatterned multilayer MoS<sub>2</sub>**  
Qian WU, Ming ZHOU  
*Tsinghua University, China*
- 50 **Theoretical study of surface interaction force considering one-dimensional periodic material distribution**  
Hiroshige MATSUOKA, Toshiki OTANI, Takeshi HIKOSAKA, Satoru MAEGAWA, Shigehisa FUKUI  
*Tottori University, Japan*
- 51 **Atomic-scale friction and superlubricity in two-dimensional materials: the first-principles calculations**  
Linfeng WANG, Tianbao MA, Yuanzhong HU, Hui WANG  
*Nanjing University of Aeronautics and Astronautics, China; Tsinghua University, China*
- 52 **In-situ formation of MoS<sub>2</sub> nano-onions acting as rollers in macroscale superlubricity**  
Kaiming HOU, Jinqing WANG, Shengrong YANG  
*Lanzhou Institute of Chemical Physics, China*
- 53 **Solutions and algorithm for two-dimensional friction problems**  
Xiaosun WANG, J.R. BARBER  
*Wuhan University, China, University of Michigan, Ann Arbor, USA*
- 54 **Modeling of hysteresis nonlinear for bolted joints**  
Ling LI  
*Xi'an University of Architecture and Technology, China*
- 55 **Relationship between micro-abrasive wear modes and contact stresses: experimental tests and CAE simulations for AISI H10 tool steel**  
Ronaldo COZZA, Gustavo DONATO  
*University Center of FEI – Educational Foundation of Ignatius “Padre Saboia de Medeiros”, Brazil*
- 56 **Changing rule of cutting force in high speed milling of CFRP**  
Zhichao WANG  
*Fuzhou University, China*
- 57 **Cyclic tangential loading of a power-law hardening elastic-plastic spherical contact in pre-sliding stage**  
Bin ZHAO, Xiqun LU  
*Harbin Engineering University, China*
- 58 **Influence of copper surface morphology on hardness and elastic modulus of micro indentation test with different indenters**  
Haosheng PANG, Chenghui GAO, Ming LIU  
*Fuzhou University, China*
- 59 **In-Situ optical tribometry of subsurface crack propagation under sliding herzian contact**  
Haiyang ZHANG, Bo TAO, Jia ZENG, Xiaojun LIU, Kun LIU, Jiaxin YE  
*Institute of Tribology, School of Mechanical Engineering, Hefei University of Technology, China*
- 60 **The effect of different load and loading rate on the VonMises equivalent stress of the contact rough body of the base end of micro-cantilever**  
Jianmeng HUANG, Lei MIN, Yuchen DAL, Hang ZHANG, Huikai GAO  
*Fuzhou University, China*
- 61 **Theoretical investigation on wear-resistance mechanism for shape memory alloy**  
Xiang CHEN, Yang ZHAO, Sheng LU, Rui LI, Xianghe PENG  
*Institute of Advanced Manufacturing Engineering, Chongqing University of Posts and Telecommunications, China; School of Aeronautics and Astronautic, Chongqing University, China*
- 62 **Experimental investigation of oblique collision for robotic two-link manipulator with friction**  
Yuahang ZHAO, Yunian SHEN  
*Nanjing University of Science and Technology, China*
- 63 **Transient dynamic computation of frictional contact-impact of flexible robotic two-link manipulator**  
Wei WANG, Yunian SHEN  
*Nanjing University of Science and Technology, China*
- 64 **Cancelled**
- 65 **Research on lubrication properties of liquid metal: Ga<sub>0.64</sub>In<sub>0.24</sub>Sn<sub>0.12</sub> alloy**  
Aijie XU  
*Department of Mechanical Engineering, Tsinghua University, China*
- 66 **Experimental estimation of viscous and inertial coefficients in the formula of pressure drop for the water flow through the spherical particles layer**  
Emir TAIROV, Polina KHAN, Svetlana BYKOVA  
*Melentiev Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, Russia*
- 67 **Research on rheological and tribological properties of lithium grease containing nano silica**  
Jianping LIU, Hong CHEN  
*Shandong university of technology, China*
- 68 **Behaviour of grease EHL films at very low speed**  
Hiroshi NISHIKAWA, Naoya IKEDA  
*Kyushu Institute of Technology, Japan*
- 69 **High temperature self-lubricating materials**  
Shengyu ZHU, Jun YANG, Jun CHENG  
*Lanzhou Institute of Chemical Physics, China*
- 70 **Research on mechanical mechanism of shear dilatancy for granular flow lubrication**  
Fanjing MENG, Kun LIU, Wei WANG  
*Hubei University of Arts and Science, China; Hefei University of Technology, China*
- 71 **Development and application of environmentally friendly high performance semi-synthetic cutting fluid**  
Hongqi XIONG  
*Guangzhou Mechanical Engineering Research Institute Co.Ltd., China*
- 72 **Infiltration mechanism and sliding friction and wear behavior of Al<sub>2</sub>O<sub>3</sub>/HSS self-lubrication composites fabricated by vacuum pressure infiltration process**  
YanJun WANG, Shouren WANG, Liying YANG, Gaoqi WANG, Xuefeng YANG  
*University of Jinan, China*
- 73 **Synthesis and investigation of tribological behavior of nano-WS<sub>2</sub> particles**  
Na WU, Ningning HU, Songquan WANG  
*China University of Mining and Technology, China; Jiangsu Normal University, China*
- 74 **Tribological properties of Ni-based plasma sprayed coating with different silver content at wide temperature**  
Hang LI  
*Nanjing University of Science and Technology, Nanjing, China*

- 75 **Elastohydrodynamic lubrication of bearings in cooling circuit of lead-bismuth based reactor**  
Jiaqi SUN, Xuanyu SHENG, Yachen XU  
*Tianjin Research Institute for Advanced Equipment, Tsinghua University, China; Tsinghua University, China*
- 76 **Anti-wear properties of WS<sub>2</sub> nanoparticles at low concentrations**  
Shizhao YANG, Jiangqiang HU, Feng XIE, Li GU  
*Air Force Logistics College, China*
- 77 **Loading characteristics of spherical bearings with elastic deformation**  
Shengdong ZHANG, Guangming LI, Xiuying YANG, Boying WU, Yiji HUANG  
*Jiujiang University, China; Wuhan University of Technology, China*
- 78 **Elastohydrodynamic lubrication with oil droplets**  
Shuyi LI, Feng GUO, Xinming LI, Chenglong LIU  
*Qingdao university of Technology, China*
- 79 **The identification of lubrication state of inner ring and roller element under sliding condition**  
Zhihe DUAN, Tonghai WU, Shuaiwei GUO, Tao SHAO, Yanwen HUO  
*Xi'an Jiaotong University, China*
- 80 **Analysis of lubrication with 3D textured surface based on CFD**  
Yang ZHAO, Heng LIU, Minqing JING  
*Xi'an Jiaotong University, China*
- 81 **In-situ study of the distribution of the lubricant additives in the contact area**  
Shaohua ZHANG, Yuhong LIU, Tao QING  
*Beijing Institute of Control Engineering, China; Tsinghua University, China*
- 82 **Modification and evaluation of novel functional polyalphaolefin (PAO) using as additive in lubricant**  
Jiusheng LI, Xuzhi XUE, Jian XU, Tianhui REN  
*Shanghai Advanced Research Institute, Chinese Academy of Sciences, China; Shanghai Jiao Tong University, China*
- 83 **A safe and environmentally friendly lubricants**  
zhuojun CHEN, Yingliang WU  
*Shenyang Ligong Uinversity, China*
- 84 **Study on the tribological properties of naphthylacetic acid ionic liquid lubricant**  
wenjing SUN, Chaoyang ZHANG, Shuai ZHANG, Rui DONG, Mingjin FAN, Desuo YANG  
*Baoji University of Arts and Sciences, China*
- 85 **Investigation on the friction characteristics and the lubrication states transition for water lubricated plain journal bearing**  
Zhongliang XIE, Zhushi RAO, Na TA  
*Shanghai Jiao Tong University, China*
- 86 **Fundamental and Tribological Properties of Thick CPB**  
Keisuke SATO, Hikaru OKUBO, Yuki HIRATA, Chiharu TADOKORO, Tomoya FUJIMORI, Ken NAKANO, Yoshinobu TSUJII, Shinya SASAKI  
*Tokyo University of Science, Japan; Graduate School of Tokyo University of Science, 6-3-1 Niijyuku, Katsushika-ku, Tokyo, Japan; Saitama University, 255 Shimo-Okubo, Sakura-ku, Saitama-shi, Saitama, Japan; Kyoto University for Chemical Research, Gokasho, Uji-shi, Kyoto, Japan; Yokohama National University, 79-1 Tokiwadai, Hodogaya-ku, Yokohama-shi, Kanagawa, Japan*
- 87 **The action mechanism and regularities of the additive for friction-increasing grease**  
Yi LIU, Xiangjun ZHANG, Huan LIU, Haoda JING, Simo MAKIMATTILA  
*Tianjin Research Institute for Advanced Equipment, Tsinghua University, China; Tsinghua University, China; KONE, Poland*
- 88 **Enzymatic oligomerization of p-methoxyphenol and phenylamine providing poly (p-methoxyphenol-phenylamine) with improved antioxidant performance in ester oils**  
Shengmao ZHANG, Changqing MIAO, Zhijun ZHANG, Pingyu ZHANG  
*Henan University, China*
- 89 **Tribology mechanism study of Cu nano-additives in DLC-based solid-liquid synergetic system**  
Yujuan ZHANG, Yaohui LIU, Shengmao ZHANG, Pingyu ZHANG  
*Engineering Research Center for Nanomaterials, China; Collaborative Innovation Center of Nano Functional Materials and Applications of Henan Province, Henan University, China*
- 90 **Study on thermogravimetry property and lubricating behavior of lathanump perrenate as oil additive in a wide temperature range**  
Junhai WANG, Sihan HOU, Yang LIU, Deli DUAN, Shu LI  
*Institute of Metal Research, Chinese Academy of Sciences, China; School of Mechanical Engineering, Shenyang Jianzhu University, China*
- 91 **Study on the antiwear properties and synergistic antioxidation of titanate with amine antioxidants in lubricants**  
Jianqiang HU, Jianjian ZHANG, Xin XU, Shizhao YANG, Feng XIE  
*Department of Aviation Oil and Material, Air Force Logistics College, China*
- 92 **On the dispersion of biodiesel soot and its influence on the tribological behaviour of liquid paraffin**  
Chuan LI, Ruhong SONG, Bingxun YANG, Tianxia LIU, Xianguo HU  
*Hefei University of Technology, China*
- 93 **All-atom molecular dynamics study of absorbing process of organic monolayers**  
Masakazu KONISHI, Hitoshi WASHIZU  
*University of Hyogo, Japan*
- 94 **Preparation of water-soluble Cu nanoparticle surface-capped by polyethylene glycol xanthate and evaluation of their tribological properties**  
Yan WANG, Chunli ZHANG, Shengmao ZHANG, Pingyu ZHANG  
*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, Henan University, China*
- 95 **Preparation of oil-soluble copper nanoparticles for lubricant applications**  
Yanhong LI, Shengmao ZHANG, Pingyu ZHANG  
*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, Henan University, China*
- 96 **Antimicropitting investigation of four EP&AW additive containing phosphorus**  
Jiping ZHANG, Peng WANG, Yuanjing DAI, Chenhui ZHANG  
*Tianjin Research Institute for Advanced Equipment, Tsinghua University, China; Tsinghua University, China; PetroChina Lanzhou Lubricating Oil R&D Institute, China*



- 97 **Synthesis of size-controlled Ag<sub>2</sub>S nanoparticles by solventless thermolytic method and their tribological properties as lubricating oil additive**  
Chunli ZHANG, Shengmao ZHANG, Pingyu ZHANG  
*National & Local Joint Engineering Research Center for Applied Technology of Hybrid Nanomaterials, Henan University, China*
- 98 **Observation of tribofilm growth and friction coefficient microscopy of tribofilms**  
Sora SHIODE, Renguo LU, Hiroshi TANI, Norio TAGAWA, Shinji KOGANEZAWA  
*Kansai University, Japan*
- 99 **Optimized characterization of lubricant (ISO VG 68) with titanium oxide by response surface methodology (RSM)**  
Nor Syahirah MOHAMAD, Salmiah KASOLANG  
*Tribology Research Group, Faculty of Mechanical Engineering, Universiti Teknologi MARA, 40450 Shah Alam Selangor, Malaysia; Faculty of Mechanical Engineering, Malaysia; Universiti Teknologi MARA, 40450 Shah Alam Selangor, Malaysia*
- 100 **Synthesis of carbon spheres and its size dependent water based lubrication**  
Guanggui CHENG, Jianning DING, Noshir.S PESIKA, Ying WANG  
*Jiangsu University, China, Changzhou University, China; Tulane University, USA*
- 101 **The study of WS<sub>2</sub> nanoparticles anti-wear and friction reducing properties in the persence of ZDDP additive**  
Ningning HU  
*Jiangsu Normal University, China*
- 102 **Antioxidant synergistic effects of environment friendly additive bismuth naphthenate**  
Xin XU, Jianqiang HU, Yunyun XU, Yumei WANG  
*Air Force Logistics College, China*
- 103 **Study on the tribological properties of the mixed system of molybdenum dialkyldithio carbamate combining with metal detergent**  
Liping WANG, Guangneng DONG, Jinbao XU, Dongya ZHANG, Youbai XIE  
*PetroChina Lanzhou Lubricating Oil R & D Institute, Lanzhou, China; Key Laboratory of Education Ministry for Modern Design & Rotor-Bearing System, Xi'an Jiaotong University, Xi'an, China; School of Mechanical and Precision Instrument Engineering, Xi'an University of Technology, China*
- 104 **Lubricating performance of phytic acid as a water-based lubricant additive in Si<sub>3</sub>N<sub>4</sub>-copper sliding contact**  
Yong WAN, Yankun YU, Shuai GAO, Qi CJEN  
*Qingdao University of Technology, China*
- 105 **Investigation of effect of super-hydrophobic MoS<sub>2</sub>/TiO<sub>2</sub> on paraffin**  
Leihua XU, Mei LENG, Dekun ZHANG  
*China University of Mining and Technology, China*
- 106 **Graphene-based engine oil**  
Shanhong WAN, Yana XIA, Kiet TIEU, Hongtao ZHU, Bach H. TRAN, Shaoqiang CUI  
*University of Wollongong, Australia*
- 107 **CO<sub>2</sub> influence on amino acid based ionic liquids as lubricating additives**  
Jian WU, Xiang YIN, Xiaohua LU, Xin FENG, Yijun SHI  
*Lule&#229, University of Technology, Sweden; State Key Laboratory of Materials-oriented Chemical Engineering, Nanjing Tech University, Nanjing 210009, China*
- 108 **Tribological properties of biological lubricating greases of lard and tallow**  
Juozas PADGURSKAS, Raimundas RUKUIZA, Arturas KUPČINSKAS, Raimondas KREIVAITIS  
*Aleksandras Stulginskis University, Lithuania*
- 109 **Analysis of tool wear mechanism in high-speed milling of carbon fiber reinforced polymer**  
Youxi LIN, Zhiying REN  
*Fuzhou University, China*
- 110 **Analysis of tool wear mechanism and wear form in high-speed milling of carbon fiber reinforced polymer**  
Hua LIN, Youxi LIN, Longyi JIAN  
*Fuzhou University, China*
- 111 **Effects of carbon nanotubes on the friction characteristics of Al<sub>2</sub>O<sub>3</sub>/TiC ceramic conical die composite**  
Xuefeng YANG  
*School of Mechanical Engineering, University of Jinan, China*
- 112 **Tool wear in dry and wet turning**  
Joanna KOWALCZYK, Stanisław PLAZA, Łukasz NOWAKOWSKI, Monika MADEJ, Dariusz OZIMINA  
*The Kielce University of Technology, Poland; University of Lodz, Poland*
- 113 **Study on tool wear in Ti<sub>6</sub>Al<sub>4</sub>V drilling and cutting parameter optimization**  
Xiaoqin WANG, Shouren WANG, Xiuli FU, Yongzhi PAN, Jun ZHAO  
*University of Jinan, China; Shandong University, China*
- 114 **Friction torque performance reliability prediction for thin walled angular contact ball bearing**  
Hui DU  
*Henan University of Science and Technology, China*
- 115 **Creep behaviors and microstructure of babbitt alloy SnSb<sub>1</sub>Cu<sub>6</sub>**  
Jianmei WANG, Fanning MENG, Yawen XUE  
*School of mechanical engineering, Taiyuan University of Science and Technology, China*
- 116 **Finite element simulation of two-dimensional high speed cutting considering the rough surface of the tool corner**  
Lei MIN  
*Fuzhou University, China*
- 117 **Mechanical behavior of confined granules in manufacturing interface**  
Wei WANG, Shuqing HOU, Kun LIU  
*Hefei University of Technology, China*
- 118 **The research on creeping phenomenon in the process of metal plastic forming based on powder lubrication**  
Yi ZHANG, Wei WANG, Kun LIU  
*Institute of Tribology, Hefei University of Technology, China*
- 119 **Galling behavior in deep drawing process with advanced high strength steel sheet**  
Wenzheng DONG, Junjie WEN, Ling XU, Qiquan LIN  
*Xiangtan University, China*
- 120 **Investigation of copper and titanium synergistic removal in TSV CMP**  
Can RAO, Tongqing WANG, Jie CHENG, Yuhong LIU, Xinchun LU  
*State Key Laboratory of Tribology, Tsinghua University, China*

- 121 **Study on simultaneous removal of silicon/copper hybrids using SiO<sub>2</sub> abrasive with different functional groups in chemical mechanical polishing**  
Gaopan CHEN, Tongqing WANG, Guoshun PAN, Yuhong LIU, Minmin GU  
*Research Institute of Tsinghua University in Shenzhen, China; State Key Laboratory of Tribology, Tsinghua University, China; Guangdong Provincial Key Laboratory of Optomechanics, China*
- 122 **Molecular dynamics simulation of abrasive water jet**  
Ruling CHEN  
*College of Mechanical Engineering, Donghua University, China*
- 123 **The behavior of slurry additives during the removal of heterogeneous**  
BingQuan WANG  
*Department of Mechanical Engineering, Tsinghua University, China*
- 124 **The recent techniques in free-form surface registration**  
Ding SHEN, Youxi LIN  
*Fuzhou University, China*
- 125 **Friction and wear behavior of phenolic resin binder during fixed-abrasive polishing**  
Zhe WU  
*Hefei University of Technology, China*
- 126 **Experimental study on surface quality in elasticity ball-end grinding of M330 steel**  
Xiaojun WU, Tianze ZHOU, Zhixue TONG  
*School of Mechanical and Electrical Engineering, Xi'an University of Architecture and Technology, China*
- 127 **Tool wear behavior in high speed milling of carbon fiber-reinforced plastic**  
Jie YU, Youxi LIN  
*Fuzhou University, China*
- 128 **Numerical modeling and analysis of sub-surface damage in the cutting process of carbon fiber**  
Youxi LIN, Zhiying REN  
*Fuzhou University, China*
- 129 **Analysis the influence of asperities in rough surface of optical lens to its subsurface damage**  
Zhiying REN, Youxi LIN  
*Fuzhou University, China*
- 130 **Simulation study on ultrasonic vibration-assisted cutting of carbon fiber reinforced polymer composites**  
Dexiong CHEN, Youxi LIN, Zhiying REN  
*Fuzhou University, China*
- 131 **Study on surface quality of optical glasses grinding assisted by ultrasonic vibration**  
Xinxin MENG  
*Fuzhou University, China*
- 132 **Effect of temperature variation on adhesive contact force behavior and deformation of substrate based on atomic scale**  
Jingjing CHEN  
*Ningde Normal university, China*
- 133 **Wear behaviors of CrAlCN composite coating for precision glass molding fabricated by PIIID**  
Feng GONG, Kangsen LI, Zhiwen XIE  
*Shenzhen University, China; University of Science and Technology Liaoning, China*
- 134 **Morphology analysis of engine valve guide wear surface**  
Pengfei ZHOU, Xiangjun ZHANG, Benfu MEI, Huan LIU, Jun CHEN, Lihua ZONG, Weiqin LANG, Lipu NING  
*Tianjin Research Institute for Advanced Equipment, China; Pan Asia Technical Automotive Center, China*
- 135 **Deposition characteristics of oil droplet in a simplified bearing chamber**  
Bo CHEN, Dingming WANG, Zhongtao GU  
*Southwest University of Science and Technology, China*
- 136 **Analysis of factors affecting rubber friction vibration of water lubricated stern bearing**  
Shengkun LAO, Yong JIN  
*Wuhan University of Technology, China*
- 137 **The modification of poly alpha olefin and its properties for using as additive in lubricant**  
Xuzhi XUE  
*Shanghai Jiao Tong University, China*
- 138 **Research for diamond-like carbon films on key parts of the automobile engine**  
Kaixiong GAO, Bin ZHANG, Li QIANG, Junyan ZHANG  
*Lanzhou Institute of Chemical Physics, China, Chinese Academy of Sciences, University of Chinese Academy of Sciences, China*
- 139 **Study on vertical vibration of high-speed wheel-rail rolling contact based on spring-damper model**  
Qian XIAO, Jifeng ZHENG, Chao CHANG, Jiao FANG, Jihua LIU  
*East China Jiaotong University, China*
- 140 **A review of research on oil consumption and transport in the piston ring pack**  
Wenbin CHEN  
*Dalian Maritime University, China*
- 141 **The research of marine engine fault diagnosis system based on cloud platform**  
Minjie CHEN, Xincong ZHOU, Yanan PU, Fuming KUANG  
*Wuhan University of Technology, China; Guangzhou Mechanical Engineering Research Institute Co., Ltd., China*
- 142 **Stability analysis of journal hybrid bearing with deep/shallow pockets considering the viscosity-temperature effect**  
Hong GUO, Ruizhen LI, Guang ZHU  
*Zhengzhou University, China*
- 143 **Performance analysis of non-circular floating ring bearing under steady-state condition**  
Sandeep SONI, D. P. VAKHARIA  
*S.V.N.I.T., India*
- 144 **Principle experiments research of noise in engine main bearing**  
Xu LIU, Xiaoyang CHEN, Peng WANG, Xuejin SHEN, Ben NI  
*Research Institute of Bearings Shanghai University, China; Ford Motor Company, China*
- 145 **Study on levitation characteristics of thrust foil gas bearing using bump metal mesh foil**  
Ryo ODAGIRI, Masayuki OCHIAI, Hiromu HASHIMOTO  
*Tokai University, Japan*
- 146 **The structural parameters of rolling bearing influence on the dynamic characteristic of the high-speed rotor system**  
Jingjing ZHANG, Liqin WANG, Ping GONG  
*Harbin Institute of Technology, China*



- 147 **Experimental study on damage mechanism of skidding for cylindrical roller bearings**  
Jun LUO, Xiangyu XIE, Mingwei FANG, Jin XU, Yonggang MENG, Yu CHEN  
*Guizhou Provincial College-based Engineering Research Center for Materials Protection of Wear and Corrosion, China; College of Chemistry and Materials Engineering, Guiyang University, China; School of Mechanical Engineering, Guizhou University, China; State Key Laboratory of Tribology, Tsinghua University, China; Guizhou Liyang Aero-engine Corporation, China*
- 148 **Effects of thermal and surface morphology factors on the skidding of high-speed and light-load roller bearings**  
Junling LI, Wei CHEN  
*Xi'an Technological University, China; Xi'an Jiaotong University, China*
- 149 **Effects of flexible supporting ways on the performance of thin-walled bearings for robots**  
Ming QIU, Chunsheng ZOU, Xiaoxu PANG, Hui DU  
*Henan University of Science and Technology, China, Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, China*
- 150 **Tribological application of elastomer seals and green tribology for energy saving and emission reduction**  
Gui-Bin TAN, Xing HUANG, Si-Wei ZHANG  
*National Engineering Research Center of Rubber&Plastic Sealing, China; College of Mechanical and Transportation Engineering at China University of Petroleum-Beijing, China*
- 151 **Numerical simulation and investigation on brush seal hysteresis based on MpCCI fluid-structure interaction**  
Yuchi KANG, Meihong LIU, Yongfa TAN, Jinbin LIU, Xueliang WANG  
*Kunming University of Science and Technology, China*
- 152 **Experimental investigation on the uneven bidirectional-wedge frictional wear characteristics of non-contacting finger seals**  
Xiangyu HU, Yongjian LI, Kaibing DU, Shuangfu SUO, Yuming WANG  
*Tsinghua university, China; CCRC Zhuzhou Institute Co.LTD, China*
- 153 **An investigation of impact-sliding wear of thermoplastic material**  
Jie JIANG, Yiyong YANG, Yongjian LI, Weifeng HUANG  
*China University of Geosciences (Beijing), China; Tsinghua University, China*
- 154 **Investigation of boundary friction property of rubbers for lip seals**  
Shigenobu HONDA, Joichi SUGIMURA  
*NOK Corporation, Japan; Kyushu University, Japan*
- 155 **Effect of interference fit on the performance of a wavy-tilt-dam mechanical seal**  
Yuechang WANG, Ying LIU, Weifeng HUANG, Yuming WANG  
*State Key Laboratory of Tribology, Tsinghua University, China*
- 156 **Interaction between transfer film formation and wear evolution of glass fiber filled PTFE**  
Feng ZHU, Dehong WANG, Jie YANG, Jiawei LIU, Songjian LI, Jiujuun XU  
*Key Lab of Ship-Machinery Maintenance & Manufacture, Dalian Maritime University, China; Shanghai MicroPowers Co. Ltd., China*
- 157 **Visualization experiment of dry gas seals under conditions of bi-directional rotation**  
Yosuke AKETO, Masayuki OCHIAI, Hiromu HASHIMOTO  
*Tokai University, Japan*
- 158 **An experimental investigation of the influence of carbon particles in engine oil on wear of radial lip seal and shaft**  
Fangman XU, Ken-ichi YOSHIMURA, Shigenobu HONDA, Hirota MIZUTA  
*NOK Corporation, Japan*
- 159 **Effects of working conditions on mixed thermo-EHL performance of a helical gear pair involving surface roughness**  
Mingyong LIU, Chenhui WU, Yadong LIU  
*Hubei university of Technology, China*
- 160 **Role of tribolayers on friction reduction and scuffing resistance of thermal spray coatings used in internal combustion engines**  
Ahmet ALPAS, Anindya BANERJI, Guanhong SUN, Ming LOU, Michael LUKITSCH, Daniel WHITE, Brian MCCLORY  
*University of Windsor, Canada; General Motors, Canada*
- 161 **Stick-slip behaviour analysis in water lubricated rubber bearing**  
Jian HUANG, Xincong ZHOU, Xiaoran ZHOU, Fuming KUANG, Jun WANG  
*Wuhan University of Technology, China*
- 162 **Experimental evaluation of bio-derived automatic transmission fluid clutch friction performance**  
Robert JACKSON, Cade GUEST, Corey DONALDSON, James MARTIN, Bethanee SMITH, Stephen SHAFFER, George COOK, Bernie ROELL, Ray ENGEL, Juncheng LIU, Claude HALL  
*Auburn University, USA; Bruker Nano Surfaces Division, USA; RSC Bio Solutions, USA; Alto Products Corp., USA*



**PS2-Wear & Surface Engineering & Biotribology & Biomimetics & Industrial Tribo-systems & Tribotest and Monitoring & Forum of Young Tribologists-Organized by CTI & STLE**  
**Time: 15:30 - 16:30, 20 September**  
**Venue: Lounge Area, 2<sup>nd</sup> Floor**

- 163 **Friction and wear behavior of cotton stalk rubbing on electroplated chromium coating**  
 Youqiang ZHANG, Yonggang MENG  
*State Key Laboratory of Tribology, Tsinghua University, Beijing 100084, China*
- 164 **Analysis of wear mechanism evolvement of the rolling die material on the basis of ring-block test**  
 G. BIAN<sup>1,2</sup>, M. CHENG<sup>1</sup>, Y. LIU<sup>1</sup>, S.H. ZHANG<sup>1</sup>  
<sup>1</sup>*Institute of Metal Research, Chinese Academy of Sciences, Shenyang, 110016, China;* <sup>2</sup>*School of Materials Science and Engineering, University of Science and Technology of China, Hefei 230026, PR China*
- 165 **Mathematical analysis of the entrapment of solid spherical particles in viscoelastic body/ metal friction pair**  
 Hongling QIN  
*China Three Gorges University, 8 University Avenue, Yichang, Hubei 443002, China*
- 166 **Effect of various oxide nanoparticles and their combinations on the tribological behavior of PEEK composite reinforced with carbon fibers**  
 Lihe GUO  
*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, No.18, Tianshui Middle Road, Lanzhou, China*
- 167 **Micromechanical analysis for fretting wear of interference-fit joint interface in carbon fiber/epoxy composites under service loading**  
 Danlong SONG, Kaifu ZHANG, Yanchao ZHANG, Jinfu DU  
*Xi'an University of Technology, China; Northwestern Polytechnical University, China*
- 168 **Wear behavior of Ag implantion GH4169 by ion beam assisted bombardment**  
 Meng XU  
*Engineering Building #551, Hunan University, China*
- 169 **Study on influence of cyclic loading on rail material wear performance**  
 Caiyun WANG, Qiyue LIU  
*LanZhou JiaoTong University, China; Southwest Jiao Tong University, China*
- 170 **Study on bending fretting fatigue damages of CuMg<sub>0.4</sub> alloy**  
 Xiyang LIU, Jinfang PENG, Zhibiao XU, Wulin ZHANG, Jianhua LIU, Minhao ZHU  
*Tribology Research Institute, Traction Power State Key Laboratory, Southwest Jiaotong University, China; Key Laboratory of Advanced Technologies of Materials of Ministry of Education, Southwest Jiaotong University, China*
- 171 **An experimental study on torsional fretting fatigue of EA4T axle steel**  
 Jinfang PENG, Xiao JIN, Zhibiao XU, Zhenbing CAI, Jianhua LIU, Minhao ZHU  
*Traction Power State Key Laboratory, Southwest Jiaotong University, China; Tribology Research Institute, Key Laboratory of Advanced Technologies of Materials of Ministry of Education, Southwest Jiaotong University, China*
- 172 **Effect of texture pattern on change in topography of AISI 1020 steel when sliding against AISI 8620 steel**  
 Deepak Kumar PRAJAPATI, Mayank TIWARI  
*Inidan Institute of Technology Patna, India*
- 173 **A study on the application of M50 NiL bearing cage-land shoulder**  
 Dong SUN, Cong Hao LIU  
*AECC Harbin Bearing co.Ltd, China; Liaoning University of Technology, China*
- 174 **Comparison of particle trajectories in the air and helium filled head-disk interface**  
 Fuhao CUI, Shengnan SHEN, Hui LI, Sen LIU, Shijing WU  
*School of Power and Mechanical Engineering, Wuhan University, Wuhan, Hubei, China*
- 175 **Damage evolution and contact mechanics of interfacial delamination in traveling wave ultrasonic motor**  
 Yu WANG, Shengnan SHEN, Hui LI, Mang CAI  
*School of Power and Mechanical Engineering, Wuhan University, Wuhan, Hubei, China*
- 176 **Sliding friction and corrosion behavior of medium manganese austenitic steel and martensitic steel**  
 Jian WANG, Qinliang WANG, Zhengxin HU, Kang XU  
*China University of Mining and Technology, China*
- 177 **Fretting behavior between the interface of PEEK and highly cross-linked polyethylene**  
 Handong XU, Dekun ZHANG, Kai CHEN  
*School of Mechanical and Electrical Engineering, China University of Mining and Technology, China*
- 178 **Isolation and analysis of artificial joint wear debris**  
 Tao ZHANG, Dekun ZHANG, Hongtao LIU  
*Institute of Tribology and Reliability Engineering, China University of Mining and Technology, Xuzhou, Jiangsu, 221116, China*
- 179 **Investigations of PTFE wear behavior using molecular dynamics simulation**  
 Deng PAN  
*Yanshan University, China*
- 180 **Study of friction and wear behaviors of pure carbon strip affected by vibration load during current-carrying sliding**  
 Yanyan ZHANG, Yongzhen ZHANG, Shangguan BAO  
*Henan University of Science and Technology, kaiyuan street, Luolong district, Luoyang, Henan, 471003, China*
- 181 **Effects of random vibration on wear of fretting interface**  
 Zhinan ZHANG, Nian YIN, Fagang ZHAO  
*Shanghai Jiao Tong University, China; Shanghai Institue of Satellite Engineering, China*
- 182 **Wear behavior of particles reinforced steel matrix composites**  
 Huahui CHEN, Yang QIN  
*China University of Mining and Technology, D11 Xueyuan Road, China*
- 183 **Tribological behaviour of nanocellulose-reinforced wooden composites**  
 Rui Rosa de MORAIS JÚNIOR, Gabriel VALIM CARDOSO, Henara LILLIAN COSTA  
*Federal University of Rio Grande, Brazil; Federal University of Pampa, Brazil; Federal University of Pelotas, Brazil*



- 184 **Sliding wear of clay-based pavers with different mineralogical rock additions**  
Michell Felipe Cano ORDONEZ, Marcelo PERUZZO, Aline Luiza BANDEIRA, Jadna CATAFESTA, Maria Cristina MORÉ FARIAS  
*Surface Phenomena Laboratory, Polytechnic School of the University of Sao Paulo, Brazil; Centro de Ciências Exatas e da Tecnologia, Universidade de Caxias do Sul, Brazil*
- 185 **A Study of abrasive wear on high speed steel surface in hot rolling by discrete element method**  
The Hoang PHAN, Anh Kiet TIEU, Hongtao ZHU, Buyung KOSASIH, Dinh Thi TA  
*Faculty of Engineering and Information Sciences, University of Wollongong, Australia*
- 186 **Wear properties between graphene and molybdenum disulfide**  
Yiming SONG, Ming MA, Li LIN, Quanshui ZHENG  
*Department of Mechanical Engineering, Tsinghua University, China; Center for Nano and Micro Mechanics, Tsinghua University, China; State Key Laboratory of Tribology, Tsinghua University, China; Department of Engineering Mechanics, Tsinghua University, China*
- 187 **Revolute clearance joint wear in mechanical system with flexible link**  
Zhengfeng BAI, Pingping WANG, Jun CHEN, Yang ZHAO  
*Harbin Institute of Technology, China*
- 188 **The friction and wear property of bainite-martensite steel used for cutter tooth of cutter suction dredger**  
Junxiang WANG, Da HU, Wenshuai TIAN, Shuren LIU  
*Tianjin Will Long Sci. & Tech. Co., Ltd, No.28 Hongze Rd, Xiqing Economic Development Area, Tianjin, China*
- 189 **The research on welding performance of medium manganese steel in gas metal-arc welding**  
Junxiang WANG, Da HU, Shuren LIU, Bin WANG  
*Tianjin Will Long Sci. & Tech. Co., Ltd, No.28 Hongze Rd, Xiqing Economic Development Area, Tianjin, China*
- 190 **Experimental study on tribological behavior of the W-Ni-Fe alloy against SIMP steel in the different atmosphere**  
Y.C. XU, X.Y. SHENG, J.Q. SUN  
*Tianjin research institute for advanced equipment, Tsinghua University, China; Department of Mechanical Engineering, Tsinghua University, China*
- 191 **Experimental study on the delamination wear of the carbon strip in the pantograph and catenary system with electric current**  
Hongjuan YANG, Lin FU, Weiwei QIAN, Guangzhu CHEN, Guangxiong CHEN  
*The College of Nuclear Technology and Automation Engineering, Chengdu University of Technology, Sichuan, China*
- 192 **Tribological behaviours of copper mesh and flaky graphite-modified carbon/carbon composite**  
Pei WANG  
*Central South University, No.932, Lushan South Road, Changsha City, Hunan Province, China*
- 193 **Relations of counterface hardness with wear behavior and mechanism of AISI H13 steel**  
Qiuyang ZHANG, Hongyan DING, Guanghong ZHOU, Lincai ZHANG, Shuqi WANG  
*Faculty of Mechanical and Material Engineering, Huaiyin Institute of Technology, China; School of Materials Science and Engineering, Jiangsu University, China*
- 194 **Analysis of nanoscale wear for a single asperity by using atom-by-atom model**  
Yunian SHEN<sup>1,2</sup>  
<sup>1</sup>*Department of engineering Science, Nanjing University of Science and Technology, Nanjing, China;* <sup>2</sup>*Department of Mechanical Engineering, University of California, Berkeley, USA*
- 195 **Improvement of wear and corrosion resistance for plasma ion nitrided austenitic stainless steel in seawater condition**  
Sang-Ok CHONG, Kwang-Hu JUNG and Seong-Jong KIM  
*DNV GL  
Mokpo National Maritime University, Korea; Division of Maritime, DNV GL, Busan, 48120, Korea*
- 196 **Research progress of piezoelectric sensors in structural health monitoring**  
Zifan XUE, Zhiguo XING, Haidou WAMG, Zhe LIU, Congshuo ZHAO  
*Academy of Armored Forces Engineering, China*
- 197 **Research progress of laser cladding coating on the surface of different substrate materials**  
Congshuo ZHAO, Zhiguo XING, Haidou WAMG, Zhe LIU  
*Academy of Armored Forces Engineering, China*
- 198 **The research of the crack propagation in thermal spray remanufacturing products**  
Feijuan WEN, Lihong DONG, Haidou WANG Yuelan DI  
*Academy of Armored Forces Engineering, China*
- 199 **Effects of atomic oxygen erosion on the microstructure and properties of the polymeric amorphous carbon films**  
Xiaoqiang LIU  
*Sichuan University of Science and engineering, China*
- 200 **Tribological properties of Cr<sub>3</sub>C<sub>2</sub>-Co coatings on 42CrMo by plasma arc welding under abrasive wear condition**  
Ruimin SHI, Lei DONG, Kun LIU  
*North university of China, China; Hefei University of Technology, China*
- 201 **Achieving engineering ultra-low friction: fullerene like structure hydrogenated carbon thin film**  
Yongfu WANG  
*Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, Lanzhou 730000, China; Chinese Academy of Sciences, China*
- 202 **Microstructures and properties of ZrC-SiC composite ceramic coating by thermal evaporation - in situ reaction**  
Yonglong XU, Wei SUN  
*State key Laboratory for Powder Metallurgy, Central South University, Changsha, Hunan, China*
- 203 **Effects of rare element La on microstructure and tribological behavior of niobium carbide coating on Cr12MoV steel prepared by packing method**  
Jian SHANG, Yue ZHANG, Pan ZHENG  
*Liaoning University of Technology, China*
- 204 **The effect of substrate bias voltage on the adhesion strength of Ta-C coated tools prepared by filtered cathode vacuum arc**  
Jongkuk KIM, Dongsik KIM, Young-Jun JANG  
*Korea Institute of Materials Science (KIMS), 797 Changwondaero, Seongsangu, South Korea*
- 205 **Finite-element analysis design on microstructure of chromium-free self-lubricating passivation film**  
Kun MENG, Fan ZHANG, Zhefeng XU, Yang LI, Yuan WANG, Xiaohua YU, Zhaolin ZHAN  
*Southwest Forestry University, China; Kunming University of Science and Technology, China*



- 206 **ZrB<sub>2</sub>-SiC ceramic coating for C/C composite material microstructure and oxidation performance**  
Xinshaung WANG, Zhaoke CHEN, Ping YANG  
*Powder Metallurgy Research Institute, State Key Laboratory of Powder Metallurgy, Central South University, Changsha, China*
- 207 **The tribological and electrochemical behavior of HVOF sprayed WC-10Co-4Cr coatings**  
Sheng HONG, Yuping WU, Bo WANG, Jianfeng ZHANG, Yuan ZHENG  
*Hohai University, 8 Focheng West Road, Nanjing, Jiangsu, 211100, China*
- 208 **Effect of 30 °C annealing on friction and wear properties of Ni-AT13 coating with different Ni content**  
Ming-ming YAN, San-ming DU  
*Henan University of Science and Technology, 263, Kaiyuan Avenue, Luoyang, Henan, China*
- 209 **Analyzation of P20 steel electro-sparking deposite Fe-base friction and wear properties**  
Chenzhu DONG, Jing YANG, Nana CAO  
*AECC Harbin Bearing Ltd.Co, China*
- 210 **Voltage biases controlled tribological properties of amorphous carbon film embedded with graphene nanocrystallites**  
Kun SUN, Lei YANG, Dongfeng DIAO  
*Xi'an Jiaotong University, China; Shenzhen University, China*
- 211 **Changes in surface structure and tribological property of anodized titanium induced by hydrothermal exposure**  
Zhaoxiang CHEN  
*Yanshan University, China*
- 212 **Tribological studies of piston rings with four Ni-P based coatings lubricated with bio-oil**  
Yubin PENG, Yufu XU, Jian GENG, Xianguo HU  
*Hefei University of Technology, 193 TunXi Rd., Hefei, Anhui, China*
- 213 **Thermodynamic theory on surface roughness during the epitaxial growth of SixGe1-x coating on Si nanowire substrate**  
Yuanyuan CAO, Dongfeng DIAO  
*Shenzhen University, China*
- 214 **Tribological performance of ionic liquids as lubricants of diamond like carbon coatings**  
Monika MADEJ, Dariusz OZIMINA, Krystian MILEWSKI, Sebastian SIERADZAN  
*Kielce University of Technology, Poland; Trzuskawica S. A. Poland*
- 215 **The tribological behaviour of HVOF sprayed composite coatings under sliding conditions**  
Dariusz OZIMINA, Ewa OZIMINA, Andrzej KRZYSZKOWSKI, Monika MADEJ, Stanislaw PLAZA  
*Kielce University of Technology, Poland; Kazimierz Pulaski University of Technology and Humanities in Radom, Poland*
- 216 **Study on microstructure and properties of HVOF sprayed Ni-CaF<sub>2</sub>-WS<sub>2</sub> coatings based on orthogonal experimental design method**  
Xiaofeng ZHANG, Zhongwei KAN, Jiaxing LI, Zhenyi HUANG  
*Anhui University of Technology, China*
- 217 **Thermo-reactive diffusion (TRD) treatment of AISI 15B30 steel**  
George TOTTEN, Ricardo AURELIANO, Fábio MARIANI, Amadeu LOMBARDI, Luiz CASTELETTI  
*Portland State University, USA; Universidade de São Paulo, Brazil; Universidade Tecnológica Federal do Paraná, Brazil*
- 218 **Wear and corrosion resistance of niobium carbide layer produced in a gray cast iron by thermo-reactive treatments**  
George TOTTEN, Fábio MARIANI, Carolina SOARES, Amadeu LOMBARDI, Luiz CASTELETTI  
*Portland State University, USA; Universidade de São Paulo, Brazil; Universidade Tecnológica Federal do Paraná, Brazil*
- 219 **TRD and boriding treatments in compact (vermicular) graphite cast iron**  
George TOTTEN, Fábio MARIANI, Carolina SOARES, Amadeu LOMBARDI, Luiz CASTELETTI  
*Portland State University, USA; Universidade de São Paulo, Brazil; Universidade Tecnológica Federal do Paraná, Brazil*
- 220 **The optimization of spraying parameters of Al<sub>2</sub>O<sub>3</sub> insulating coating based on orthogonal test**  
Ming QIU, Zhansheng ZHOU, Qinglin LI, Yingchun LI  
*Henan University of Science and Technology, China; Collaborative Innovation Center of Machinery Equipment Advanced Manufacturing of Henan Province, China*
- 221 **The corrosive wear resistance of TIN-PEEK composite coating**  
Yanbin LI, Yanchun DONG, Fang LANG, Yanbin LI  
*Hebei University of Technology, Tianjin, China*
- 222 **Pulse electrodepositon of Cu-WC composite coating**  
Muhammet KARTAL, Ahmet, ALP, Hatem AKBULUT  
*Sakarya University Esentepe Campus M7 Block Room Nb. 7006, Turkey*
- 223 **Effect of various DLC coatings on the durability of AFM tips**  
Chun WANG, Abdel DORGHAM, Vishal KHETAN, Anne NEVILLE  
*School of Mechanical Engineering, University of Leeds, UK*
- 224 **Tribological studies of high velocity oxygen fuel (HVOF) superalloycoatings**  
M. KANDEVA<sup>1</sup>, D.KARASTOYANOV<sup>2</sup>, ZH. KALITCHIN<sup>3</sup>, P. SVOBODA<sup>4</sup>  
<sup>1</sup>Faculty of IndustrialEngineering, Tribology Center, Technical University – Sofia, 8 Kl. OhridskiBlvd, 1000 Sofia, Bulgaria, E-mail: kandevam@gmail.com; <sup>2</sup>Institute for Information and CommunicationTechnologies, Bulgarian Academy of Sciences, Bulgaria, dimikara@abv.bg; <sup>3</sup>SciBuCom 2 Ltd., P.O.Box 249, 1113Sofia, Bulgaria kalitchin@gmail.com; <sup>4</sup>Faculty of MechanicalEngineering, Brno University of Technology, 2 Technicka,616 69 Brno, Czech Republic, E-mail: Petr.Svoboda@vut.cz
- 225 **Tribological properties of CrN coated 20CrMo at high temperatures**  
Jiliang LIU , Ridong LIAO, Guoxin XIE, Jun LUO, Bin LIAO  
*Beijing Institute of Technology, China; State Key Laboratory of Tribology, Tsinghua University, China; College of Nuclear Science and Technology, Beijing Normal University, China*
- 226 **The influence of APTES interlayer on the properties of RGO-APTES lubricant coating on titanium substrate**  
Pengfei LI, Hui LIU, Xianhua CHENG  
*Liaoning Technical University, China; Liaoning Technical University, China; Department of Mechanical Engineering, Shanghai Jiao Tong University, China*
- 227 **Investigation on influence of ultrasonic stirring on mass transfer in through-mask electrochemical micromachining process**  
Quandai WANG, Xingxing CAI, You LV, Li WANG, Pengyang LI, Jiming XIAO  
*Xi'an University of Technology, China; Xi'an JiaotongUniversity, China*



- 228 **Optimized design and experimental research on parameters of laser texturing micro-dimples on cylinder bore**  
Huiqin ZHOU, Bifeng YIN, Bo XU  
*School of Automotive and Traffic Engineering, Jiangsu University, China*
- 229 **The collision sliding contact of textured surface under micro-gravity**  
Zefen QUAN, Ruiting TONG, Geng LIU  
*Northwestern Polytechnical University, Youyi Road, Xi'an, Shaanxi, China*
- 230 **Tribological properties of laser textured surface**  
Dawit Zenebe SEGU, Chengxu LU, Pyung HWANG  
*280 Daehak-Ro, Gyeongsan, Gyeongbuk 38541, Republic of Korea*
- 231 **Deposition and tribological properties of silver based composite lubricating coatings on the textured surfaces**  
Jianliang LI, Hang LI, Dangsheng XIONG, Jun WANG, Heguo ZHU  
*Nanjing University of Science and Technology, China*
- 232 **The tribological performance of striped TiN film**  
Yingqian LA  
*University of Science and Technology Beijing, No.30, Xueyuan Road, Haidian District, Beijing, China*
- 233 **Study on high temperature friction characteration and properties of Ta alloying layer on M50 steel induced by high current pulsed electron beam**  
Dian LUO, Guangze TANG, Xinxin MA, Le GU, Liqin WANG, Qiang MU, Tingbao WU  
*School of Materials Science and Engineering, Harbin Institute of Technology, Nangang District, Heilongjiang, China*
- 234 **Macro-scale tribological properties of carbonhydrate polymer film with stearic acids as additive**  
Shih-Chen SHI SHI, Yao-Qing PENG  
*National Cheng Kung University (NCKU), Taiwan*
- 235 **Tribological performance of rice husk ceramic particles**  
Enzhu HU  
*Hefei University, China*
- 236 **The analysis of nano scratch based on fractal surface**  
Junyan ZUO, Youxi LIN, HaoSheng PANG  
*Fuzhou University, China*
- 237 **Developing polymer brush lubrication solutions for silicon nitride hybrid contacts: from LFM to pin-on-disk**  
Simon WATSON, Ling WANG, Mengyan NIE, Steve HINDER, Keith STOKES  
*University of Southampton, UK; University of Surrey, UK*
- 238 **Morphology and wettability transition of impregnated graphite by laser treatment**  
Zhixiang SONG, Songtao HU, Fei GUO, Ying LIU, Xiangfeng LIU, Yuming WANG  
*State Key Laboratory of Tribology, Tsinghua University, Beijing, China*
- 239 **Enhancement of microtribological properties of locally modified single crystalline SiC by laser irradiation**  
Koki OGAWA, Yuko AONO, Atsushi HIRATA  
*Tokyo Institute of Technology, Japan*
- 240 **Effect of nitrogen ion implantation on scuffing behaviors of M50 steel in sliding-rolling contacts**  
Chuanwei ZHANG, Le GU, Xinxin MA, Liqin WANG  
*Harbin Institute of Technology, China*
- 241 **Composition structure of diffusion layer as a key factor of wear resistance increase of boron-aluminized steels**  
Undrakh MISHIGDORZHIIYN, Igor SIZOV  
*East Siberia State University of Technology and Management, Russia*
- 242 **Preparation of robust CuO/TiO<sub>2</sub> superamphiphobic steel surface through chemical deposition and sol-gel methods**  
Bingbing XIA, Hongtao LIU, Yinan, FAN  
*College of Materials Science and Engineering, China University of Mining and Technology, Xuzhou, China*
- 243 **Study on the movement characteristics of droplets on composite structured hydrophobic surfaces**  
Meiyun ZHAO, Yang WU, Xinze ZHAO, Zekun YUAN, Wenyu PENG, Shenming XI  
*China Three Gorges University No. 8, Daxue Road, Yichang City, Hubei Province, China*
- 244 **Experimental study of a web slipping on rollers with holes under considering air temperature**  
Puttha JEENKOUR, Kittipong BOONLONG  
*Faculty of engineering, Burapha university, Thailand*
- 245 **Cavitation erosion behavior of friction stir processed stainless steel**  
Karthikeyan Tamil SELVAM, Grewal HARPREET, Arora HARPREET  
*Shiv Nadar University NH91, Tehsil Dadri Gautam Buddha Nagar Uttar Pradesh - 201314, India*
- 246 **Improved fused silica optics surface quality using CMP with colloidal silica**  
Chunli ZOU, Guoshun PAN, Li XU, Hua GONG, Yan ZHOU  
*Research Institute of Tsinghua University in Shenzhen, China; State Key laboratory of Tribology, Tsinghua University, China; Guangdong Provincial Key Laboratory of Optomechatronics, China*
- 247 **Effect of hybrid surface treatment composed of plasma nitriding and nanostructure WC coating on tribological behavior of AISI 316L steel**  
Yang LI, Yongyong HE, Wei WANG, Baoguo HU, Jun ZHAO, Junyuan MAO  
*Yantai University, China; Tsinghua University, China*
- 248 **Effect of laser shock peening on impact and sliding tribology performance of 690 alloy tube**  
Jianying JING, Zhenbing CAI, Weifeng HE, Minhao ZHU  
*Southwest Jiaotong University, China; Air Force Engineering University, China*
- 249 **Frictional response of perfluorooctanoic acid (PFOA) self-assembled monolayer (SAM) on steel.**  
Shubha H NATARAJ, Muthu Kumar M, Satish V KAILAS  
*Indian Institute of Science, India*
- 250 **Effects of shot peening treatment on cavitation erosion characteristics of gray cast iron**  
Il-Cho PARK, Min-Su HAN and Seong-Jong KIM  
*Mokpo Maritime University, Korea*
- 251 **Observation of the unexpected morphology of graphene wrinkle on copper substrate**  
Wen WANG  
*Tribology Institute, School of Mechanical Engineering, Southwest Jiaotong University, China*
- 252 **Connectivity characterization of surface topography based on percolation theory**  
Lei DONG, Ruimin SHI, Xiaojun LIU, Kun LIU  
*North university of China, China; Hefei University of Technology, China*

- 253 **Generation mechanism of Fe-base nanostructures induced by cavitation erosion**  
Fengbin LIU, Yan CUI  
*North China University of Technology, China*
- 254 **Effect of soot on the distribution and mechanical performances of ZDDP tribofilm**  
Weimin FENG, Ruhong SONG, Bingxun YANG, Yiming LIU, Xianguo HU  
*Hefei University of Technology, 193 TunXi Rd., Hefei, Anhui, China*
- 255 **The observation of tribo-induced spin seebeck effect in graphene nanocrystallited carbon film**  
Chao WANG, Dongfeng DIAO  
*Institute of Nanosurface Science and Engineering (INSE), Shenzhen University, China*
- 256 **Revising the fractal contact model of rough surfaces**  
Cuicui Ji, Xiulin Ji, Wei JIANG  
*School of Mechanical and Electrical Engineering, Hohai University, Changzhou, Jiangsu 213022, China*
- 257 **Surface crystallization of Zr-based amorphous alloy induced by erosion wear**  
Xiulin Ji, Yiping SHAN  
*Hehai University, China*
- 258 **Observation of contact angle of water droplet by fringe method with bottom up oblique incident light**  
He Li, Kentaro TANAKA, Katsumi IWAMOTO  
*Tokyo University of Marine Science and Technology, Japan*
- 259 **New comparison of topographical surface evaluation methods**  
Ralph STENGLER, Wolfgang WEINHOLD  
*Hochschule Darmstadt, Germany; Innowep GmbH, Germany*
- 260 **Corrosion-wear behaviour of surface nanocrystalline martensite steel in acid and alkaline solution**  
Licai FU, Lingping ZHOU  
*Hunan University, China*
- 261 **Corrosion-erosion interaction of in-situ transformed Cf / Al<sub>2</sub>O<sub>3</sub>**  
Chunyang WANG, Huahui CHEN  
*China University of Mining & Technology (Beijing), China*
- 262 **Research on characteristic of tribo-electric arc**  
Lianmei SONG, Yongzhen ZHANG, Shanguan BAO  
*Key Laboratory of Material Tribology, Henan University of Science and Technology, China; Henan University of Science and Technology, China*
- 263 **Corrosion and wear properties of plasma sprayed nanostructured WC-10Co-4Cr coatings**  
Xiaojing YUAN  
*Xi'an research insitute of Hi-Tech, China*
- 264 **Water lubrication properties between stainless steel and silicon nitride**  
Kenta AKAGAMI, Takatori TAKENO, Koshi ADACHI  
*Tohoku University, Japan*
- 265 **Effects of impressed current on cavitation-corrosion of Al alloy in natural seawater solution**  
Jung-Hyung LEE, Yejin YANG, Min-Su HAN and Seong-Jong KIM  
*Korea Institute of Industrial Technology, Korea*
- 266 **Design and application of polyimide based frictional materials in travelling wave ultrasonic motors**  
Gai ZHAO, Jingfu SONG, Qingjun DING, Jinhao QIU, Qihua WANG  
*Nanjing University of Aeronautics and Astronautics, China; Lanzhou Institute of Chemical Physics, China*
- 267 **Effect of rare earth oxides on tribological properties of bamboo fiber reinforced resin based friction materials**  
Kaikui ZHENG, Chenghui GAO, Fushan HE, Youxi LIN  
*School of Mechanical Engineering and Automation, Fuzhou University, 2 Xue Yuan Road Fuzhou, Fujian, China*
- 268 **Tribology behaviour and subsurface structure of nanostructured copper in low-amplitude oscillating wear**  
Zhong HAN  
*Institute of Metal Research, CAS, China*
- 269 **Friction and wear behavior of carbon film against Kevlar/PTFE braided composites in oscillatory contacts**  
Xianjuan PANG, Jian LIU, Peng WANG  
*Henan University of Science and Technology, China; State Key Laboratory of Solid Lubrication, Lanzhou Institute of Chemical Physics, China*
- 270 **The evaluation on tribological performance of NAO friction materials containing nano-ZrO<sub>2</sub> and granulated ZrO<sub>2</sub>**  
Hongyun JIN, Zhengjia Ji, Wanyue LUO, Shuen HOU  
*China University of Geosciences, Lumo road No. 388, Hongshan District, Wuhan, Hubei, China*
- 271 **Friction and wear behavior of MoS<sub>2</sub>/WS<sub>2</sub> filled PTFE composites**  
Wenzheng DONG, Yantao LI, Bo MAO, Qiquan LIN  
*School of Mechanical Engineering, Xiangtan University, Xiangtan City, Hunan Province, China*
- 272 **A study the tribological characteristics under in mixed and boundary lubrication conditions for tilting pad bearing new development materials**  
Hiromitsu KATSUKI  
*Daido Metal Co., Ltd., Japan*
- 273 **Thermo-mechanical and tribological analysis of pad-disc contact in a braking tribometer**  
Yannick DESPLANQUES, David TUMBAJOY-SPINEL, Anne-Lise CRISTOL, Sylvie DESCARTES, Y. BERTHIER  
*Centrale Lille, France; Université de Lyon, INSA-Lyon, LaMCoS, CNRS UMR5259, Villeurbanne F-69621, France; Ecole Centrale de Lille, LML, CNRS UMR8107, Villeneuve d'Ascq F-59651, France*
- 274 **Optimized characterization of fluid flow in micro pumps for biotribochemistry application**  
Mohamad Mazwan MAHAT, Salmiah KASOLANG  
*Universiti Teknologi Mara, Malaysia*
- 275 **Influence of synovial fluid pressure on biphasic lubrication property in articular cartilage**  
Shoko HORIBATA, Seido YARIMITSU, Hiromichi FUJIE  
*Tokyo Metropolitan University, Japan*
- 276 **Sliding soft interfaces**  
Espinosa MARZAL, Rosa MARIA  
*University of Illinois at Urbana-Champaign, UK*
- 277 **Torsional friction and wear behavior of Ti<sub>6</sub>Al<sub>4</sub>V alloy modified by DLC film**  
Linmin XU, Dekun ZHANG, Kai CHEN, Xuehui YANG, Qingliang WANG, Jianwei QI  
*China University of Mining and Technology, China*



- 278 **Thermal oxidation of Zr-2.5Nb alloy and its biotribological properties**  
Yong LUO, Ting YANG, Min LI, Junyang WANG, Xu RAO  
*China University of Mining and Technology, China*
- 279 **Frictional behavior of carbon nanotube reinforced artificial articular cartilage**  
Feng LI, Feng GUO, Anmin WANG, Gang ZHANG  
*Qingdao University of Science and Technology, China; Qingdao Technological University, China*
- 280 **The self-repair of cell overlay induced by the surface texture**  
Liguo QIN, Hongxing WU, Junde GUO, Guangneng DONG, Jinyou SHAO, Yali ZHANG, Mahshid HAFEZI, Sufyan MUHAMMAD  
*Xi'an Jiaotong University, China*
- 281 **Improving the biotribological properties of PEEK with combination of surface texture and UV-initiated polymerization**  
Xiaoduo ZHAO, Dangsheng XIONG  
*Nanjing University of Science and Technology, China*
- 282 **Study on the biotribology of contact interface between materials of artificial knee joint**  
Dongliang LIU, Qingliang WANG, ang, Xiao ZHANG  
*China University of Mining and Technology, China*
- 283 **The microstructure and tribological performance of functional gradient nanocomposite coatings on Ti<sub>6</sub>Al<sub>4</sub>V alloy**  
Zhangbo CHEN, Danfeng HE, Jianwei QI, Qingliang WANG  
*China University of Mining and Technology, China*
- 284 **Wear evaluation of the M340 martensitic stainless steel for biomedical applications treated by optical fiber laser**  
Ronaldo COZZA, Eurico PIERETTI, Mauricio Das NEVES  
*University Center of FEI – Educational Foundation of Ignatius “Padre Saboia de Medeiros”, Brazil; CEETEPS – State Center of Technological Education “Paula Souza”, Brazil; IPEN – Energy and Nuclear Research Institute, Brazil*
- 285 **Tribological and biological characterisation of biocompatible coatings exposed to microorganisms**  
Sławomir OKLA, Stanisław Gózdź, Bogusław RAJCHEJ, Monika MADEJ, Dariusz OZIMINA  
*Holycross Cancer Center, Poland; Institute of Nuclear Physics PAN; Poland; Kielce University of Technology, Poland*
- 286 **Influences of fingerprints and working conditions on the mechanical responses of tactile perception using finite element method**  
Wei TANG, Jiankai ZHANG, Hua ZHU, Shirong GE  
*China University of Mining and Technology, China*
- 287 **Biomimetic hierarchical structure graphene/polymer composite and its tribological property**  
Hong LIU  
*Lanzhou Jiaotong University, China*
- 288 **Adhesion and water lubrication of silastic micro-fiber arrays with monolayer surface modification**  
Yan DING  
*Nanjing University of Aeronautics and Astronautics, China*
- 289 **Enhanced the bio-tribological properties of the modified layers of Fe<sup>+</sup>/C<sup>+</sup> implanted Ti<sub>6</sub>Al<sub>4</sub>V by bionic shark skin texturing**  
Yuan WANG, Xiaohua YU, Wengang CHEN, Yu ZHENG, Kun MENG  
*Southwest Forestry University, China*
- 290 **The microstructure and contact angle of plant leaf surfaces**  
Xiaobing LI, Zhiyuan DONG, Pengxiang ZHANG, Nan TAO, Zhaoshuo GE, Hanjian LAI  
*Nanchang University, China*
- 291 **The influence of nanostructured features on bone cell functions on titanium alloy using ultrasonic surface rolling processing and plasma nitriding**  
Ke REN, Wen YUE, Hongyu ZHANG  
*China University of Geosciences(Beijing), China; Tsinghua University, China*
- 292 **Effects of immersion in simulated body fluids on the corrosion resistance and tribological behavior of carbon film**  
Liangliang HUANG, Dongfeng DIAO  
*Institute of Nanosurface Science and Engineering (INSE), Shenzhen University, China*
- 293 **Study on dynamic friction loading characteristics in friction driven servo loading system with small amplitude and high accuracy**  
Chenghu JING, Hongguang XU, Xiaoming SONG, Biao LU  
*Harbin Institute of Technology, China; Aerospace System Engineering Shanghai, China; Chengde Petroleum College, China*
- 294 **Ecological tribotechnology for renovation of automotive air filters**  
M. KANDEVA<sup>1</sup>, Zh. KALITCHIN<sup>2</sup>, P. KORNIK<sup>3</sup>  
*<sup>1</sup>Faculty of Industrial Engineering, Tribology Center, Technical University – Sofia, 8 Kl. Ohridski Blvd, 1000 Sofia, Bulgaria, E-mail: kandevam@gmail.com; <sup>2</sup>SciBulCom 2 Ltd., 32, Maragidik Str., 1505 Sofia, Bulgaria; <sup>3</sup>“RUDSERVIS K”, Industrial-Innovative Tribotechnical Center TOO “Reliability And Durability”, Zhezkazan, Kazakhstan, E-mail: kornikpetr@mail.ru*
- 295 **Preparation and tribological properties of 3D needle-punched C/C-SiC composites for railway brake system**  
Zhuan LI, Peng XIAO, Yang LI, Jinwei LI, Yuhai LU, Bengu ZHANG  
*Central South University, China*
- 296 **A calculation model of the rail corrugation growth based on the friction induced self-excited vibration of a wheel-rail system**  
Weiji QIAN, Zhiqiang HUANG  
*Southwest Petroleum University, China*
- 297 **On the sliding behavior of PAEK composites in vacuum environment**  
Géraldine THEILER, A P HARSHA, Thomas GRADT  
*Bundesanstalt für Materialforschung und -prüfung, Germany; Indian Institute of Technology, India*
- 298 **In-situ observation of sand medium movement during tool-wellbore slide friction process in horizontal well**  
Liu YANG, Yanbao GUO, Deguo WANG, Shuhai LIU, Zheng ZHANG  
*China University of Petroleum-Beijing, China*
- 299 **Vibration analysis of high speed motorized spindle supported on angular contact ball bearing system**  
PingPing HOU, Liqin WANG, Qiuyang PENG  
*Harbin Institute of Technology, China; Guangzhou Haozhi Industrial Co., LTD, China*
- 300 **DEM simulations of the impact of lifter wear on the flow properties of iron ore particles in a ball mill**  
Yuxing PENG, Tongqing LI, Zhencai ZHU, Shengyong ZOU, Zixin YIN  
*China University of Mining and Technology, China; CITIC Heavy Industries Co., Ltd., China*



- 301 **A new apparatus and method for preloading bearing assemblies**  
Min FANG, Jianguo LU  
*The Timken Company, China*
- 302 **Research of effect transverse and longitudinal vibration of rope on friction transmission in the process of coal mine friction**  
Yongbo GUO, Dekun ZHANG  
*China University of Mining and Technology, China*
- 303 **Comparison of lubrication characteristics in reciprocating fuel pump with variation of groove type for medium-speed engines**  
Sung-Ho HONG, Bora LEE  
*Hyundai Heavy Industries, Korea; Pusan National University, Korea*
- 304 **Relating premature pump failures to friction and wear behaviour of fuel oils**  
Philip DE VAAL, Leslie BARKER, Howard BENADE, Krugel OBERHOLZER  
*University of Pretoria, Chief Engineering Advisor, Eskom, South Africa*
- 305 **Lubricant-coated slider recording and its feasibility exploration**  
Yuehua HUANG, Lawrence WAH NG, Yonggang MENG  
*State Key Laboratory of Tribology, Tsinghua University, China; Fujii Electric (Malaysia) Sdn. Bhd., 09000Kulim, Kedah, Malaysia*
- 306 **On the correlation of three-body abrasion testing with two-body abrasion testing**  
Kenneth G BUDINSKI, Steven T BUDINSKI  
*Bud Labs USA, USA*
- 307 **Mechanical measurement of wood rotation friction welding**  
Wei YIN, Hongyu LU, Yelong ZHENG, Zheyu LIU, Yu TIAN  
*Tsinghua University, China*
- 308 **Friction and wear characteristics of PTFE braided composites**  
Jian LIU, Yongzhen ZHANG, Sanming DU  
*Henan University of Science and Technology, China*
- 309 **The theory and practice of rolling bearing life and reliability**  
Xinglin LI  
*Hangzhou Bearing Test & Research Center With Assistance of UNDP/UNIDO (ISO/IEC 17025 Accreditation CNAS L0309), China*
- 310 **Estimation of grease life in automotive wheel bearings using a laboratory bearing test methodology**  
Ajay Kumar HARINARAIN, Rahul MESHRAM, Joseph ANTONY, Sanker BHADHAVATH, Deepak SAXENA, SK MAZUMDAR  
*Indian Oil Corporation Ltd, India*
- 311 **Experimental study of wet skid resistance at different water-film thickness**  
Yunlong JIAO, Xiaojun LIU, Kun LIU  
*Hefei University of Technology, China*
- 312 **Research on monitoring wear of hydraulic motor in low temperature environment**  
Gao WAN  
*Wuhan University of Technology, China*
- 313 **Friction and wear Properties of diesel engine cylinder surface with the oblique groove structure**  
Xiang RAO, Chengxing SHENG, Zhiwei GUO  
*Reliability Engineering Institute, China*
- 314 **Effect of load and sliding speed on the friction and wear characteristics of PMMA**  
PratipPratip VONGBANDIT, Duangporn OUNPANICH  
*Thailand Institute of Scientific and Technological Research, Thailand*
- 315 **The application of in-service grease analysis technology to condition monitoring of machine equipment**  
Jiangang LIU, Yiyong YING  
*Petroleum Product Testing, Instrument Calibration, Condition Monitoring, China*
- 316 **Research on the friction vibration induced by debris in lubricant based on four-ball test**  
Chenxing SHENG, Huiyang WANG  
*Reliability Engineering Institute, China; Wuhan University of Technology, China*
- 317 **Prediction of engine performance degradation trend**  
Wei CAO, Ning WANG, Yang ZHANG, Runling PENG, Guangneng DONG, Youbai XIE  
*Xi'an Technological University, China; Xi'an Jiaotong University, China*
- 318 **Adaptive adjustment of sampling parameters for on-line wear monitoring based on wear debris image features**  
Longxin WANG, Tonghai WU, Shuo WANG, Lingfeng YANG  
*Xi'an Jiaotong University, China*
- 319 **Tribological properties on modified RBD palm stearin using esterification process**  
Zuan Azhary MOHD SALLEH, Syahrullail SAMION, Norzita NGADI  
*Universiti Teknologi Malaysia, Malaysia*
- 320 **Extreme-point symmetric mode decomposition method and its application to fault diagnosis of rolling element bearing**  
Ping XIA  
*Xi'an Jiaotong University, China; Department of Mechatronics Engineering, Malaysia*
- 321 **Direct observation of contact on non-transparent viscoelastic polymers surfaces: A new way to study creep and recovery**  
Nan YI, Anne RUBIN, Damien FAVIER, Pierre DANIEAU, J-P. CHAMBARD, Thierry ROLAND, Christian GAUTHIER  
*CNRS, France; Dutch Polymer Institute, France; HOLO 3, France*
- 322 **Rough surface measurement using compressed sensing**  
Weifan LI, Chao ZHOU  
*Fuzhou University, China*
- 323 **Study on the friction mechanism of the water-lubricated bearing**  
Zumin WU, Chenxing SHENG, Zhiwei GUO  
*Reliability Engineering Institute, China*
- 324 **Development and investigation of lubricant degradation test using tapered roller bearing**  
Genki KAMEI  
*Showa Shell Sekiyu, Japan*
- 325 **In-situ observation of adsorption film thickness of lubricant additives on the copper surface using SPR contact microscopy in otto-configuration**  
Koki FUKUTA, Toshinari ISHII, Satoru MAEGAWA, Fumihito ITOIGAWA, Takashi NAKAMURA  
*Nagoya Institute of Technology, Japan; Tottori University, Japan; JX Nippon Oil & Energy Corporation, Japan*



- 326 **Developmental studies on rolling contact fatigue test rig**  
Yuting ZHANG, Liqin WANG  
*Harbin institute of technology, China*
- 327 **On-line lubricant film thickness measurement for a slider-on-disc contact based on dichromatic interferometry**  
Qinghua BAI, Feng FUO, Chao LI  
*Qingdao University of Technology, China*
- 328 **Design and application of the experimental system for synergistic effect of ship antifouling and drag reduction**  
Xing YANG  
*Wuhan University of Technology, China*
- 339 **New comprehensive standards for the evaluation of the reliability and durability of aircraft cabin interior**  
Wolfgang WEINHOLD, Olaf GÜNNEWIG  
*Innowep GmbH, SGS Institut FRESENIUS GmbH, Germany*
- 330 **Structure optimization and deposition effect analysis of used oil magnetic filtergram based on ANSYS**  
Minjie CHEN, Xincong ZHOU, Wang CAO, Qingcheng HUANG  
*Wuhan University of Technology, China; Guangzhou Mechanical Engineering Research Institute Co.,Ltd., China*
- 331 **The driving mechanism and prototype design for NFAL transport platform**  
Bin WEI  
*Tribology Laboratory, (CT) Siemens Ltd., China*
- 332 **Dry sliding friction and wear behavior of vacuum carburized martensitic stainless bearing steel**  
Longcheng YIN, Guangze TANG, Xinxin MA, Liqin WANG, Zhongyuan FU, Yanhua ZHENG, Bobo ZHANG  
*School of Material Science & Engineering, China; Harbin Institute of Technology, China; State Key Laboratory of Advanced Welding and Joining, China; Harbin Institute of Technology, China; School of Mechatronics Engineering, China; Harbin Institute of Technology, China; Harbin Bearing Company of AECC Group, China*
- 333 **The effect of carbon fiber content on current carrying friction and wear properties of Al<sub>2</sub>O<sub>3</sub> dispersion strengthened copper**  
Yibo WEN  
*Henan University of Science and Technology, China*
- 334 **Tribological properties of laser textured surfaces on 45 steel under dry friction**  
Yajun LI, Lemin SUN, Xianjuan PANG  
*Henan University of Science and Technology, China*
- 335 **Effect of loop size of looped carbon fiber brush on friction coefficient**  
Motoyuki MURASHIMA, Eishun KOHNO, Noritsugu UMEHARA, Tomoki KITAMURA, Taichi NAKAO, Toshiya SAWAKI  
*Nagoya University, Japan*
- 336 **The calibration of geometric parameters of current-carrier friction arc**  
Honghui CHANG  
*Henan University of Science and Technology, China*
- 337 **The limitation wear particles observation by fluorescent staining method at in-situ friction test under the optical microscope**  
Takayuki TOKOROYAMA, Takahiro NISHINO, Shiso OU  
*Akita University, Japan*
- 338 **Study on the behavior of the rolling current-carrying red copper friction pairs**  
Yang YUE  
*Henan University of Science and Technology, China*
- 339 **A structural optimization design method for planetary roller screw based on modification of rollers' pitch diameter**  
Zhijie XIE, Le GU  
*Harbin Institute of Technology, China*
- 340 **Influence of ferroboron content on property of copper-based brake materials by powder metallurgy**  
Zhenjun YUAN, Tiantian HE, Sanming DU, Yongzhen ZHANG  
*Henan University of Science and Technology, National United Engineering Laboratory for Advanced Bearing Tribology, Luoyang 471023, China*



# ***AUTHOR INDEX***



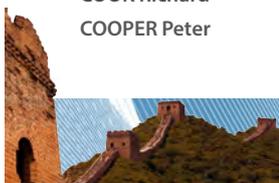
Author Name	Page	Author Name	Page
A RAHMAN Mohd Rahmat	89	ARIURA HIDEAKI	92
AB. LATIF Najibah	41	ARMADA Sergio	52
ABD MALEK Muhamad Hafiz	78	ARORA Harpreet Singh	61, 90
ABDO Jamil	64	ARQUIETA Patsy	64
ABDULLAH Usman	37, 82	ARVIDSSON Magnus	55
ABE Shunsuke	88	ASADA Ryota	43
ABEVI Folly	94	ASAKAWA Yusuke	68
ABOUA Kouami Auxence Melardot	37	ASENSIO Maria Carmen	51
ABU BAKAR Mimi Azlina	66	ASHFAQ Mian	37
ABU HASSAN Hasrawati	40	ASHIZAWA Ryota	52
ADACHI Koshi	37, 37, 47, 49, 59, 59, 72, 81	ATHARTON Mark	43
ADAMS Heather	38	ATKIN Rob	80, 80
AFFERRANTE Luciano	76, 84, 87	AUGUSTO SOUSA MARQUE Luis	78
AFFI Jon	65	AVILA Jose	51
AFZAL Naqash	82	AWANG M.	43
AHMAD MOHAMAD ALI	66	AYAME Yusuke	39
Al Xiaolan	55	AZETSU Akihiko	67
AKAMATSU Atsushi	40	AZHARI Che Husna	40
AKAMATSU Naoki	39	AZIBERT Henri	83
AKHBARI Pouya	53	AZZI ABDELHAK	83
AKINLABI ESTHER	88	BAART Pieter	70
AKIYAMA Hirotoshi	59	BABU Abhishek	61
ALAZEMI Abdullah	62	BADER Norbert	79
ALBAHRANI Sayed	60	BADISCH Ewald	90
ALBERDI A.	71	BADSHAH Fazal	82
ALBERS Albert	61, 70	BähRE Dirk	41
ALEMANI Mattia	56	BAI Linqing	38
ALEMANNNO Fabio	60	BAI Shandan	50
ALEXENKO V.O.	77	BAI Shaoxian	49, 50
ALIAS Aidil Azli	89	BAI Xiuqin	40, 71
ALJEBOORI Yasir	68	BAJWA Rizwan	62
ALMANDOZ X.	71	BAKOLAS Vasileios	60
ALPAS Ahmet	48	BAKOLAS Vasilios	60
ALVES Sofia	90	BALAKRISHNAN Sashi	74
ALVES RADI Polyana	78	BALASOORIYA Winoj	69
AMRAN Siti Nur Azizah	89	BALINT Daniel	87
ANAND Mayank	62, 78	BANQUY Xavier	85
ANDERSEN Michael Skipper	65	BAO heyun	93, 94
ANDO Yasuhisa	88	BARATOFF Alexis	86
ANDREAS Herrmann	91	BARBER James Richard	87
ANDREAS Kolja	38	BARCELÓ Francisco	63
ANDRIUSIS Albinas	43	BARROI Alexander	89
ANGELINI Thomas	72, 75	BARTEL Dirk	81, 93
ANGELINI Thomas E.	91	BATTEAS James	73
ANH Nguyen Duc	77	BAYÓN R.	71
AOKI Saiko	81, 85	BEAKE Ben	62, 73
AOTA Hiroto	52	BEAURAIN Jérôme	55
AOTSUKA Takuya	41	BECK Guillaume	43
ARAFUNE Hiroyuki	63	BECKER Andre	82, 82
ARAI Hirokazu	77	BECKER Michael	86
ARAKERE PUTTASWAMY HARSHA	65	BEHESHTI Ali	91
ARAMAKI Hirotoshi	41	BEHRENS Bernd-Arno	89
AREITIOAURTENA O.	71	BEILICKE Ronny	93
ARGHIR Mihai	55, 83	BELIN Michel	35, 40, 51, 63



Author Name	Page	Author Name	Page
BENASSI Andrea	86	BRUNETIÈRE Noël	60, 69
BENNETT Alexander	75	BRUNSKILL Henry	58
BENNEWITZ Roland	74	BRYANT Michael	91
BENOIT Mathieu	94	BURGHARDT Gero	47, 55, 84
BERCION Yves	74	BURRIS David	72
BERGLUND Kim	47, 52, 57	BUSEYNE Wim	35
BERGSETH Ellen	44	BUSQUET Magali	57
BERNAT Szymon	52	BUSSCHER H.J.	91
BERTHIER Yves	57	BUVANESWARAN Sadhanaa	36
BEWSHER Stephen	68	BUYANOVSKII Iliya	88
BHATTACHARJEE Tapomoy	72, 91	CAI Chengmo	80
BHOWMICK Sukanta	48	CAI Ligang	65
BHUSHAN Bharat	91	CAI Ran	36
BHUTTA Usman	37, 82	CAI Zhen-bing	73
BIASOLI DE MELLO Jose Daniel	70	CAI Zhenbing	61
BIBOULET Nans	60, 94	CALIN Andrei	81
BIERWISCH Nick	73	CAMPEN Sophie	35, 40
BIJWE Jayashree	47	CANN Philippa	53, 91
BIN AZMI Mohammad Azrul	43	CAO Bingqiang	52
Firdhaus		CAO Fang	35
BIN TAIB MOHD TAUFIK	51	CAO Hui	59
BIN YUSOF Muhammad Naqeeb	70	CAO xu	90
BINDER Cristiano	48	CAO Zhongyue	86
BINTI ABU BAKAR Amalina Balqis	43	CARBONE Giuseppe	71, 76, 84, 87
BLUET Jean-Marie	60	CARPEN L.	90
BLUTMAGER Andreas	36	CASTILHO Felipe	47
BOBACH Lars	93	CAVORET Jérôme	40
BOBJI M. S.	45	CAYER-BARRIOZ Juliette	36, 46, 46, 46, 60, 74
BOCHKAREVA S.A.	77	CAZE David	56
BOISSON Nicolas	89	CELIS Jean-Pierre	90
BOIVIN Willy	60	CERRILLO C.	71
BOLSHAKOV Andrey	88	CHAI LIQIANG	48
BONAVENTURE Julien	60	CHAISE Thibaut	89
BONDAREV Andrey	48	CHANG Li	73
BONK Christian	89	CHANG Qiuying	64, 88
BONNAUD Patrick	44	CHANG Xiangdong	46
BOU-SAID Benyebka	55	CHANGJIANG Zhou	47
BOUGUECHA Anas	89	CHARRIN Catherine	51
BOULANGE Claire	53	CHEGDANI Faissal	67
BOUSCHARAIN Nathalie	57	CHEN Ao	49
BOUSMAT Jonas	56	CHEN Bo	39
BOUVARD Gaetan	73, 92	CHEN Cheng	35, 35, 44, 62, 73, 89
BOUYER Jean	43, 55	CHEN Darong	40
BRAGA DOS SANTOS Marcelo	70	CHEN Deqiang	78
BRANDT G.	67	CHEN Guangxiong	47, 49
BREITMAN Peter	40	CHEN Guiming	49
BREMNER Tim	83	CHEN GuoZhong	69, 82
BREMOND Florian	56	CHEN Haosheng	45
BRESME Fernando	45	CHEN hong	79
BRIZMER Victor	42	CHEN jingbai	78
BRODMANN Boris	66	CHEN Kai	58
BRONOVETS Marat	57	CHEN Kangmin	62, 78
BROOKS Hadley	68	CHEN Lei	35, 35, 44, 66, 73, 86, 88
BRUNEL Jean Francois	56	CHEN Lin	88



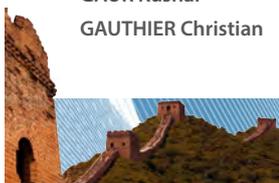
Author Name	Page	Author Name	Page
CHEN Minjie	58	COORS Timm	89
CHEN Ping	77	COSTA Henara	90
CHEN Rong-gang	84	COSTA Henara Lillian	89
CHEN Shi	54	COWIE Stephen	80
CHEN Shiwei	75	COZZA Ronaldo	47, 71
CHEN Shuai	69, 91	CRESPO Alexia	74
CHEN Si	81	CRISTEA Alex-Florian	43
CHEN Sicheng	38	CRISTOL Anne Lise	56
CHEN Siyu	93	CROPPER A B	92
CHEN Song	57, 77	CRUZ-BAUELOSL José Santiago	64
CHEN Sulin	50, 85	CUI Jinlei	39
CHEN Tianchi	41	CUI Lu	83
CHEN Tianyang	60	CUI shaogang	63
CHEN Wei	94	CUI Shuhui	49
CHEN Wencong	48	CUI Shun	45
CHEN Xiang	79	CUI Yahui	48, 82, 82
CHEN Xiao-lei	84	DA SILVA LABIAPARI Wilian	70
CHEN Xiaoyang	54	DAHLEM Franck	51
CHEN Xinchun	51, 86	DAI Kang	39
CHEN Xubin	54	DAI Qingwen	79
CHEN Yan	76	DAI Wei	89
CHEN Yan-Ming	56	DAI Xiangyu	43
CHEN Yu	65	DAI Yadong	74
CHEN Yuan	69, 83, 94	DAI Yuanjing	51
CHEN Zefeng	51	DAI Yuchen	87
CHEN ZHE	39	DAI Zhendong	40, 70, 75, 91
CHEN Zhenxian	65	DAISHO Yasuhiro	82
CHEN Zhou	48	DAS CHAKLADAR Nilanjan	45
CHENG Bingxue	57, 77	DASSENOY Fabrice	35, 39, 40, 40
CHENG Hsiu-Wei	36	DAVIES James	84
CHENG Jie	63	DAVIN Edouard	56
CHENG zhilin	65	DE BAETS Patrick	61, 71
CHOE Bokseong	44	DE BARROS BOUCHET Maria Isabel	37, 51, 86
CHONG William Woei Fong	36, 73	DE LAURENTIS Nicola	61
CHROMIK Richard	88	DE MELLO Jose Daniel	48
CHUGREEVA Anna	89	DE MELLO Jose Daniel Biasoli	89
CIAVARELLA Michele	67, 76	DE PAUW Jan	71
CICONE Traian	60	DE VRIES Erik	81
CIHAK-BAYR Ulrike	76	DE VRIES Lieuwe	70
CIHAN Ebru	85	DEARN K. D	92
CINIERO Alessandra	75	DEARN Karl	49, 84, 92, 94
ÇITAK Emre	62	DEEVA Vera	76
CIULLI Enrico	44	DELIGNY Sylvain	80
CLARK Emily	91	DELLACORTE Christopher	55
CLARK Ray	83	DEMELIO Giuseppe P.	84, 87
CLARKE Henry	84	DENCH Jonathan	63
COBIAN Manuel	51, 59	DENG Guanyu	53
COBO P.	71	DENG Mingming	71
COCHAIN Jeremy	69	DENG Qiangguo	69
CODDET Christian	85	DEORAS Saurabh	44
CODDET Pierre	85	DESCARTES Sylvie	71, 88
COHEN Yossi	40	DESHPANDE Pushkar	40
COOK Richard	78	DESPLANQUES Yannick	56
COOPER Peter	80		



Author Name	Page	Author Name	Page
DESSARZIN Pascal	62	EL KHLIFI Mohamed	55
DEVILLE Lilas	83	EL MANSORI Mohamed	49, 67
DI MARE Luca	63	ELERT Anna	89
DIABY Moussa	40, 56	ELINSKI Meagan	73
DIAO Dongfeng	37, 38, 48, 48, 62, 62, 74, 75, 75, 75, 89	EMAMI Nazanin	47, 77, 77, 77
DIAO Hao	65	ENDRINO Jose	62
DIENWIEBEL Martin	77, 85, 85	ENEKES Claus	50
DIETRICH Philipp	94	ERDEMIR Ali	37
DING Chuanxian	78	ERNESTO André	46
DING Haohao	48	ERNESTO TESTONI Giorgio	78
DING Qi	64	ERYLIMAZ Osman	37
DING Shaopeng	50	ESCOBAR Jorge	44
DINI Daniele	35, 35, 39, 46, 46, 60, 61, 71, 82, 91, 91, 92	ESPALLARGAS Nuria	51, 52
DINI Diniele	87	ESPEJO Cayetano	51
DJEGHLOUL Mehdi	80	ETSION Izhak	48, 62
DOHDA Kuniaki	53	EWEN James	46, 91
DOIKIN Alexei	67	F. BOHN Holger	40
DONATO Gustavo	47	FAJARDO Oscar	45
DONG Daming	46	FALL Marieme	73
DONG Guangneng	40, 49, 64, 65, 92	FAN Qun	53
DONG Hanshan	62, 89	FAN Xiaoqiang	79
DONG Lei	52	FAN Xue	62, 75
DONG Yalin	85	FANG Congcong	67
DONG Yanchun	78	FANG Haotian	78
DONG Yue	66	FANG Junqiang	70
DORGHAM Abdel	73	FANG Liang	73
DOU Pan	70, 84	FANG Qinghua	64
DOU Pingchuan	65	FANG Shiqi	41
DRYZEK JerzyJerzy	44	FATOBA OLAWALE	88
DU Chuan	69	FATOUHECHI Ehsan	93
DU Hejun	43	FATU Aurelian	68, 83, 83
DU Hui	48, 54	FAUCONNIER Dieter	61
DU Jialei	55	FEDERICO Colombo	82
DU Jianjun	82	FEDOROV Sergey	73
DU Pengfei	82	FENG cunao	84
DU Run	84	FENG Dong	38
DU Sanming	75, 77	FENG Jianpeng	91
DU Ying	57	FENG Juzhen	70
DUAN Deli	47, 73, 78, 78, 90	FENG Kai	82, 82
DUAN Haitao	57, 77	FENG Li	52
DUAN YIQIN	53, 92	FENG Xiaochun	87
DUBE Anshuman	71	FENG Xingguo	89
DUBE Narendra Mohan	71	FENG Yu-Jie	44
DUBOC Martin	56	FENG Zhiqiang	61
DUFRENOY Philippe	56	FENNELL Daniel	84
DWYER-JOYCE Rob	58, 58, 70, 70, 84	FERNÁNDEZ B.	71
DYSART Arthur	62	FERNÁNDEZ Luis	63
DZIERWA Andrzej	36	FERNÁNDEZ X.	71
ECKOLD David	84, 94	FERREIRA Jos?	71
EHRKE R.	67	FILHO Paulo	90
EHSANI MAJD Sara	52	FILIP Peter	44
EISENBERG Boris	68	FILLON Michel	43, 43, 55, 55
		FILLOT Nicolas	46, 46, 59
		FLIEDNER Michael	48



Author Name	Page	Author Name	Page
FOKO FOKO Flavien	69	GAVRILOV Konstantin	67
FOREST Cyrielle	51	GE Shirong	52, 81, 84, 84, 92
FORTE Antonio	91	GE Xiangyu	79
FOX-RABINOVICH German	62	GEBRETSADIK Daniel W.	83
FRANEK Friedrich	76	GEDAN-SMOLKA Michaela	62
FRANKE Rainer	62	GÉDIN Patrice	43
FREGONESE Marion	64	GEE Mark	57
FREUND Sara	86	GENG Jian	49
FRIBOURG DIDIER	83	GENG Zhe	90
FRIDRICI Vincent	92	GHAZALI Mariyam jameelah	40
FRIEDL Alexander	93	GIACOMELLI Renan	48
FRIESENBICHLER Walter	36	GIASSON Suzanne	85
FRITZ Bernhard	52	GIRAUDEAU Célia	55
FRY Ben	40	GLATZEL Thilo	86
FU Hao	60	GLAWS Peter	87
FU Xuesong	75	GLOVNEA Romeo	55, 55, 79, 80
FU Yifeng	40	GÓDOR István	92
FU Yonghong	60	GOLCHIN Arash	77
FUENTES E.	71	GOLIZADEH Mehran	48
FUJIE Hiromichi	65	GOLTSBERG Roman	48
FUJITA Hiroyuki	45	GÓMEZ R.	71
FUKAGAWA Hiroki	42	GONCALVES JUNIOR Jose Lucio	89
FUKUDA KEISUKE	92	GONG Tao	82
FUKUI Shigehisa	43	GONG Xiansheng	46
FUKUYAMA Kazuki	56	GOODE Alexandra	64
FUKUZAWA Kenji	39, 74, 74, 79	GORITSKIY Yurii	67
FULLAM Spencer	66	GORYACHEVA Irina	45
FURLONG Octavio	45	GOTO Kunio	83
G Biju	74	GOTZEN Nicolaas-Alexander	35
GACHOT Carsten	38, 38, 38, 57, 62, 91	GRADT Thomas	56
GAERTNER Catherine	56	GRAF-GOLLER Oliver	42
GALDA Lidia	49	GRAHAM Brian	72
GALLE Timothy	61, 71	GREENE Wren	63
GALLO Jiří	52, 65	GREENING Chuck	44
GALMICHE Benedicte	63, 71	GREWAL Harpreet Singh	61, 90
GANGOPADHYAY Arup	49	GRISHAEVA N.Yu.	77
GAO Chenghui	58, 73, 75, 77	GROCHE Peter	53
GAO Chuanping	77	GROLET Aurelien	67
GAO Hongyu	59	GRÜN Florian	92
GAO Kai	64, 88	GRUNDEI Stefan	50
GAO Lei	74	GRUPP Thomas M.	52
GAO Leiming	45, 65	GRÜTZMACHER Philipp	38
GAO Ming	74	GU Jun	68
GAO Siyang	78, 78	GU Kaixuan	88
GAO Xing	91	GU Kali	77
GAO Xinlei	39	GU Le	49, 51, 94
GAO Yang	45	GU Yanhong	47
GAO Zengfeng	82	GU Zhongtao	39
GARCIA Regina	90	GUAN Jian	42
GARVEY Seamus	55	GUILLONEAU Gaylord	73
GASNI Dedison	65	GULZAR Mubashir	37
GATTINONI Chiara	46	GUO Chang-jian	41
GAUR Kushal	71	GUO Dan	66, 90
GAUTHIER Christian	37, 87	GUO Feiqian	91



Author Name	Page	Author Name	Page
GUO Feng	35, 42, 80	HATTORI Hideaki	39
GUO Jia	88	HAUGEN BJØRN	42
GUO Junde	92	HAULEITNER Rudolf	55
GUO Kai	44	HAUSBERGER Andreas	68, 69
GUO LIANG	35, 87	HE Fushan	77
GUO Lichang	70	HE Haoran	78
GUO Meiling	48	HE Jianguo	79
GUO Shuaiwei	58	HE Qingsong	70
GUO Xiaoguang	41	HETENGFEL	48
GUO Xiuhua	87	HE Tianian	77
GUO Yanbao	83, 84	HE Yongyong	65
GUO Yongbo	84	HEGEDUS Phil	87
GUO yuexia	80	HéLÈNE Mathieu	55
GUO Yuzheng	73	HEMMI Makoto	84
GUO Zhiwei	71, 83	HERMSDORF Jörg	89
GUPTA NIHARIKA	93	HERTELÉ Stijn	61
GUPTE Chinmay	53	HEWSON Rob	45
GUTIERREZ GUZMAN Francisco	84	HEWSON Robert	65
GYSIN Urs	86	HIGUCHI Yuji	50, 59, 59, 59
HABCHI Wassim	60	HINKLE Adam	85
HAFEZI Mahshid	65	HIRATA Yuki	45
HAJI HASSAN MASJUKI BIN	69	HIRAYAMA Tomoko	39, 50, 71
HASSAN		HIROYOSHI Tanaka	86
HALENAHALLY VEEREGOW	56, 60	HISLER Valentin	87
Deepak		HOCHREIN David	42
HALL Richard M	45	HOD Oded	35, 45
HALMOS Fabian	79	HOFFMANN Norbert	67
HAMDAN Siti Hartini	36, 73	HOHUKU Hiroki	68
HAN Bo	42, 55	HOKAO Michita	51
HAN Gaofeng	90	HOKKIRIGAWA Kazuo	41, 50, 81
HAN Hongbiao	75	HOLMBERG Kenneth	57
HAN Huali	48	HOLWEGER Walter	36, 42
HAN Ninghui	63	HOMAYOUN M.R	77
HAN Qi-Nan	94	HONDA Shigenobu	69
HAN Wei	66	HONDA Tomomi	44, 67
HAN Xu	93	HONG Hong	50
HAN Zhiwu	40	HORIIKE Junpei	56
HANSMANN Stephan	89	HORMEL Tristan	72
HAO Lichun	38	HORMEL Tristan T.	91
HAO Shi-Peng	44	HORN Roger	63
HARDELL Jens	83	HOSSEIN ZAVIEH Amin	51
HARMAIN G A	68	HOU Kaiming	48
HARRIS Kathryn	75	HOU Sihan	78, 90
HARRIS Kathryn L.	50	HOU Xinbin	57
HARTL M.	39	HOUPERT Luc	54
HARTL Martin	52, 60, 65	HOWELL-SMITH Sebastian	74
HARUYAMA tomohiko	80	HSU Chia-Jui	38, 41
HASE Alan	71	HSU Stephen	40, 79, 88
HASHIM F. M.	43	HU Chengliang	54
HASHIMOTO Chie	52	HU Li-ming	84
HASHIMOTO Naoya	65	HU Litian	64, 80
HASSAN Masjuki	37	HU Min	94
HASSINI Mohamed-Amine	55	HU Wenbin	63
HATAKEYAMA Nozomu	44	HU Xia	87, 87



Author Name	Page	Author Name	Page
HU Xianguo	49	JANG Young Jun	37
HU Yuanzhong	66, 74	JANG Young-Jun	62
HU Zhihong	47	JANUSZEWSKI Rachel	42
HUA Meng	49	JARNIAS Frédéric	40, 64
HUA Zikai	65, 65	JARRAY Mohamed	83
HUA Zisen	43	JAVAKHISHVILI Irakli	86
HUAI Wenjuan	51	JEAN-FULCRAND Annelise	83
HUANG Chuanhui	84	JEFFREYS Stephen	71
HUANG Fuzhan	82	JENEI Istvan	35
HUANG Guoquan	44	JENG Yeau-Ren	47
HUANG Haibo	56	Jl Cancan	43
HUANG Jianmeng	73, 87	Jl Cuicui	52
HUANG Lina	51	Jl Hongbing	52
HUANG Ping	63	Jl Jiaxin	54
HUANG Shuigen	41	Jl Jinghu	60
HUANG Wei	79	Jl Keju	91
HUANG Weijiu	78	JIA Dan	57
HUANG Xiao	90	JIA Junhong	87
HUANG Yating	66	JIANG BOCHENG	66
HUDYAKOV Vlad	43	JIANG Jinbo	69, 83
HULTQVIST Tobias	54	JIANG Kun	84
HUMPHREY Edward	93	JIANG Shengli	73, 90
HUNTER Andrew	53	JIANG Shulan	54, 85
HUNTER Gary	35	JIANG Song	83
HUTTUNEN-SAARIVIRTA Elina	90	JIANG WEI	52
HWANG Pyung	82	JIANG Yi	42
IBRAHIM Mohd Danial	89	JIANG Yuhang	70
IGARTUA Amaya	71	JIANG zhengquan	51
IMAI Kimio	40	JIANGWANG Zhan	63
IMURA Tadatsugu	72	JIAO Chunxiao	56
INOSE Keita	83	JIAO Lanqing	54
INOUE Daiki	85	JIE Jin	89
INOUE Hideyuki	72, 85	JIN Chenning	66
IQBAL M.	72	JIN Guanghu	93, 94
ISHIGO Osamu	71	JIN Ke	73
ISMAILOVA Yuliya	67	JIN Xiaoqing	76, 87
ISRAELACHVILI Jacob	73, 85	JIN Xiaoyue	88
ISSA Jimmy S.	60	JIN Yong	56
ITAGAKI Ryo	41	JIN Yongliang	57
ITO Shota	45	JIN Zhongmin	52, 65, 65, 65, 65
ITO Shintaro	39, 74, 74, 79	JING Haoda	75
ITOIGAWA Fumihito	40	JISA Robin	76
IWAI Toshiaki	83	JOEHR Res	86
IWAMOTO Katsumi	87	JOERGER Arn	61
IWASAKI Hideyuki	67	JOLY Laurent	59
JABBARZADEH Ahmad	65	JOTAKI Koichi	56
JACKSON Robert	76, 76, 91	JUNQIU Zhang	40
JACOBS Georg	45, 47, 55, 84	JURKSCHAT Thomas	93
JACOBS Peter	35	KADIRIC Amir	42, 42, 42, 44, 46, 60, 61,
JADHAO Vikram	39		63, 92
JAGGARD Matthew	53	KAFEXHIU Fevzi	88
JAIN A.	77	KAIERLE Stefan	89
JANA Richard	85	KAILAS Satish V.	53
JANG Yong Hoon	87	KAILAS Satish Vasu	69

Author Name	Page	Author Name	Page
KALAM Abul	37	KIM Seong H.	59, 59
KALBARCZYK Marek	93	KIMURA Yoshitsugu	46, 56
KALELI Hakan	62	KING Andrew	44
KALIN Mitjan	41, 64	KING Paul	84
KAMIJO Toshio	63	KIRYUKHANTSEV-KORNEE Philipp	48
KAMIYA Kento	39	KITAMURA Kazuhisa	57
KAMPF Nir	45	KLEIN Aloisio N.	48
KANAPATHIPILLAI Sangarapillai	35	KLEIN Jacob	45
KANAZAWA Yuta	46	KLEIN Sven	41
KANDA Koki	72	KLEMENZ Andreas	59
KANEBAKO Hideki	72	KLIGERMAN Yuri	40, 47
KANEKO Natsuki	67	KOBAYASHI Shinji	72
KANEKO Satoru	42	KOBAYASHI Takayuki	74
KANG Guozheng	69	KOBLMILLER Tobias	92
KANG Kyeong-Hee	61	KOCH Christian	89
KANG Nan	85	KOCH Oliver	47
KANG Yong-Jin	62	KOCHI Tsuyoshi	46
KANO Makoto	86	KOEL Bruce	71
KAPER Hans	52	KOENIG Florian	55
KAPER Hans J.	81	KOGANEZAWA Shinji	41, 79
KAPSA Philippe	48, 73, 92	KOHLHAUSER Bernhard	62
KARTTUNEN Mikko	47	KOMISSAROV Victor	69
KARVANKOVA Pavla	62	KONDO Akihito	82
KASEM Haytam	40, 47	KONDO Kyoji	39
KASOLANG Salmiah	41, 66	KONG Linghui	53
KASSMAN RUDOLPHI Åsa	44	KONG Ning	51
KATIYAR Jitendra Kumar	63	KONICEK Andrew	35
KATO Takahisa	86	KONISHI Masakazu	59
KATSUMI Shunji	44	KONO S	92
KATSURASHIMA Yu	50	KONTOU Artemis	68
KAWADA Shouhei	80	KORN Gregor	94
KAWAI Shigeki	86	KORNIENKO L.A.	77
KAWAMOTO Yuki	67	KORNYSHEV Alexei	45
KEER Leon	87	KOSARIEK Shahriar	68
KENSUKE Nishiura	61	KOSASIH Buyung	63
KHAFIDH M.	76, 94	KOSHIMA Motohiko	71
KHAN Polina V.	82	KOU yuanlin	42
KHARISSOVA Oxana	64	KOUSAHA Hiroyuki	37, 37
KHONSARI M.	79	KOVALEV Alexander	61
KHONSARI Michael	75, 75	KOYAMA Akira	57
KHONSARI Michael M	73	KRAČUN Ana	88
KHOO Wee Shen	43	KRAMER Philipp	53
KHOZENIUK Nadezhda	43	KRICK Brandon	71
KHURRAM Muhammad	82	KRICK Brandon A.	50
KIKUCHI Masao	52	KRISTIANSEN Kai	85
KIKUCHI Masataka	43	KRUPKA I.	39
KILPI L.	90	KřUPKA Ivan	52, 60, 65
KILPI Lauri	47	KRYNISKI Krystof	44
KIM Dae-Eun	60, 61, 71	KUANG Fuming	58, 70
KIM Hyun-Joon	71	KUBO Momoji	50, 59, 59, 59, 59
KIM Jong Kuk	37	KUBO Takeshi	41
KIM Jongkuk	62	KUDO Mitsugu	83
KIM Kwang Jin	70	KUKUREKA S. N	92
KIM Min-Gyu	38	KUMAR Ameet	79



Author Name	Page	Author Name	Page
KUMAR Arvind	63	LI Hongbo	51
KUMAR Charchit	40	LI Hongkai	67
KUMAR Deepak	60	LI Hua	80, 80
KUMAR Manish	71	LI Hui	43
KUNISHIMA Takeshi	77	LI Jian	57, 70, 77
KUNZE Klaus	62	LI Jianjun	89
KURIHARA Kazue	63	LI Jianliang	48, 50, 52, 79
KUROKAWA Takanori	77	LI Jiansheng	88
KWAK Jan	64	LI Jinjin	86
KWAK Wonil	44	LI Jiusheng	39, 63, 92
KWOK Ngaiming	57	LI Jiyun	69, 83, 83
LADEROU Angeliki Christina	54	LI Junyi	73
LAEUGER Joerg	63	LI Ke	79, 86
LAGHRABLI Salem	55	LI Kuankuan	68, 79
LAI Iianfeng	73	LI L.K.Y	62, 78
LANÇON Denis	51	LI Lawrence	57
LANG Haojie	74	LI Liang	49
LARSSON Roland	47, 54, 79	LI Longqiu	37, 44
LAUKKANEN Anssi	57	LI Na	75
LAUTERWASSER Frank	68	LI Ning	41, 44
LE Ha Manh	39, 59	LI Pu	76
LE Manh Ha	50	LI Qijun	92
LE BOT Alain	56	LI Qunyang	85, 85
LE GUYADEC Erick	43	LI Rui	75, 79
LE HOUÉROU Vincent	37, 40, 87	LI Shayu	54
LE MOGNE Thierry	39, 40, 40, 51, 64	LI Shu	73, 78, 78, 90
LEE Damon	60	LI Tongqing	85
LEE Seunghwan	86, 91	LI Tongyang	82
LEE Woo Young	37	LI Wei	65, 80, 81
LEE Yongbok	44	LI Xi	79
LEHMANN Dieter	62	LI Xiangwei	70
LEI Hong	66, 67	LI Xiaoying	62, 89
LEI Mingkai	72	LI Xiaoyu	72
LEI Xiao	43	LI Xin	74
LEI Zhengquan	52	LI Xing	40
LEIDICH Ing. Erhard	62	LI Xinliang	94
LEIGHTON Michael	74, 84	LI Xinming	51
LESON Andreas	37, 86	LI Yi	64, 80
LETTE Walter	81	LI Yingchun	48
LEVANOV Igor	43, 50	LI Yingru	65
LEVCHENKO Vladimir	88	LI Yong	91
LEVEN Itai	35	LI Yongjian	45
LEVEQUE David	57	LI Yu	92
LEWIS Roger	58	LI Yufeng	94
LI bing	51	LI Yuliang	59
LI Bo	57	LI Yunbin	54
LI Changkun	66	LI Yupeng	72
LI Changlin	82	LI Zheng-yang	73
LI Chao	42	LI Zili	70
LI Dan	70	LIANG Guozhu	55
LI Dangguo	40	LIANG HE	63
LI Decai	55	LIANG Hong	66
LI Hang	48	LIANG Peng	55
LI Haoyu	35	LIANG Xia	83



Author Name	Page	Author Name	Page
LIANG Xingxin	49, 56	LIU Qingkang	37, 44
LIANG Yangyang	69	LIU Qiyue	70, 85
LIANG Yong	70	LIU Sa	79
LIAO Bin	88	LIU Sen	43
LIAO Hanlin	85	LIU Shanshan	51
LIAO Xiping	54	LIU Shengchao	54
LIAO ZHENHUA	53, 53	LIU shuai	37
LIEBEL Alexander	60	LIU Shuhai	65, 83, 83, 84
LIGIER Jean-louis	94	LIU Songyong	85
LILLIAN COSTA Henara	70	LIU Teng	79
LIN Bin	63, 64	LIU tiantian	40
LIN Cheng-Te	51	LIU Tingting	67
LIN Chengxiong	81	LIU Weimin	75
LIN Guoliang	54	LIU Weiping	94
LIN Jenfin	94	LIU Weiqiang	53, 53, 53
LIN Lin	92	LIU Xiangfeng	94
LIN Shuyuan	51	LIU Xiaojun	41, 76
LINDHOLM Per	44	LIU Xiaoling	39, 46
LINDON John	53	LIU Xiaoxiao	66
LISKIEWICZ Tomasz	73	LIU Xiaoxu	36
LITWIN Wojciech	68	LIU Xinmei	49
LIU Bang-Jun	84	LIU yaohui	64
LIU Dameng	73, 73, 74	LIU Yimeng	81
LIU Deshuang	79, 86	LIU Ying	68, 89, 94
LIU Dongwen	66	LIU Yong	77
LIU Erjia	37	LIU Yuan	84
LIU Eryong	87	LIU yuanqing	73
LIU Fan	77	LIU YUHONG	39, 53, 65, 74, 92, 92
LIU Feng	52	LIU Yunhai	86
LIU Fengbin	83	LIU Yuwei	87
LIU Gen	77	LIU Zan	65
LIU Gongping	54	LIU Zhan-Guo	77, 88
LIU Haojiang	49	LIU Zhanjian	62
LIU Heli	84	LIU Zhenglin	49, 55, 56, 56
LIU Hongbin	54	LIU Zheyu	81, 91
LIU Hongtao	41	LIU Zhifeng	65
LIU Hua	93	LIU Zhuotong	73
LIU Huaiju	84	LIU zili	57
LIU Jianfang	57, 70	LLANES Luis	41
LIU Jianhua	61	LLIU Bin	41
LIU Jianping	79	LOEHLÉ Sophie	51
LIU Jingang	93	LOHNER Thomas	93, 93, 93
LIU Jinpeng	56	LÓPEZ A	71
LIU Jiushan	75	LOUBRIEU Gauthier	66
LIU Jun	85	LÖWENSTEIN Markus	82
LIU Kai	82, 82	LU Changhou	55
LIU Kaipeng	44	LU Fengxia	93, 94
LIU Kun	41, 53, 76	LU Hailin	40
LIU Lei	52	LU Hongyu	41, 81, 91
LIU Lin	77	LU Jia	46
LIU Ming	58, 75	LU Ping	49
LIU Nannan	49	LU Renguo	79
LIU Peng	65	LU Xinchun	66, 66, 66, 66, 66, 67, 70, 74
LIU Pengxiao	92	LU Xiqun	38, 82



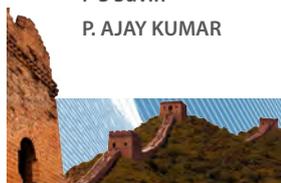
Author Name	Page	Author Name	Page
LU Zhide	68, 79	MANZI Sergio	45
LUBRECHT Antonius	45	MAO J	54
LUBRECHT Ton	60	MAO Junhong	46
LUISANA Luisana	64	MAO Junyun	65
LUNDMARK Jonas	66	MAO Wenyuan	69
LUO Guihai	66	MAOUI ABDELGHANI	83
LUO Jian	70	MARES Cristinel	43
LUO Jianbin	35, 39, 41, 51, 64, 65, 66, 67, 70, 70, 71, 74, 74, 75, 86,	MARGUERITAT J�r�mie	46
86		MARIAN Max	38
LUO Ting	52	MARIAPPAN MUTHU KUMAR	38, 45
LUO Yong	88, 89	MARKLUND P�r	54, 57, 72
LUQUAN Ren	40	MARS Julian	36
LV Fangrui	56	MARSCHNER Anne	62
LV Xiuyi	82	MARTIN Jean Michel	51, 86
LYUKSHIN B.A.	77	MARTIN Jean-Michel	37
LYUKSHIN P.A.	77	MART�NEZ DE ALCOCER I.	71
M SAHAB Abdul Rahim	78	MARTINI Ashlie	38, 59
M. HEYES David	91	MARTINIE Laetitia	46, 46
M.S. Bobji	38	MARUSMAN Norliza	89
MA Guoen	79	MARUYAMA Taisuke	51
MA Huijuan	47	MARX Nigel	63, 71
MA Ka	63	MASEN M.A.	76, 94
MA Liran	35, 44, 70, 74, 75	MASEN Marc	81, 83, 91
MA Ming	35, 74, 86, 86, 86	MASSOUD Toni	51
MA Ming-Tang	67	MASUKO Masabumi	52, 79, 82
MA Mingming	46	MAT RIPEN Zakiah	66
MA Qiang	62, 62	MATHIS Christian H.	36
MA Shuanhong	92	MATSUKAWA Hiroshi	35
MA Tianbao	35, 66, 66, 74	MATSUMURA Shohei	81
MA Xinxin	42, 79	MATSUOKA Hiroshige	43
MA Xuan	38	MATSUOKA Takashi	39, 50
MA Xuezhong	69	MATSUZAKI Yasuo	36
MA Yuefeng	39	MATTA Christine	42
MAEDA Tatsuya	59	MATTHIAS Tim	89
MAEGAWA Satoru	43	MATVEENKO Vladimir	88
MAGYAR Bal�zs	69, 82	MAUGER Cyril	89
MAI Jiahua	52	MAWATARI Toshifumi	39, 57
MAKHATHA ELIZABETH	88	MAYER Christoph	50
MAKHOVSKAYA Yulia	45, 76	MAYER Joachim	42
MAKINO Ryosuke	68	MAYRHOFER Paul Heinz	36, 62
MAKIS Viliam	57	MAZARIN Micha�l	51
MAKOWSKI Stefan	37, 86	MAZUYER Denis	36, 43, 46, 46, 46, 60
MALDONADO-CORT�S Dem�filo	64	MCALEESE Colin	71
MALLIPEDDI Dinesh	92	MCCARRON Ruby	61
MANABE Keisuke	48	MEDINA Simon	35
MANDAL Joydeb	92	MEHDIZADEH Mohammad	75
MANDELLI Davide	35	MEHTA Viral S.	38
MANIERI Francesco	42	MEI Jie	69
MANIWA Kazuaki	57	MELLO Jos?Daniel Biasoli de	50
MANKOWSKA-SNOPCZYNSK	93	MENDOZA G.	71
Anita		MENG Fanming	48
MANSOT Jean-Louis	74	MENG Guiyun	91
		MENG Junhu	54
		MENG Xianghua	45



Author Name	Page	Author Name	Page
MENG Xianghui	67	MORIYASU Kenta	76
MENG Xiangkai	69, 83, 83	MORRIS Nicholas	84
MENG Yanan	53	MORRIS Nick	74, 93
MENG Yonggang	43, 54, 59, 61, 61, 75, 81, 91	MORSTEIN Marcus	62
MENG Yoonggang	38	MOSELER Michael	59, 74
MENG Yuan	64	MS Bobji	74
MENGA Nicola	84, 87	MU Jiefeng	49
MERIC Cevdet	40	MU XIAOHONG	53
MERKLEIN Marion	38	MÜCKLICH Frank	38, 41
MEROLA Claudia	36	MUELLER Michael	45
MEYER Ernst	86	MUFTI Riaz	37, 82
MEZGER Markus	36	MUKCHORTOV Igor	50
MEZGHANI Sabeur	67	MUKHERJEE Sundeep	90
MEZIANE Bilel	46	MULYADI Ismet Hari	65
MICHALCZEWSKI Remigiusz	93, 93	MURABAYASHI Hiroki	59
MIDDELKAMP Martijn	60	MURAKAMI Teruo	52, 53, 65
MIHAILOV Valentin	43	MURAMOTO Yuta	92
MIHARA Yuji	67, 68, 82	MURASHIMA Motoyuki	36, 37, 51
MIKI Hiroyuki	35	MUSA Saad Salahuddin	89
MINFRAY Clotilde	40, 51, 64	MUSER Martin	75
MITA Kentaro	43	MYSHKIN Nikolai	77
MITA Yuma	46	MYSZKA Dawid	36
MITSUYA Yasunaga	74	NABHANI Mohamed	55
MIURA Kouji	86	NADERMANN Daniel	76, 94
MIURA Kouta	68	NAEIMI Meysam	70
MIURA Mamoru	47	NAGATOMI Eiji	80
MIURA Ryuji	44	NAIR Rakesh	90
MIYAMOTO Akira	44	NAJAR Farooq	68
MIYAMOTO Naoto	44	NAKAGAWA Yuta	90
MIYATA Shinji	58	NAKAJIMA Akira	57
MIYATAKE Masaaki	41, 43, 56, 56, 68, 68, 82	NAKAMURA Miho	59
MIZUTA Hirotaka	69	NAKAMURA Takashi	40, 56
MO Jiliang	49, 49, 70, 70	NAKASHIMA Kazuhiro	53
MOHAMED N. M.	43	NAMBOODIRI Vishnu	53
MOHAMMADPOUR Mahdi	54, 68, 93, 93	NANRI Kouta	80
MOHAMMED Abdul Samad	38	NARDIN Michel	87
MOHRBACHER Hardy	41	NARITA Keiichi	83, 93
MOHTAR Muhammad Zaidi	89	NARITA Takeshi	86
MOLLON Guilhem	45	NDIAYE Serigne	46
MOLZA Audrey	74	NEČAS David	65
MOORE Axel	72	NEDELCO Ileana	42
MORALES Guillermo	92	NEGISHI Yuta	72
MORALES-ESPEJEL Guillermo E	55	NEGRITO Mealani	73
MORALES-ESPEJEL Guillermo E.	46	NEHME Gabi	39, 52
MORALES-ESPEJEL Guillermo Enrique	42	NELIAS Daniel	89, 94
MORAS Gianpietro	59	NEVILLE Anee	68
MOREIRA Fausto	65	NEVILLE Anne	36, 51, 73, 91
MORGADO MAZUYER Nazario	74	NG WAH	43
MORGAN Neal	46, 63, 68	NI Jinxing	78
MORI Shigeyuki	79	NI Xu	85
MORI Wataru	80	NICHOLAS Gary	84
MORINA Ardian	36, 51, 68, 73	NIE Xueyuan	36
MORITA TAKEHIRO	92	NISHI Toshiaki	76
		NISHIDA Kazuki	39



Author Name	Page	Author Name	Page
NISHIKAWA Hiroshi	46	P. Anirudhan	53
NISHIWAKI Tsuyoshi	76	PACIOS N.	71
NISTE Vlad Bogdan	64	PADGURSKAS Juozas	43
NIU Yongping	78	PAGANO F.	71
NIU Zhenhua	54	PAILLER-MATTEI Cyril	80, 80
NODA Takashi	58	PAN Bingli	36
NOGI Takashi	57	PAN Guoshun	66, 67, 90
NOHAVA Jiri	62	PAN Lijun	93
NOORDERMEER J.W.M.	94	PAN Shuaihang	45, 85
NORELL Mats	92	PANDA Jitendra Narayan	47
NORIYUKI Hayashi	61	PANDEY R. K.	93
NOSAKA Masataka	86	PANG Haosheng	75
NOSKO Oleksii	56	PANG Minghua	41
NOUTARY Marie-Pierre	60	PANG Xiaoxu	48, 54, 83
NUNN John	57	PANIN Sergey	77
NYBORG Lars	92	PAP Balint	43
OBARA Shingo	57, 57	PAPANGELO Antonio	67, 76
OBERBILLIG Thomas	48	PAPE Florian	89
OCHIAI Masayuki	67, 82	PARAB Sulaksha	40
OFFNER Guenter	68, 93	PARISI Cristian	91
OGAWA Masato	83	PARK Tae-Jo	38
OHGOSHI Yoshie	59	PARSONS Timothy	91
OHMUKI Shuya	86	PASCOVICI Mircea	43, 60
OHNO Nobuyoshi	57	PASTEWKA Lars	59, 85
OHNP Nobuyoshi	46	PATZER Gregor	71
OHTA Makoto	92	PAULA L.O	78
OIKE Mamoru	43	PAUSCHITZ Andreas	76
OKUMURA MOTOYUKI	37	PAVLIDES Constantino	70
OKUMURA SHUNSUKE	37	PAWLAK Remy	86
OKUSHI Kotaro	44	PAWLUS Pawel	36
OLOFSSON UIF	44, 56	PEI Xian-Qiang	74
OLSON Dustin	59	PELLEREJ Diego	56
OLSZEWSKI Artur	68	PELTO Jani	47
OMASTA Milan	60, 71	PEñA-PARÁS Laura	64
ONO Kyosuke	35	PENG BO	44
ONODERA Tasuku	52	PENG Jinfang	70
ONSY Ahmed	68	PENG Xudong	69, 69, 83, 83, 83
OOTAIN Yusuke	59	PENG Yeping	57, 58
OOTANI Yusuke	50, 59, 59, 59	PENG Yitian	74
ORENDORZ Adam	50	PENG Yubin	49
OROZCO Diego	66	PENG Yuxing	46, 85
OST Wouter	71	PENG Zhongxiao	35
OSTERMEYER Georg-Peter	45	PEREIRA DE MATOS Rafael	51
OSUCH-SLOMKA Edyta	93	PERRET-LIAUDET Joel	63
OU Yangwu	49	PESIKA Noshir	91
OUYANG Huajiang	49, 49, 61, 70	PHILIPPON David	46, 60, 71
OUYANG Jia-Hu	77, 88	PIEKOSZEWSKI Witold	93
OUYANG Wengen	35, 74	PIERRAT Dominique	56
OUYANG Wu	56, 56	PINEDO B.	71
OVERMEYER Ludger	89	PINTER Gerald	68, 69
OYAMA Satoru	41	PITENIS Angela	72, 75
OZAWA Nobuki	50, 59, 59, 59	PITENIS Angela A.	50, 91
P S Suvin	44	PODDAR Surojit	58
P. AJAY KUMAR	53	PODGORNIK Bojan	88



Author Name	Page	Author Name	Page
PODSIADLO Pawel	46, 46, 57, 58, 60	RAMIREZ Giovanni	37
POL Vilas	62	RAMOS FERNANDEZ Eduardo	39
POLCAR Tomas	62	RANA Zafar	82
POLL Gerhard	54, 79, 89	RANI A. M. A.	43
POLYCARPOU Andreas	37	RANUŠA Matúš	52
PONDICHERRY Kannaki	61	RAO T V V L N	43
PONDICHERRY Kartik	44, 63, 81	RAO Xu	88
POPOOLA PATRICIA	88	RAO Zhushi	56
POPOV Mikhail	76	RASTOGI Avijit	76
POPOV Valentin	76	REBUFA Jocelyn	43
PORRAS-VAZQUEZ Alejandro	46	REDDYHOFF Thomas	46, 82
PORTER Karen	91	REDDYHOFF Tom	35, 49, 75, 81
POURROY Mitchell	44	REDMORE Eleanor	89
PRAKASH Braham	41, 54, 83	REICHERT Stefan	61
PRASHANT K. Sharma	91	REISS Peter	60
PRICE Chris	72	REIZER Rafal	36
PRIESTNER Christoph	67	REMŠKAR Maja	64
PRIGGE Felix	54	REN Dejun	75
PROCOPIOU Haris	61	REN Li	79
PROFITO Francisco	82	REN Pingdi	84
PROROK Bart	76	REN Tianhui	65, 81
PUENTE REYNA Ana Laura	52	REN Xianghong	45
PUTIGNANO Carmine	71, 76	REN Zhongming	85
QI Huimin	77	RENOUF Mathieu	57
QI Mingjie	89	REPKA Martin	71
QI Shaojun	62	REPPICH Charlotte	44, 81
QI Xuelian	86	RHODES Jerry	55
QI Yizhou	85	RIEDL Helmut	62
QIAN Linmao	35, 35, 44, 54, 66, 66, 73, 85, 86	RIGAUD Emmanuel	36
QIAN Shanhua	81	RISTIC Ivana	91
QIAN Xuzheng	70	ROBBINS Mark	35, 39
QIAO LI	48	ROCHA Luís	90
QIAO Lijie	53, 90	ROCHAS Aham	81
QIN Liguo	49, 65	RODIOUCHKINA Maria	47
QIN Wenbo	50, 88	RODRÍGUEZ J. C.	71
QING Tao	83	RODRIGUEZ N.V.	76
QITAO Huan	77	RODRIGUEZ RIPOLL Manel	62, 64, 90
QIU Ming	48, 54, 83	RODRIGUEZ Y BAENA Ferdinando	91
QIU Saizhou	62, 75	ROGOS Elzbieta	93
QIU Wenhui	94	RON Troels	86, 91
QU Cangyu	86	RONG Jian	78, 78
QU Yao	88	RONKAINEN H.	90
RABASO Pierre	40	RONKAINEN Helena	47, 57
RADI P. A	78	ROSENKRANZ Andreas	38
RADIM Mrazek	67	ROSSI André	90
RAHMAN Samiur	82	ROTHWELL Benjamin	55
RAHMANI Ramin	68, 74, 93, 93, 93	ROZHDESTVENSKY Yury	50
RAHNEJAT Homer	68, 74, 84, 93, 93, 93	RUDENKO Pavlo	85
RAHNEJAT1 Homer	54	RUKUIZA Raimundas	43
RAJEEV NAYAN Gupta	65	RUMMEL Florian	44, 63, 81
RAKESH KUMAR GAUTAM Rakesh	88	RUTLAND Mark	80, 80
Kumar Gautam		RUTLAND Mark W	80
RAMAN Vedantham	44	RYCERZ Pawel	42, 92
		SAAD Nor Hayati	78



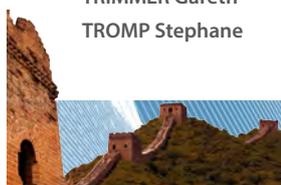
Author Name	Page	Author Name	Page
SADEGHI Farshid	62	SCHWARZ Thomas	68, 69
SAENZ	62	SCHWARZE Hubert	76, 94
SAENZ DE VITERI V.	71	SCHWARZER Norbert	73
SAITO Masatoshi	88	SCHWEDT Alexander	42
SAITO Yasuyoshi	41	SCHWIESAU Jens	52
SAKAI Kazumi	80	SEDLAČEK Marko	88
SAKAI Masataka	46	SEOUDI Tarek	60
SAKAI Nobuo	52, 53	SEP Jaroslav	49
SAKAI Yoshie	52	SHAFFER Steve	44, 62
SAKAMOTO Yohei	39	SHAFFER Steven	47, 75
SALARI Sepehr	91	SHAKHVOROSTOV Dmitriy	56, 93
SALASI Mobin	90, 90	SHANG Hongfei	78, 90
SALDÍVAR Karla Itzel	64	SHANG Yi-Bo	94
SALLES Loic	67	SHANGGUAN Bao	69, 78
SALVARO Diego	48	SHAO Guangbin	37
SANDU Sebastian	94	SHAO Tao	58
SANTIAGO MACIEL Homero	78	SHAO Tianmin	49, 78, 90
SARASWAT Rahul	77	SHARMA Prashant	52
SARAVANAN Prabakaran	86	SHARMA Prashant K.	81
SASAKI Naruo	86	SHEN Bin	50, 85
SASAKI Ryuichi	67	SHEN Huoming	76
SASAKI S.	67	SHEN Mingxue	69
SASAKI Shinya	45, 80	SHEN Shengnan	43
SASAO Yusuke	79	SHENG Dezun	86
SATHEESAN Bobby	38	SHEPHERD Duncan	94
SATISH V.Kailas	44	SHERBAKOV Sergei	69, 70, 75, 75, 75
SATO Hirotsumi	49	SHERRINGTON Ian	68
SATO Takaaki	45	SHI Bao-Jun	44
SATO Takaya	63	SHI Baojun	43
SATO Yoshiki	90	SHI Hongyu	74, 92
SAUER Bernd	69, 82, 82	SHI Hui-Ji	94
SÁVIO PESSOA Rodrigo	78	SHI LuBing	70, 85
SAWADA Naoki	80	SHI Minghui	82
SAWAE Yoshinori	52, 53, 92	SHI Pengfei	51
SAWYER W Gregory	50, 75	SHI Songlin	86
SAWYER W. Gregory	72, 91	SHI Xiujiang	73
SAYLES Richard S.	46	SHI Yan	52
SCARAGGI Michele	92	SHI Yijun	52, 80, 80
SCHADLER Werner	92	SHIBASAKI Kenichi	58
SCHALLER Frank	37, 86	SHIBATA Kei	41, 81
SCHIEBERT Julien	56	SHIGYO YOSHIFUMI	92
SCHIAVON Irene	52	SHIMIZU Shoma	43
SCHINOW Vitali	61, 89	SHIMIZU Yasunori	59
SCHIPPER D.J.	76, 94	SHINGAI Aya	52
SCHIRRU Michele	58	SHINOHARA Fumiya	43
SCHOEN Claudio	47	SHINOHARA Koki	50
SCHÖNGRUNDNER Ronald	90	SHIOMI Hiroshi	57
SCHORGEL Matthias	81	SHIPWAY Philip	61
SCHORR Dietmar	66	SHIRZADEGAN Mohammad	54
SCHRECK Erhard	44	SHITARA Yuji	39, 80
SCHRITTESSER Bernd	69	SHOCKLEY Michael	88
SCHULZE Kyle	75	SHOKUHFAR Tolou	90
SCHULZE Kyle D.	91	SHTANSKY Dmitry	48
SCHWACK Fabian	54, 79	SHU KUN	94



Author Name	Page	Author Name	Page
SHUKUR Zainab	92	STRATMANN Andreas	38, 47
SI Chenguang	48	STRÖMBERGSSON Daniel	57
SI Lina	40	SU Benlong	47
SICRE Jacques	57	SU Bo	54
SIMIC Rok	36	SU Dashi	42
SINGH Jayant	60	SU Fenghua	64
SINGH Manvandra Kumar	88	SUBHI Kussay	81
SINHA Sujeet Kumar	63	SUDO Takayuki	43
SINZARA Wilbert	68	SUEN Benjamin	44
SIVAYOGAN Gajarajan	93	SUGIMURA Joichi	36, 39, 48, 55, 64, 69, 80, 85, 86
SLOBODYAN Stepan	76	SUGINO Masaaki	83
SLOUKA Marek	67	SUI Tianyi	64
SMELOVA Viktorija	42	SUKUMARAN Jacob	61
SMIRNOV Anatolij	56, 93	SUN Chao	75
SMITH Edward	39, 68	SUN Dan	69
SÖDERBERG Anders	44	SUN Guan hong	48
SONDE Emmanuel	89	SUN Hongyan	51
SONG Chenfei	57, 69, 75	SUN Jianlin	53
SONG Fuzhi	94	SUN Na	40
SONG JIAN	53, 53, 61, 89, 92	SUN Shiqing	40
SONG Jingan	76	SUN Shisheng	46
SONG Li	42	SUN Ya-Ru	44
SONG Pengyun	69	SUN Yaru	43
SONG Wei	52	SUN Yixiang	75
SONG Xintao	47	SUN Yong	94
SONG Yang	88	SUNAMI Yuta	89
SONG Yi	40, 75	SUZUKI Ai	44
SOPOUCH Martin	93	SUZUKI Atsushi	53, 65
SOSA Mario	92	SUZUKI Daiki	81
SOSNOVSKIY Leonid	69, 70, 75, 75, 75	SUZUKI Kenta	72
SOUCHET DOMINIQUE	83, 83	SWAN Patrick G.	69
SOUS Christopher	55	SZCZEREK Marian	93, 93
SOUTHBY Mark	68	TA Dinh Thi	50
SPALLEK Reiner	50	TA Huong Thi Thuy	39, 59
SPALTMAN Dirk	61	TA Na	56
SPALTMANN Dirk	61	TA Thi Dinh	39, 59
SPECK Thomas	40	TA Thuy Huong	50
SPENCER Nicholas D.	36, 38	TABATA Hideyuki	67
SPERKA Petr	39, 60, 60, 71	TACHIBANA Hiroaki	52
SPETH Willibald Jakob Ludwig	62	TAGAWA Norio	41, 79
SPIKES Hugh	40, 46, 59, 59, 63, 68, 71, 71	TAGO Masahiro	81
SRIVASTAVA Abhishek	44	TAHERI Reza	63
STACHOWIAK Grazyna	90, 90	TAKADA Satoshi	43
STACHOWIAK Gwidon	46, 46, 57, 58, 60, 90, 90	TAKAGI Fumiaki	39
STACHOWIAK Gwidon W.	57	TAKAGI Toshiyuki	35
STAHL Karsten	93, 93, 93	TAKAHASHI Naoki	59, 59
STEAD Iestyn	84	TAKAHASHI Shun	67
STENGLER Ralph	61	TAKANO Tomoyuki	43
STEPANOV Feodor	76	TAKENO Takanori	37, 47
STEVENSON Harriet	53	TAKEUCHI Hiroaki	42
STEWART David	61	TAKEUCHI Yusuke	74
STEYER Philippe	71	TALKE Frank E.	44
STOICA Nicolae	81	TAMURA Yukio	52
STOLARSKI Tadeusz	43, 82		



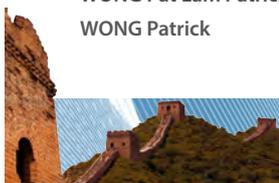
Author Name	Page	Author Name	Page
TAN Deqiang	70	TSOLAKIS Athanasios	84
TAN Xipeng	37	TUDELA Ignacio	62, 78
TAN Yuanqiang	93	TUDOR Andrei	81
TAN Zhengchu	91	TUFAIL Khizer	49
TANAKA Hiroyoshi	48, 64, 80	TUNG Simon	94
TANAKA Keji	80	TURTOI Petrica	60
TANAKA Kentaro	87	TUSZYNSKI Waldemar	93
TANAKA Shinji	52	TYAGI Rajnesh	77
TANDON N	93	TYSOE Wilfred	38, 45, 59
TANDON N.	60	UB Jayadeep	74
TANDON Naresh	58	UETA Tomoya	39
TANG Chun	59	UJVARI Szerena Krisztina	91
TANG Fei	65	UMEHARA Noritsugu	36, 37, 37, 37, 47, 51
TANG Jinyuan	84	UMER Jamal	74
TANG Zhengqiang	37	URBAKH Michael	35, 35, 45, 74, 86
TANI Hiroshi	41, 79	URUEÑA Juan	72, 75
TANIGUCHI Masato	58	URUEÑA Juan Manuel	91
TANISHIMA Ayano	72	USAMI Hatsuhiko	67, 82
TANSU Nelson	71	USSA Paula	39, 40
TAO Bo	76	UYAMA Hideyuki	42
TAO Dashuai	40, 41, 81, 91	VACHER Béatrice	39, 40, 40, 64
TAO Shunyan	78	VADIVEL Hari Shankar	77
TATIEVSKI Boris	63	VAGHELA Uddhav	53
TAURA Hiroo	42	VALTINER Markus	36, 85
TER OVANESSIAN Benoit	64	VAN DER S.M.	79
THEILER Géraldine	89	VAN DER HEIDE Emile	65, 81
THEODOSSIADES Stephanos	54, 93	VAN DER MEI H. C.	91
THIEBAUT Benoit	39, 40, 40, 51, 51	VAN EIJK Marcel	70
THIELEN Stefan	69, 82	VAN ZOELLEN Marco	70
THOMAS Evan	55, 55	VANCOILLIE Jonathan	71
THOUVEREZ Fabrice	43	VANOSSI Andrea	86
TIAN Yanwen	49, 77	VARENBERG Michael	40
TIAN Yu	36, 40, 41, 75, 81, 91	VARGA Markus	36
TIANMIN Shao	89	VARGIOLU Roberto	61, 80, 80
TIEU Anh Kiet	39, 50, 59, 63	VARJUS Simo	47
TIEU Kiet	53, 53, 63	VARMAN Mahendra	37
TOH Wei Quan	37	VEDANTHAM RAMAN	43
TOKOROYAMA Takayuki	37	VEEREGOWDA Deepak H.	91
TOKUMO Yasuha	39	VENGUDUSAMY	50
TOKUNAGA Yuichiro	72, 85	Balasubramaniam	
TOMALA Agnieszka	64	VENNER Cornelis	79
TOMCZEWSKI Leszek	49	VERBICKAS Rolandas	62, 78
TONG Hao	91	VERDU Catherine	64
TONG Qun	42	VERGNE Philippe	46, 46, 60
TOR Shu Beng	37	VERNES Andras	91
TORSKAYA Elena	76	VIEIRA Lucia	78, 78
TORTORA Angela Maria	56	VIERNEUSEL Bernd	47
TOSATTI Erio	45, 74, 74	VILLE Fabrice	40
TOUCHE Thomas	46, 46	VINCENT FRIDRICI	48, 73
TOUSSAINT Lionel	67	VINKE Jeroen	81
TRAUSMUTH Andreas	90	VISSINK Arjan	81
TREMMELE Stephan	38, 42	VIVEK Menon	45
TRIMMER Gareth	84	VIVIER Florence	56
TROMP Stephane	59	VLADESCU Sorin	81



Author Name	Page	Author Name	Page
VLADESCU Sorin-Cristian	49, 82	WANG Jun Yang	88
VLEUGELS Jef	41	WANG Junjie	88
VLEUGELS N.	94	WANG Junjun	78
VOKOUN David	70	WANG Junxiang	90
VONNA Laurent	87	WANG Junyuan	52
VRBKA Martin	52, 65	WANG Kuifang	44
VRCEK Aleks	54	WANG Lei	56, 77
WACHTENDORF Volker	89	WANG Li	57
WAHAD Haider	81	WANG Linfeng	74
WAKABAYASHI Toshiaki	39	WANG Ling	36, 42
WALSH Frank	48	WANG Linqing	78
WAN Daozheng	64	WANG Liping	85
WAN Hongping	91	WANG Liqin	42, 73, 79, 84
WAN Lining	78	WANG Longxin	57
WAN Shanhong	63	WANG Moyang	60
WAN Yi	50	WANG Peng	48, 78
WAN Yiyang	40	WANG Pengfei	62, 75
WANG Aiguo	92	WANG Qian	35, 63, 73, 76, 84, 87, 87,
WANG Anying	63		87, 87
WANG Bao	40, 69	WANG Qian Jane	38
WANG Bin	64, 88	WANG Qianzhi	62, 62, 77, 78
WANG bingqing	83	WANG Qihua	77, 77, 94
WANG Bo	56	WANG Rong	49, 86
WANG Chao	68, 69	WANG Shanshan	46
WANG Chen	74	WANG Shunca	48
WANG Chengbiao	50, 88	WANG Shuo	57
WANG Chijia	62	WANG Shuwen	49, 69
WANG Dagang	84, 84	WANG Song	53, 53
WANG Daoai	75	WANG Tianxian	67
WANG Deguo	83, 84	WANG Tingjian	79
WANG Di	81	WANG Tingmei	77, 94
WANG Dingming	39	WANG Tingting	39
WANG Dongan	79	WANG Wei	64, 65
WANG Dongfeng	54	WANG Weiqi	66
WANG Dongwei	49, 49	WANG Wen	55, 86, 87
WANG Haidou	46	WANG Wenjian	70, 85
WANG Haiyang	54	WANG Wenzhong	42, 54, 60, 73, 78
WANG Helen	48	WANG Xiao	88
WANG Hongbing	47	WANG Xiaochen	75
WANG Hongbo	54	WANG Xiaocui	70
WANG Hongjian	73	WANG Xiaojie	75
WANG Huaiyuan	62	WANG Xiaojing	65
WANG Hui	66, 74	WANG Xiaolei	79
WANG Huiping	41	WANG Xiaoli	40, 47
WANG Jia-Dao	91	WANG Xin	66
WANG Jiadao	38, 69	WANG Xuejun	48
WANG Jian	49, 56	WANG Ya-Ming	77
WANG Jianlei	48	WANG yan	41
WANG Jianmei	55	WANG Yang	59
WANG Jianzhang	90	WANG Yanshuang	79
WANG JING	45	WANG Yanxu	51
WANG Jinqing	48	WANG Yazhen	42
WANG Jiugen	36	WANG Ye	81
WANG Jun	48, 70	WANG Yingjun	79



Author Name	Page	Author Name	Page
WANG Yongfu	65	WOOD Robert	90
WANG Youshan	47	WOOD Robort JK	36
WANG Yu-Jin	77, 88	WOYDT M.	67
WANG Yuechang	94	WOYDT Mathias	41, 61, 61
WANG Yuming	69, 83, 89, 94	WU Bin	84, 87
WANG yunlong	54	WU Gefei	79
WANG Zhan	39	WU Guoping	89
WANG ZhanChao	68	WU Hong	49, 77
WANG Zhanjiang	76, 87, 87	WU hongxing	64
WANG Zhongwei	53, 90	WU Jian	47
WANG Zhouyi	40	WU Jiunn-Jong	35
WANTZEN Knut	70	WU Junwei	88
WARTZACK Sandro	38, 42	WU lili	51
WäSCHE R.	67	WU Lupeng	51
WASHIZU Hitoshi	59	WU Peirong	65
WATANABE Akira	40	WU Pu	51
WATANABE Kazuya	80	WU Qiong	53
WATANABE Seiya	80	WU Shifeng	83
WATANABE Wataru	41	WU Sudong	86
WATARI Tomomi	47	WU Tonghai	35, 57, 57, 57, 58, 70, 84
WATASE Keiko	59	WU Wei	49
WEBBER Grant B	80	WU Yan-ping	73
WEBSTER John	55	WU Zhiwei	77
WEBSTER Martin	35	WULCZYNSKI Jan	93
WEI Chao	60	XIA Jing	66
WEI Kejian	88	XIA Zhenhai	40
WEI Lei	57, 70, 77	XIANG Dingding	53
WEI Ronghua	36	XIANG Li	37
WEI Xicheng	88	XIAO Chen	35, 35, 44, 73
WEI Xinsheng	54	XIAO Huaping	65, 83
WEIDNER Steffen	89	XIAO Linjing	49
WEIHNACHT Volker	37, 86	XIAO Xingming	84
WEINHOLD Wolfgang	48	XIAO Zeliang	93
WEISS Henning	36	XIE Guoxin	64
WEN Heng	88	XIE Renjian	79
WEN Jialin	66	XIE Youbai	67
WEN Peng	88	XIE Zhijie	51
WEN Shizhu	65, 92	XIN Hua	65
WEN Zefeng	69	XING Songling	38
WIECZOREK Andrzej	93	XING Xiaofang	84
WIECZOREK Andrzej N.	36	XIONG Dangsheng	48, 50, 52
WILLIAMS Horace	53	XIONG Shaomin	44
WILSON Marc	67	XU Bing	94
WIMMER Markus	66	XU Bo	81
WINCIERZ Christoph	56, 68, 93	XU Dichu	36
WODTKE Michal	68	XU Hengjie	69
WOLOSZYNSKI Tomasz	46, 46, 60	XU Jian	39
WOLSKI Marcin	57, 58	XU JIAO	48
WOLTER Christian	56	XU Jie	85
WONG Janet	35, 40, 63, 63, 71, 80, 83	XU Jingxiang	50, 59, 59
WONG Lee Kwang	89	XU Li	66, 67
WONG Pat Lam	42	XU Quan	40
WONG Pat Lam Patrick	46, 54	XU Wenxue	46
WONG Patrick	35, 87	XU Xiaojun	61



Author Name	Page	Author Name	Page
XU Xuefeng	67, 75	YANG Xiao	83
XU Yang	76, 91	YANG Xiaofang	71
XU Yilun	87	YANG Xiaoguang	73
XU Yufu	49	YANG Xiaoniu	64
XUE Peidong	37, 89	YANG Xin-an	86
XUE weihai	78, 78	YANG Ye	41
XUE Wenbin	88	YANG Z.	48
XUE Ying	38	YANG Zenghui	94
YA H. H.	43	YANG Zhenghai	69
YAGI Kazuyuki	36, 39, 42, 55, 82	YANG Zongrong	83
YAHIAOUI Malik	36	YANO S.	67
YAMADA Hiroki	42	YAO Hang	79
YAMADA Hiyoyuki	42	YAO Hao	42
YAMADA Naohiro	37, 47	YAO Peng	39
YAMADA Norifumi	39	YAO Quanzhou	85
YAMAGUCHI Ryo	36	YARIMITSU Seido	52, 53, 65
YAMAGUCHI Takeshi	41, 50, 81	YASUI Shuta	81
YAMAGUCHI Tetsuo	53, 92	YE Feng	64
YAMAI Naoki	81	YE Jiaxin	41, 76
YAMAKAWA Kazuyoshi	57	YE Xiao	84
YAMAMOTO Hiroshi	52	YEO Chang-Dong	76
YAMAMOTO Kenji	67	YI Gewen	87
YAMASHITA Naoya	41	YI Meirong	50
YAMASHITA Tomoaki	84	YIN Bifeng	81
YAN Feiyan	49	YIN Hong	94
YAN Fengyuan	90	YIN Nian	45, 85
YAN Jincan	52	YIN Qiang	54
YAN Jiwang	62	YIN Wei	40, 41
YAN Panyun	55	YIN Xuebin	42
YAN Shuai	63, 64	YIN Yanjing	54
YAN Xinping	40, 56, 56, 57, 71, 79, 86	YOROZU Hidenori	81
YAN Ying	41	YOSHIMIZU Hiromichi	69
YAN Yu	53, 90	YOSHIMOTO Shigeka	41, 43, 56, 56, 68, 68, 82
YANAGISAWA Rina	81	YOU Tao	49
YANG Chengzhang	48	YU Bingjun	54, 66
YANG Fang	94	YU Chengjiao	87
YANG Guangbin	50, 65	YU Haibo	50
YANG He	38	YU Hao	87
YANG Hongmei	63	YU Hualong	87, 87
YANG Huayong	54	YU Min	70
YANG Jun	55	YU Qingyuan	80
YANG Kai	78, 78	YUAN Chengqing	40, 71, 83
YANG Lei	37, 38, 48, 74	YUAN Haomiao	61, 89
YANG Lingfeng	57, 57	YUAN Junya	89
YANG Liu	83	YUAN Shihua	60
YANG Min	43	YUAN Yungang	88
YANG Peiran	39, 46	YUAN Zhenjun	77
YANG Ping	39	YUE Wen	50, 59, 88
YANG Qianqian	63	YUE Yang	75
YANG Shengrong	48	YükSEK Levent	62
YANG Shiping	93	YUNOS Yana Shaheera	89
YANG Shuyan	80	YUYING Lei	47
YANG Weixu	47	ZABALA B.	71
YANG Wen-jin	73	ZADOROZHNAJA Elena	43, 50



Author Name	Page	Author Name	Page
ZAHID Rehan	37	ZHANG Mengqi	87
ZAHNER Michael	38	ZHANG Peng	35, 35, 44, 73
ZAHOUANI Hassan	49, 61, 80, 80	ZHANG Pingyu	50, 51, 51, 51, 51, 64, 65, 77, 83
ZANG Shuyan	42	ZHANG Qi	49
ZEHETHOFER Gerald	90	ZHANG Qida	65
ZELIKOV Eido	47	ZHANG Rui	48
ZENG Guosong	71	ZHANG Shangxiong	41
ZENG Han	77	ZHANG Shaohua	83
ZENG Hongbo	85	ZHANG Shengguang	73
ZENG Jia	76	ZHANG Shengmao	50, 51, 51, 51, 51, 64, 65, 77, 83
ZENG ningning	78	ZHANG Shumin	86
ZENG Qingdao	74	ZHANG Silun	55
ZENG Qunfeng	37, 86	ZHANG Simon	56
ZENG Xiangqiong	65, 81, 92	ZHANG Songwei	64, 80
ZENG Xiangqiong (Lydia)	63	ZHANG Tao	54, 82
ZENG Xingzhong	74	ZHANG Varian	38
ZHAN Pujie	77	ZHANG Weiqiang	62, 75
ZHANG Ani	83	ZHANG Xi	75
ZHANG Beibei	90	ZHANG Xiangjun	75
ZHANG Bin	62, 86	ZHANG Xiangning	76
ZHANG Binbin	45	ZHANG Xiaofeng	63
ZHANG Bo	39, 57, 90	ZHANG Xiaogang	35
ZHANG Caixia	65	ZHANG Xiaohan	91
ZHANG CHAO	82	ZHANG XIAOQIN	48
ZHANG Chaohui	68, 79	ZHANG Xiaoru	93
ZHANG Chenhui	41, 50, 51, 51, 70, 71, 86, 86	ZHANG Xiaoyu	84
ZHANG Chuanbing	47	ZHANG Xin	76
ZHANG Chuanwei	43, 49, 51, 84, 94	ZHANG Xingnan	79, 80
ZHANG Dekun	84, 84, 84	ZHANG Yali	35
ZHANG Dongya	48	ZHANG Yanchao	48, 82, 82
ZHANG Ga	77, 77, 94	ZHANG Yanjuan	55
ZHANG Gang	91	ZHANG Yaoguang	60
ZHANG Gangqiang	65, 81	ZHANG Yazhao	61
ZHANG Gaolong	94	ZHANG Yi	62, 69, 78, 82
ZHANG Guangyu	37	ZHANG Yingying	86
ZHANG GuoYuan	69, 82	ZHANG Yinyin	88
ZHANG Haibo	78	ZHANG Yong-Wei	91
ZHANG Haiyang	76	ZHANG Yongzhen	57, 69, 75, 75, 77, 78
ZHANG Hedong	39, 74, 74, 79	ZHANG Youfeng	37
ZHANG Hui	49	ZHANG Yue	90
ZHANG Huichen	73, 86	ZHANG Yufeng	62
ZHANG Huijie	37, 83	ZHANG Yujuan	51, 64
ZHANG Ji	85	ZHANG Zhaozhu	89
ZHANG Jianhua	61	ZHANG ZHIMING	87
ZHANG JiaPing	47	ZHANG Zhinan	45, 54, 85
ZHANG Jie	51, 59	ZHANG Zhiqiang	84
ZHANG Jing	65	ZHAO Chen	36
ZHANG Jingzeng	36	ZHAO Dewen	66, 66, 70
ZHANG Jiping	51	ZHAO Fei	40
ZHANG Jun	84, 84	ZHAO Haiyan	88
ZHANG Junhui	94	ZHAO Hao	69
ZHANG Junyan	51, 86	ZHAO JIN	92
ZHANG Kai	70, 84, 86		
ZHANG Kai-shuan	84		



Author Name	Page	Author Name	Page
ZHAO Jun	65	ZHU Caichao	84
ZHAO Junhua	65	ZHU Dong	54
ZHAO Lala	85	ZHU Hongtao	39, 50, 53, 59, 63, 63
ZHAO Linshan	40	ZHU Hongwei	51
ZHAO Moses	67	ZHU Jiahua	80
ZHAO Ning	87	ZHU Min-Hao	70, 73
ZHAO Su	44	ZHU Minhao	49, 49, 61, 70, 70
ZHAO Tong	82, 82	ZHU Pengzhe	66
ZHAO Xin	60	ZHU Qiang	53
ZHAO Xuechu	67	ZHU Rupeng	93, 94
ZHAO Xueyuan	82	ZHU Shouxing	67
ZHAO Y	54	ZHU Wentao	70
ZHAO Yang	46	ZHU Xuli	49
ZHAO Yixing (Philip)	64	ZHU Yanji	62
ZHAO Yuzhen	63	ZHU YI	44, 54, 85
ZHAO Zhen	54	ZHU Zhencai	46, 85
ZHAO Zhiqiang	54	ZHUANG Yin	78
ZHAO Ziqiang	42, 60, 78	ZIEGLTRUM Andreas	93
ZHENG Jianpeng	88	ZONG Cong	83
ZHENG Jing	66, 66, 66, 84	ZOU Chunli	66, 67
ZHENG Kaikui	77	ZOU Jun	54
ZHENG Liang	66, 66	ZOU Shengyong	46, 85
ZHENG Quanshui	74, 86, 86	ZOU Wei	52
ZHENG Wenkai	89	ZOU Zhi-qiang	84
ZHENG Yelong	41	ZULKIFLI Nurin	37
ZHENG Zhizhen	89	ZUNDA Audrius	43
ZHENG Ziqi	48		
ZHMUD Boris	63, 66, 68		
ZHONG Fangshang	85		
ZHOU Changjiang	93, 93		
ZHOU Dawei	83		
ZHOU Dongdong	37		
ZHOU Fei	62, 62, 77, 78		
ZHOU Feng	35, 75, 80, 92, 92		
ZHOU Gang	83		
ZHOU Huiqin	81		
ZHOU Linlei	69		
ZHOU Luhai	88		
ZHOU Ming	87, 91, 92		
ZHOU Nan	48		
ZHOU Ping	41		
ZHOU Qinghua	87		
ZHOU Quanbao	81		
ZHOU Shuaiyu	82		
ZHOU Xiang	74		
ZHOU Xiaobo	42, 55		
ZHOU Xiaoxue	63		
ZHOU XinCong	58, 70		
ZHOU Yan	66, 67		
ZHOU Ye	84		
ZHOU Yongjie	84		
ZHOU Yuan	88		
ZHOU Zhifeng	62, 78		
ZHOU Zhongrong	49, 49, 66, 66, 66, 66, 70, 80		



Author Name	Page	Author Name	Page
ABDEL-AAL Hisham	97	CHEN Kai	103, 107
ADACHI Koshi	97, 97, 107	CHEN Minjie	101, 110
AKAGAMI Kenta	107	CHEN Ruling	101
AKBULUT Hatem	105	CHEN Shuai	97
AKETO Yosuke	102	CHEN Wei	102
AKIYAMA Hirotooshi	97	CHEN Wenbin	101
ALP Ahmet	105	CHEN Wengang	108
ALPAS Ahmet	102	CHEN Xiang	98
ANTONY Joseph	109	CHEN Xiaoyang	101
AONO Yuko	106	CHEN Yu	102
AURELIANO Ricardo	105	CHEN Zhangbo	108
BAI Qinghua	110	CHEN Zhaoke	105
BAI Zheng Feng	104	CHEN Zhaoxiang	105
BANDEIRA Aline Luiza	104	CHEN zhuojun	99
BANDEIRA DOTTA Aline Luísa	96, 97	CHENG Guanggui	100
BANERJI Anindya	102	CHENG Jie	100
BARBER J.R.	98	CHENG Jun	96, 98
BARKER Leslie	109	CHENG M.	103
BATTEAS James	97	CHENG Xianhua	105
BELIN Michel	96	CHENG Yang	97
BENADE Howard	109	CHONG Sang-Ok	104
BHADHAVATH Sanker	109	CJEN Qi	100
BIAN Ge	103	COOK George	102
BINGBING Xia	106	COSTA H.L.	103
BOONLONG Kittipong	106	COZZA Ronaldo	98, 108
BUDINSKI Kenneth G Budinski	109	CRISTOL Anne-Lise	107
BUDINSKI Steven T	109	CUI Fuhao	103
BYKOVA Svetlana	98	CUI Shaogang	100
CAI Mang	103	CUI Yan	107
CAI Xingxing	105	DAI Yuanjing	99
CAI Zhen-bing	97, 106	DAI Yuchen	98
CAI Zhenbing	103	DANIEAU Pierre	109
CANO ORDONEZ Michell Felipe	97, 104	DARIVA BEUX Tanara	97
CAO Nana	105	DAS NEVES Mauricio	108
CAO Wang	110	DE BARROS Maria-Isabel	96
CAO wei	109	DE VAAL Philip	109
CAO Yuanyuan	105	DESPLANQUES Yannick	107
CARDOSO G.V.	103	DI Yuelan	104
CARRE Matt	96	DI MARE Luca	97
CASTELETTI Luiz	105, 105, 105	DIABY Moussa	96
CATAFESTA Jadna	104	DIAO Dongfeng	105, 105, 107, 108
CAYER-BARRIOZ Juliette	97	DING Hongyan	104
CHAMBARD J-P.	109	DING Jianning	100
CHANG Chao	101	DING Qingjun	107
CHANG honghui	110	DING Ya	96, 97
CHEN Bo	101	DING yan	108
CHEN Dexiong	101	DONALDSON Corey	102
CHEN Gaopan	101	DONATO Gustavo	98
CHEN Guangxiong	104	DONG chenzhu	105
CHEN Guangzhu	104	DONG Guangneng	100, 108, 109
CHEN Hong	98	DONG Lei	104, 106
CHEN Huahui	103, 107	DONG Lihong	104
CHEN Jingjing	101	DONG Rui	99
CHEN Jun	101, 104	DONG Wenzheng	100, 107



Author Name	Page	Author Name	Page
DONG Yanchun	105, 105	GU Minmin	101
DONG Zhiyuan	108	GU Zhongtao	101
DORGHAM Abdel	105	GUEST Cade	102
DR. WEINHOLD Wolfgang	107	GünNEWIG Olaf	110
DU Chuan	97	GUO Fei	106
DU Hui	100, 102	GUO Feng	99, 108
DU Jinfang	96	GUO Hong	101
DU Jinfu	103	GUO Junde	108
DU Kaibing	102	GUO lihe	103
DU San-ming	105	GUO Shuaiwei	99
DU Sanming	109, 110	GUO Xiaodong	96
DUAN Deli	99	GUO Yanbao	108
DUAN Haitao	96	GUO YINGYING	97
DUAN Tianying	97	GUO yongbo	109
DUAN Zhihe	99	GUO Zhiwei	109, 109
ENGEL Ray	102	H NATARAJ Shubha	106
ESPINOSA MARZAL Rosa Maria	107	HAFEZI Mahshid	108
FAN Mingjin	99	HALL Claude	102
FANG Jiao	101	HAN Min-Su	106, 107
FANG Min	109	HAN Zhong	107
FANG Mingwei	102	HARINARAIN Ajay Kumar	109
FAVIER Damien	109	HARPREET Arora	106
FENG Weimin	107	HARPREET Grewal	106
FENG Xie	99	HARSHA AP	108
FENG Xin	100	HASHIMOTO Hiromu	101, 102
FERREIRA E.S.	103	HE Danfeng	108
FU Lei	97	HE Fushan	107
FU Licai	96, 107	HE Kaichen	96
FU Lin	104	HE Tiantian	110
FU Xiuli	100	HE Wei-feng	106
FU Zhongyuan	110	HE Yongyong	106
FUJIE Hiromichi	107	HEMETTE Sylvain	97
FUJIMORI Tomoya	99	HIGUCHI Yuji	97
FUKUI Shigehisa	98	HIKOSAKA Takeshi	98
FUKUTA Koki	109	HINDER Steve	106
FUO Feng	110	HIRATA Atsushi	106
GAJEWSKI Juliusz B.	97	HIRATA Yuki	99
GAO Chenghui	98, 107	HONDA Shigenobu	102, 102
GAO Huikai	98	HONG Sheng	105
GAO Kaixiong	101	HONG Sung-Ho	109
GAO Shuai	100	HONGTAO Liu	106
GAUTHIER Christian	109	HORIBATA Shoko	107
GE Shirong	108	HÖRMANN Johannes Laurin	97
GE Zhaoshuo	108	HOU Junsen	96
GENG Jian	105	HOU Kaiming	98
GERASINA Yulia	97	HOU pingping	108
GLOGOWSKI Marek	97	HOU Shuen	107
GONG Feng	101	HOU Shuqing	100
GONG Hua	106	HOU Sihan	99
GONG Ping	101	HRIOUECH Amal	96
GONG Xiansheng	96	HU Baoguo	106
Gózdź Stanisław	108	HU DA	104, 104
GRADT Thomas	108	HU Enzhu	106
GU Le	106, 106, 110	HU Jianqiang	99, 100



Author Name	Page	Author Name	Page
HU ningning	98, 100	KAWASAKI Kenji	97
HU Songtao	106	KHAN Polina	98
HU Xianguo	99, 105, 107	KHETAN Vishal	105
HU Xiangyu	102	KIM Dae-Eun	97
HU Yanqiang	97	KIM Dongsik	104
HU Yuanzhong	98	KIM Jongkuk	104
HU Zheng xin	103	KIM Seong-Jong	104, 106, 107
HUANG Jian	102	KITAMURA Tomoki	110
HUANG Jianmeng	98	KOGANEZAWA Shinji	100
HUANG Li	96	KOHNO Eishun	110
HUANG Liangliang	108	KONISHI Masakazu	99
HUANG Qingcheng	110	KOSASIH Buyung	104
HUANG Weifeng	102, 102	KOWALCZYK Joanna	100
HUANG Xing	102	KREIVAITIS Raimondas	100
HUANG Yiji	99	KRZYSZKOWSKI Andrzej	105
HUANG Yuehua	109	KUANG Fuming	101, 102
HUANG Zhenyi	105	KUBO Momoji	97, 97
HUANG Zhiqiang	108	KUPČINSKAS Arturas	100
HUO Yanwen	99	KURIHARA Kazue	97
HWANG Pyung	106	KUZHAROV Andrey	97
IKEDA Naoya	98	LA YingQian	106
ISHII Toshinari	109	LAI Hanjian	108
ISHIKAWA Makoto	97	LANFERDINI SERAFINI Francisco	97
ITOIGAWA Fumihiro	109	LANG Fang	105, 105
IWAMOTO Katsumi	107	LANG Weiqin	101
JACKSON Robert	102	LAO Kunsheng	101
JANG Young-Jun	104	LEE Bora	109
JEENKOUR Puttha	106	LEE Guangyu	96
JI CUICUI	107	LEE Jung-Hyung	107
JI Xiulin	107, 107	LENG Mei	100
JI Zhengjia	107	LEWIS Roger	96
JIAN Longyi	100	LI Chao	110
JIANG Jie	102	LI Chuan	99
JIANG Jinlong	96	LI Feng	108
JIANG Wei	107	LI Gu	99
JIANGQIANG Hu	99	LI Guangming	99
JIAO Yunlong	109	LI Hang	98, 106
JIN Hongyun	107	LI He	107
JIN Xiao	103	LI Hui	103, 103
JIN Yong	101	LI Jian	96
JING Chenghu	108	LI Jianliang	106
JING Haoda	99	LI Jiaxing	105
JING Jian-ying	106	LI Jinwei	108
JING Minqing	99	LI Jiusheng	99
JUNG Kwang-Hu	104	LI Junning	102
KALITCHIN Zhetcho	105, 108	LI Kangsen	101
KAMEI Genki	109	LI Ling	98
KAN Zhongwei	105	LI Min	108
KANDEVA Mara	105, 108	LI Pengfei	105
KANG Yuchi	102	LI Pengyang	105
KARASTOYANOV Dimitar	105	LI Qinglin	105
KARTAL Muhammet	105	LI Qunyang	97
KASOLANG SALMIAH	100, 107	LI Rui	97, 98
KATSUKI Hiromitsu	107	LI Ruizhen	101



Author Name	Page	Author Name	Page
LI Shu	99	LIU Tianxia	99
LI shuyi	99	LIU Weimin	96, 96
LI Songjian	102	LIU Xiangfeng	106
LI Tongqing	108	LIU Xiaohong	97
LI Weifan	109	LIU Xiaojun	96, 96, 98, 106, 109
LI Xiaobing	108	LIU Xiaoqiang	104
LI Xinglin	96, 109	LIU Xiyang	103
LI Xinming	99	LIU xu	101
LI yajun	110	LIU Y.	103
LI yanbin	105, 105	LIU Yadong	102
LI Yang	104, 106, 108	LIU Yang	99
LI yanhong	99	LIU Yaohui	99
LI Yantao	107	LIU Yi	99
LI Yingchun	105	LIU Yiming	107
LI Yongjian	102, 102	LIU Ying	102, 106
LI Zhuan	108	LIU Yuhong	99, 100, 101
LI Zifeng	97	LIU Zhe	104, 104
LIANG erguo	97	LIU Zheyu	109
LIAO Bin	105	LIU Zhuotong	97
LIAO Ridong	105	LOMBARDI Amadeu	105, 105, 105
LIN Hua	100	LOU Ming	102
LIN Li	104	LOU yi	96, 96
LIN Qiquan	100, 107	LU Biao	108
LIN Youxi	100, 100, 101, 101, 101, 101, 101, 106, 107	LU Cheng Xu	106
LIU Chenglong	99	LU Hongyu	109
LIU Cong Hao	103	LU Jianguo	109
LIU Dongliang	108	LU Renguo	100
LIU Fengbin	107	LU Sheng	98
LIU Geng	106	LU Xiaohua	100
LIU Heng	99	LU Xinchun	100
LIU Hong	108	LU Xiqun	98
LIU Hongtao	103	LU Yuhai	108
LIU Huan	99, 101	LUBRECHT A.A.	96
LIU Hui	105	LUKITSCH Michael	102
LIU Huran	96, 96	LUO Dian	106
LIU jian	107, 109	LUO Jun	102, 105
LIU Jiangang	109	LUO Wanyue	107
LIU Jianhua	103, 103	LUO Yong	108
LIU Jianping	98	LV Xiaoren	97
LIU Jiawei	102	LV You	105
LIU Jihua	101	M Muthu Kumar	106
LIU Jiliang	105	MA Ming	96, 104
LIU Jinbin	102	MA Tianbao	98
LIU Juncheng	102	MA WAN	96
LIU Kun	96, 96, 98, 98, 100, 100, 104, 106, 109	MA Xinxin	106, 106, 110
LIU Meihong	102	MACHADO Izabel Fernanda	96
LIU Ming	98	MADEJ Monika	100, 105, 105, 108
LIU Mingyong	102	MAEGAWA Satoru	98, 109
LIU Qiyue	103	MAHAT MOHAMAD MAZWAN	107
LIU Sen	103	MAHMOOD Awais	97
LIU Shuhai	108	MAKIMATTILA Simo	99
LIU Shuren	104, 104	MAO Bo	107
		MAO Junyuan	106
		MARIANI Fábio	105, 105, 105



Author Name	Page	Author Name	Page
MARTIN James	102	OUNPANICH Duangporn	109
MATSUKAWA Hiroshi	97	OZAWA Nobuki	97
MATSUOKA Hiroshige	98	OZIMINA Dariusz	100, 105, 105, 108
MAZUMDAR SK	109	OZIMINA Ewa	105
MAZUYER Denis	97	PADGURSKAS Juozas	100
MCCLORY Brian	102	PAN Deng	103
MEI Benfu	101	PAN Guoshun	101, 106
MEIYUN Zhao	106	PAN Yongzhi	100
MENG Fan Jing	98	PANG Haosheng	98, 106
MENG Fan ning	100	PANG Xianjuan	96, 107, 110
MENG Kun	104, 108	PANG Xiaoxu	102
MENG xinxin	101	PARK Il-Cho	106
MENG Yonggang	96, 97, 102, 103, 109	PENG Chaolin	96
MESHRAM Rahul	109	PENG Jinfang	103, 103
MIAO Changqing	99	PENG Qiuyang	108
MICHAL Guillaume	96	PENG Runling	109
MILEWSKI Krystian	105	PENG Xianghe	98
MILOV Aleksey	97	PENG Yao-Qing	106
MIN Lei	98, 100	PENG Yubin	105
MINAMI Ryosuke	97	PENG Yuxing	96, 108
MISHIGDORZHIYN Undrakh	106	PERRET-LIAUDET Joel	96
MIURA Kouji	97	PERUZZO Marcele	97, 104
MIZUTA Hirotaka	102	PESIKA Noshir.S	100
MOHAMAD Nor Syahirah	100	PHAN The Hoang	104
MOHD SALLEH ZUAN AZHARY	109	PIERETTI Eurico	108
MOR? FARIAS Maria Cristina	104	PRAJAPATI DEEPAK KUMAR	103
MORAIS JR R.R.	103	PROF. DR. STENGLER Ralph	107
MORE FARIAS Maria Cristina	96, 97	PU Yanan	101
MU Qiang	106	PIAZA Stanisław	100, 105
MUHAMMAD Sufyan	108	QI Jianwei	107, 108
MURASHIMA Motoyuki	110	QIAN Weiji	104, 108
NAKAMURA Miho	97	QIANG Li	101
NAKAMURA Takashi	109	QIN Hongling	103
NAKANO Ken	99	QIN Liguó	108
NAKAO Taichi	110	QIN Na	96
NEVILLE Anne	105	QIN Yang	103
NGADI NORZITA	109	QING Tao	99
NI Ben	101	QIU Jinhao	107
NIE Mengyan	106	QIU Ming	102, 105
NING Lipu	101	QUAN Zefen	106
NISHIKAWA Hiroshi	98	RAJCHEJ Bogusław	108
NISHINO Takahiro	110	RAO Can	100
NOWAKOWSKI Łukasz	100	RAO Xiang	109
NUNOSHIGE Jun	97	RAO Xu	108
OBERHOLZER Krugel	109	RAO Zhushi	99
OCHIAI Masayuki	101, 102	REN Ke	108
ODAGIRI Ryo	101	REN Tianhui	99
OGAWA Koki	106	REN Zhiying	100, 101, 101, 101
OKUBO Hikaru	99	ROELL Bernie	102
OKIA Sławomir	108	ROLAND Thierry	109
ONODERA Tasuku	97	RONGONG Jem	96
OOTANI Yusuke	97	RUBIN Anne	109
OTANI Toshiki	98	RUKUIZA Raimundas	100
OU Shiso	110	SAMION SYAHRULLAIL	109

Author Name	Page	Author Name	Page
SASAKI Naruo	97	SUN wenjing	99
SASAKI Shinya	99	SUN Yang	97
SATO Keisuke	99	SUO Shuangfu	102
SATO Seiichiro	97	SUZUKI Masaru	97
SAWAKI Toshiya	110	SUZUKI Tatsuro	97
SAXENA Deepak	109	SVOBODA Petr	105
SEGU Dawit Zenebe	106	TA Dinh Thi	104
SHAFFER Stephen	102	TA Na	99
SHAN Yiping	107	TADOKORO Chiharu	99
SHANG Jian	104	TAGAWA Norio	100
SHANGGUAN Bao	103, 107	TAIROV Emir	98
SHAO Jinyou	108	TAKENO Takanori	107
SHAO Tao	99	TAMIL SELVAM karthikeyan	106
SHEN Ding	101	TAN Gui-Bin	102
SHEN Jia wei	97	TAN Xuefeng	96
SHEN Shengnan	103, 103	TAN Yongfa	102
SHEN Xuejin	101	TANAKA Kentaro	107
SHEN Yunian	98, 98, 104	TANG Guangze	106, 110
SHENG Chengxing	109	TANG Haiyan	96
SHENG Chenxing	109, 109	TANG wei	108
SHENG X.Y.	104	TANI Hiroshi	100
SHENG Xuanyu	99	TANIGUCHI Junko	97
SHENMING Xi	106	TAO Bo	96, 96, 98
SHI Ruimin	104, 106	TAO Nan	108
SHI Shih-Chen Shi	106	TERTULIANO Ana Julia	96
SHI Yijun	100	THEILER Géraldine	108
SHIN Dong-gap	97	TIAN Wenshuai	104
SHIODE Sora	100	TIAN Yu	109
SHIZHAO Yang	99	TIEU Anh Kiet	104
SIERADZAN Sebastian	105	TIEU Kiet	96, 100
SIZOV Igor	106	TIWARI Mayank	103
SMITH Bethanee	102	TOKOROYAMA Takayuki	110
SOARES Carolina	105, 105	TONG Ruiting	106
SONG Danlong	103	TONG Zhixue	101
SONG Jingfu	107	TOTTEN George	105, 105, 105
SONG Lianmei	107	TRAN Bach H.	100
SONG Ruhong	99, 107	TSUJII Yoshinobu	99
SONG Shuyuan	97	TUMBAJOY-SPINEL David	107
SONG Xiaoming	108	UMEHARA Noritsugu	110
SONG Yiming	104	V KAILAS Satish	106
SONG Zhixiang	106	VAKHARIA D. P.	101
SONI SANDEEP	101	VOBODA Petr	108
STOKES Keith	106	VONGBANDIT PratipPratip	109
SU hua	96	WAH NG Lawrence	109
SUGIMURA Joichi	102	WAN Gao	109
SUN Dong	103	WAN Shanhong	100
SUN Guanhong	102	WAN Yong	100
SUN J.Q.	104	WANG Anmin	108
SUN Jiaqi	99	WANG Bin	104
SUN Kun	105	WANG BingQuan	101
SUN Lemin	110	WANG Bo	105
SUN Shan	96	WANG caiyun	103
SUN Shisheng	96	WANG Chao	107
SUN Wei	104	WANG Chenglong	96, 97



Author Name	Page	Author Name	Page
WANG Chun	105	WANG Yumei	100
WANG Chunyang	107	WANG Yuming	102, 102, 106
WANG Dagang	96	WANG Zhichao	98
WANG Deguo	108	WANG Zhiqiang	96
WANG Dehong	102	WANG Zhongmin	97
WANG Dingming	101	WASHIZU Hitoshi	97, 99
WANG Dong	96	WATSON Simon	106
WANG GAOQI	98	WEI Bin	110
WANG Haidou	104, 104, 104	WEINHOLD Wolfgang	110
WANG Hui	98	WEN Feijuan	104
WANG Huiyang	109	WEN Junjie	100
WANG Jiadao	97, 97	WEN Yibo	110
WANG Jian	103	WENYU Peng	106
WANG Jian mei	100	WHITE Daniel	102
WANG Jinqing	98	WITTENBRINK Robert	96
WANG Jun	102, 106	WONG Janet	97
WANG Junhai	99	WU Boying	99
WANG Junxiang	104, 104	WU Chao	97
WANG Junyang	108	WU Chenhui	102
WANG Li	105	WU Hongxing	108
WANG Li Qin	110	WU Jian	100
WANG Linfeng	98	WU Na	98
WANG Ling	106	WU Qian	98
WANG Liping	100	WU Shijing	103
WANG Liqin	101, 106, 106, 108, 110	WU Shuai	96
WANG Longxin	109	WU Song-bo	97
WANG Ning	109	WU Tengfei	97
WANG Pei	104	WU Tingbao	106
WANG Peng	99, 101, 107	WU Tonghai	96, 99, 109
WANG Ping Ping	104	WU Xiaojun	101
WANG Qihua	107	WU Yingliang	99
WANG Qin Liang	103	WU Yuping	105
WANG Qingliang	107, 108, 108	WU Zhe	101
WANG Quandai	105	WU Zumin	109
WANG Shijie	97	XIA Ping	109
WANG SHOUREN	98, 100	XIA Yana	100
WANG Shuo	109	XIAO Bang	96, 97
WANG Shuqi	104	XIAO Jiming	105
WANG Songquan	98	XIAO Peng	108
WANG Tongqing	100, 101	XIAO Qian	101
WANG Wei	98, 98, 100, 100, 106	XIE Feng	99
WANG Weiwei	96	XIE Guoxin	105
WANG Wen	106	XIE Ting	96, 97
WANG Xiaoqin	100	XIE Xiangyu	102
WANG Xiaosun	98	XIE Youbai	100, 109
WANG Xinshaung	105	XIE Zhijie	110
WANG Xueliang	102	XIE Zhiwen	101
WANG yan	99	XIE Zhongliang	99
WANG YANJUN	98	XING Zhiguo	104, 104
WANG Ying	100	XINZE Zhao	106
WANG yongfu	104	XIONG Dangsheng	106, 108
WANG Yu	103	XIONG Hongqi	98
WANG Yuan	104, 108	XU Aijie	98
WANG Yuechang	102	XU Bo	106



Author Name	Page	Author Name	Page
XU Fangman	102	YIN Nian	103
XU Handong	103	YIN Wei	109
XU Hongguang	108	YIN Xiang	100
XU Jian	99	YIN Zixin	108
XU Jin	102	YINAN Fan	106
XU Jinbao	100	YING Yiyong	109
XU Jiujun	96, 102	YONG Jin	96
XU Kang	103	YOSHIMURA Ken-ichi	102
XU Leihua	100	YU Jie	101
XU Li	106	YU Laigui	99
XU Ling	100	YU Xiaohua	104, 108
XU Linmin	107	YU Yankun	100
XU Meng	103	YUAN xiaojing	107
XU Xin	99, 100	YUAN ZhenJun	110
XU Y.C.	104	YUE Wen	97, 108
XU Yachen	99	YUE Yang	110
XU yong long	104	ZEKUN Yuan	106
XU Yufu	105	ZENG Jia	96, 96, 98
XU Yunyun	100	ZHAGN Pingyu	99
XU Zhefeng	104	ZHAN shengpeng	96
XU Zhibiao	103, 103	ZHAN Zhaolin	104
XUE Xuzhi	99, 101	ZHANG Bengu	108
XUE Ya wen	100	ZHANG Bin	101
XUE Zifan	104	ZHANG Bobo	110
YAN Ming-ming	105	ZHANG Chaoyang	99
YAN Shaoze	96	ZHANG Chenhui	99
YAN Zhijun	96	ZHANG Chuanwei	106
YANG Bingxun	99, 107	ZHANG Chunli	99, 100
YANG Desuo	99	ZHANG Dekun	100, 103, 103, 107, 109
YANG Guangbin	99	ZHANG Dongya	100
YANG Hongjuan	104	ZHANG Fan	104
YANG Jie	102	ZHANG Gang	108
YANG Jing	105	ZHANG Haiyang	98
YANG Jun	96, 96, 98	ZHANG Hang	98
YANG Lei	105	ZHANG Hongyu	108
YANG Lingfeng	109	ZHANG Jennifer	96
YANG Liu	108	ZHANG Jianfeng	105
YANG LIYING	98	ZHANG Jianjian	99
YANG Ping	105	ZHANG Jiankai	108
YANG Shengrong	98	ZHANG Jie	96
YANG Shzhao	99	ZHANG Jingjing	101
YANG Ting	108	ZHANG Jiping	99
YANG WU	106	ZHANG Junyan	101
YANG Xing	110	ZHANG Kaifu	103
YANG Xiuying	99	ZHANG Lincai	104
YANG XUEFENG	98, 100	ZHANG Pengxiang	108
YANG Xuehui	107	ZHANG Pingyu	99, 99, 99, 100
YANG Ye-Jin	107	ZHANG Qiuyang	104
YANG Yiyong	102	ZHANG S.H.	103
YARIMITSU Seido	107	ZHANG Shaohua	99
YE Jiaxin	96, 96, 98	ZHANG Shengdong	99
YI Nan	109	ZHANG Shengmao	99, 99, 99, 99, 100
YIN Bifeng	106	ZHANG Shuai	99
YIN Longcheng	110	ZHANG Si-Wei	102



Author Name	Page	Author Name	Page
ZHANG Tao	103	ZHU Minhao	103
ZHANG Wulin	103	ZHU Shengyu	98
ZHANG Xiangjun	96, 99, 101	ZHU Zhencai	96, 108
ZHANG Xiao	108	ZHUI Minhao	103
ZHANG Xiaofeng	105	ZONG Lihua	101
ZHANG Xiaogang	96	ZOU chunli	106
ZHANG Yali	96, 108	ZOU Chunsheng	102
ZHANG Yanchao	103	ZOU Shengyong	108
ZHANG Yang	109	ZUO JunYan	106
ZHANG Yanyan	103		
ZHANG Yi	100		
ZHANG Yongzhen	96, 103, 107, 109, 110		
ZHANG youqiang	103		
ZHANG Yu Ting	110		
ZHANG Yue	104		
ZHANG Yujuan	99		
ZHANG Zheng	108		
ZHANG Zhijun	99		
ZHANG Zhinan	103		
ZHAO Bin	98		
ZHAO Congshuo	104, 104		
ZHAO Fagang	103		
ZHAO Gai	107		
ZHAO Jieliang	96		
ZHAO Jun	100, 106		
ZHAO Xiaoduo	108		
ZHAO Yang	98, 99, 104		
ZHAO Yuahang	98		
ZHENG Jifeng	101		
ZHENG Kaikui	107		
ZHENG Pan	104		
ZHENG Quanshui	104		
ZHENG Yanhua	110		
ZHENG Yelong	109		
ZHENG Yu	108		
ZHENG Yuan	105		
ZHOU Chao	109		
ZHOU Guanghong	104		
ZHOU Huiqin	106		
ZHOU Lingping	107		
ZHOU Ming	98		
ZHOU mingli	96		
ZHOU Pengfei	101		
ZHOU Tianze	101		
ZHOU Xiaoran	102		
ZHOU Xincong	101, 102, 110		
ZHOU Yan	106		
ZHOU Zhansheng	105		
ZHU Feng	102		
ZHU Guang	101		
ZHU Heguo	106		
ZHU Hongtao	96, 100, 104		
ZHU Hua	108		
ZHU Min-hao	97, 106		





### Portable X-ray Residual Stress Analyzer



Portable X-ray Residual Stress Analyzer μ-X360s is the world's lightest and smallest residual stress analyzer. This is non-destructive measurement system for residual stress, retained austenite, FWHM based on X-ray diffraction technique, and excellent for portability, reliability, safety, operability, cost and etc.

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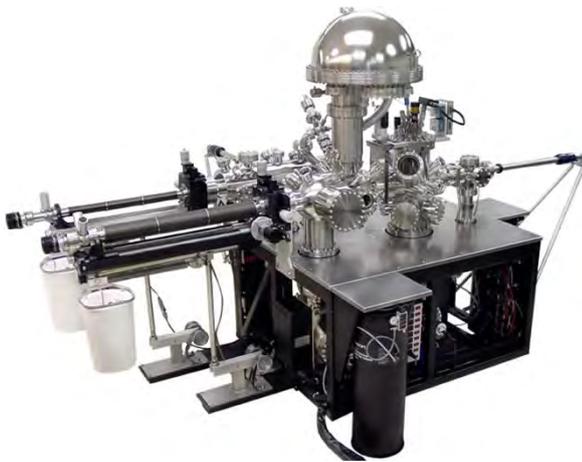


Laboratory or workshop use



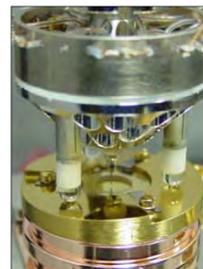
Field use

### Beetle™ UHV Variable Temperature AFM/STM



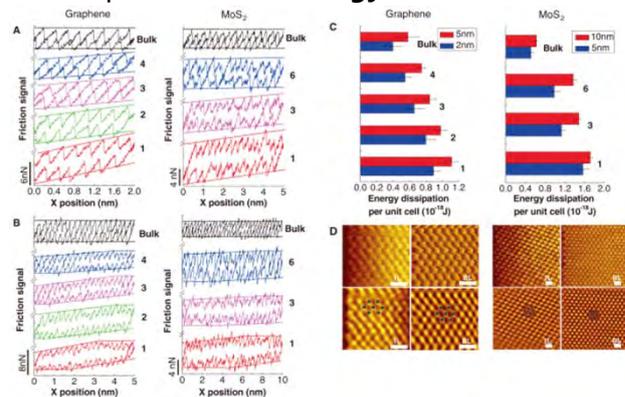
Founded in 1981, RHK Technology (in USA) brings over 25 years of experience to the design and manufacture of advanced UHV SPM instruments.

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#### Superb Nano-tribology characterization

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