Forum D Ecological Environment Materials

D01 (Invited)

Technical Progress of Permeable Concrete Pavement in the Construction of Sponge City in China

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This presentation mainly introduces the construction background and standardized system status of Sponge Urban in China. The technical status of pervious pavement in the construction of Sponge Urban, such as the prefabricated pervious concrete pavement brick and the whole cast-in-situ pervious concrete pavement.

D02 (Invited)

Lignin Based Functional Materials and Their Application

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As a kind of natural polymer with phenolic structure, lignin had such advantages as recycling and low cost etc. And, many kinds of lignin based functional materials, i.e., coal water slurry additive, a concrete water reducing agent, dye dispersion agent, ceramic additives and oil removal flocculant could be prepared by modification of lignin raw material. According to the domestic and foreign research reports of lignin based functional materials, the modification methods of lignin and their application in industry and agriculture were thus introduced. In addition, the economic and environmental benefits of lignin based functional materials were also reported.

Keywords: Lignin, Functional Materials, Modification, Application

D03

Study on the Microstructure and Properties of Rice Straw with Streptomyces Rochei

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To explore the impact of Streptomyces rochei unsterilized rice straw on the structure and performance, the paper discusses the two different conditions Lou's Toru Streptomyces Fermentation of Rice Straw structure and properties. Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), scanning electron microscopy (SEM) and other methods to analyze the structural changes before and after treatment of rice straw, thermal gravimetric analysis (TG) and Differential Scanning Calorimetry (DSC) analysis of the thermal performance of straw. The results showed that, after thorough Lou's handling of Streptomyces, straw waxy surface destruction cellulose, hemicellulose, lignin degradation are, rice straw pyrolysis part of functional groups, straw roughened surface morphology, porosity increased exposure silicide structure significantly reduce the length of the fiber, reducing the polarity; handle 1,2 crystallinity than the original straw improved 44.1%, 50.9%, respectively, after the initial thermal decomposition temperature extension 44, 62 ℃, the residual percentage increased up 48.3%, 35.3%, ΔH than the original straw decreased 16.6%, 24.9%, improved thermal stability.

Keywords： Rice straw； Streptomyces rochei； Structural changes; Thermal stability; Degree of crystallinity

D04

Mesoporous Silica (HMS) Based Composite Adsorbents and Its CO_2 Adsorption Performance

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A series of amines modified adsorbents were prepared in this work. And characteristics like thermal gravimetric analysis and nitrogen analysis were also used to investigate their CO_2 adsorption performance, amine efficiency and stability. The results showed that the optimal TEPA loading amount was 45% and the CO_2 adsorption capacity could be high to 248 mg/g at 75 ℃. The additive surface active agent ethylene glycol (EG) could enhance the amine efficiency for

these composite adsorbents. And the adsorption capacity presented minor decline after 10 times of cyclic adsorption-desorption operation. This research work provided a new idea to improve the amine efficiency of amines modified composite adsorbents and laid a theoretical basis for their industrial application.

Keywords: Mesoporous silica zeolites; amine modified composite adsorbents; CO_2 capture; adsorption capacity

D05

Rapid Synthesis of Photocatalytic $(BiO)_2CO_3$ Single-crystal Nanosheets Via an Eco-friendly Approach

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$(BiO)_2CO_3$ single-crystal nanosheets were successfully fabricated via an eco-friendly aqueous process using $CO_2$and bismuth nitrate as raw materials under mild conditions within 30 min. Compared with previous preparation methods, this facile method avoids treatment at high temperature, use of organic precursors and production of undesirable organic byproducts during synthesis process. The as-prepared samples were characterized by XRD, SEM, TEM, BET-BJH measurement, UV-vis DRS, FT-IR, Time-resolved ns-level PL in detail. It was found that the size and the thickness of $(BiO)_2CO_3$nanosheets can be influenced by reaction temperature and CO_2 concentration. The as-prepared $(BiO)_2CO_3$ nanosheets were applied to photocatalytic removal of NOx under artificial UV–vis and UV light irradiation and showed admirable photocatalytic performance. Significantly, $(BiO)_2CO_3$ nanosheets can be directly fabricated using the CO_2 in air without extra separation process, and the as-prepared $(BiO)_2CO_3$nanosheets exhibited efficient and durable photocatalytic performance for NOx removal. The present work created a novel method utilizing CO_2 to produce functional inorganic carbonate with applications in environment and energy, which is expected to fabricate other functional metal carbonate as well.

D06 (Invited)

Preparation and Activation of Belite-calcium Sulfoaluminate-ferrite (BCSAF) Eco-cement

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Belite-calcium sulfoaluminate-ferrite (BCSAF) eco-cement clinker was prepared from clay, bauxite and calcium carbonate. The influence of the mineral proportion on the compressive strength of cement paste was then analyzed. By doping boron (B^{3+}), the belite was activated, and an improved compressive strength was expected at early ages. X-ray powder diffraction, scanning electron microscopy, and thermal analysis were conducted to study the structure and composition of the cement clinker. Results figure out that the optimal BCSAF cement clinker consists of 40%-50% belite, 35%-40% calcium sulfoaluminate, and 10%-15% ferrite. The doping of B^{3+}, on one hand, can prompt the chemical reactions during the calcination. On the other hand, it helps to stabilize the α'-C_2S, which owns an improved hydration activity. As a result, the compressive strength of cement paste at 3d age is enhanced.

D07 (Invited)

Progress of Heat-induced Inkless Eco-printing & Beetle Forewing Biomimetic Research

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Part I：The Progress in Heat-induced Inkless Eco-printing Research

The authors have proposed heat-induced inkless eco-printing (HIEP), a new printing technology with the potential to eliminate printing-related environmental pollution. The progress in HIEP research, including the printing effect, degree of carbonization, environmental impact and feasibility, is reviewed in this paper: 1) The paper used in HIEP is predominantly yellow in color, which enables a practical printing effect. 2) After HIEP, the paper exhibits no significant carbonized microstructure. Moreover, HIEP is an ecologically and environmentally preferable technology. Only a small amount of toxic products is generated, and no carcinogens are emitted. 3) No significant damage to the paper is evident following HIEP, as the degree of heat experienced during HIEP is far below that experienced during a thermogravimetric (TG) experiment. Additionally, the evaporated water has a buffering effect. 4) HIEP is suitable for office paper and silk printing but not for newsprint. Potential research directions for HIEP are also proposed.

Part II：The Progress of Beetle Forewing Biomimetic Research in China

This Part reviews the research progress made in China regarding the microstructures of the beetle forewings, their modeling, and its mechanical properties. We focus on 1) the forewing microstructures can be classified into six phases, the first three of which are characterized by sandwich, multilayer and fiber layer structures, respectively. 2) The forewing colors are derived from three features: regulation of the structural parameters of the internal optical structures, scattering on the three-dimensional surface of the bowl-shaped structure and reversible color changes due to changes in the physical microstructure of fluffs. Their formation mechanisms were clarified, and fibers with ecological biomimetic structural colors have been developed. 3) Beetles exhibit a lightweight sectional frame structure with a trabecular core structure. Both of the joints on the left and right are concave-convex butt-joint structures with burrs, which provide an efficient docking mechanism with high intensity. 4) The forewing of *dichotoma* exhibits a non-equiangular layered structure, which results in anisotropy in its tensile strength; the structure of the trabeculae and a proposed 3D model with an integrated trabeculae-honeycomb structure; 5) finite element analyses and experimental results showing that the average anti-peeling strength in the presence of trabeculae can be as much as approximately three-fold greater than that in the absence of trabeculae; 6) the strengthening mechanisms of these structures and describe an optimized double thin-walled biomimetic structure that possesses excellent absorption and buffering properties;7) the development of technologies to produce fully integrated honeycomb plates with short fibers as a reinforced composite material and the verification that these plates are strong and lightweight and exhibit good integrity. Finally, the authors note the shortcomings in China in this field of research and propose potential new research directions for the next 20 years.

D08

Dynamic Moisture Sorption and Hygroexpansion of Populus euramericana Cv. under Two Cyclic Hygrothermal Conditions

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Poplar (Populus euramericana Cv.) specimens, 20mm in radial (r) and tangential (t) directions with thicknesses of 4 and 10mm along the longitudinal direction, were subjected to

cyclic environmental conditions, in the course of which the relative humidity (RH) changed sinusoidally between 75-45% at 20°C (condition A), or the temperature (T) was changed sinusoidally within 5-35°C at 60% RH (condition B). Moisture content (MC), as well as the t- and r-dimensional changes were measured as a response to the dynamic environmental conditions. The measured data also changed sinusoidally but they lagged behind the triggering original RH or T data. This effect was much higher under condition A than that of B. The observed equivalent RH and T changes at different ΔMCs or Δts served for comparison of the responses to RH and T, while the former were less pronounced than the latter. MC and t- dimensional changes per unit change of RH were greater than those per unit change of T but still lower than static values. In summary, the effects of dynamic RH change are larger than those of T, especially concerning MC responses compared to dimensional changes.

D09

Research Progress on the Cellulose-based Aerogel Functional Materials

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As a new green material, cellulose-based aerogels has such advantages as large specific area and high porosity etc. And, it also inherits the natural and renewable properties from cellulose. Additionally, it have great potential in enhancing mechanical performance, improving hydrophobicity and oil-absorption, promoting thermal insulation and biological antisepticity etc. The preparation procedures of cellulose aerogels were briefly introduced. And, the functionality of cellulose-based aerogels was reported. Ultimately, the prospective development of cellulose-based aerogel material was presented.

Keywords: cellulose; aerogel; porous material; functionality

D10

Graphene Aerogel for Oil Remediation and Air Purification

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Three-dimensional (3D) carbon-based architectures with marcoscopic monolithic shape, well defined interconnected porous network, large surface area and excellent adsorption capacity have received extensive attention in the field of oil adsorption and .photocatalysis. Herein, our work focus on the GA toward hydrothermal preparation, mechanical enhancement and the supporter of photocatalyst. For the hydrothermal preparation, we studied the role of reducing agents and hydrothermal condition on the mechanical strength and adsorption capacity of GA. Following, we added the carbon nanotube (CNT) to enhance the GA toward the mechanical strength as well as adsorption capacity. In order to extend the application of 3D GA, 2D photocatalysts (C_3N_4, MoS_2 and BN) were employed to prepare the multifunctional aerogels, which not only showed excellent adsorption toward the oil but also can decompose contaminants in both water and air. The large area and various shape of the photocatalyst aerogel has significantly extended the GA for broader application.

D11

Photocatalytic Property of White Cement Pastes Surface-treated $BiOBr@SiO_2$ core-shell Structures

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Photocatalytic techniques are applied in building materials to develop more environmentally-friendly cementitious materials solving the environmental pollution problems. The white cement pastes treated $BiOBr@SiO_2$ core-shell structures showed excellent photocatalytic property for the degradation of RhB under visible light. In the first 20 min, the color fading rate of $BiOBr@SiO_2$ treated samples reached more than 75 %, which showed more superior photocatalytic property. SiO_2 in the system can change the morphology of untreated cement pastes, and plenty of gels consisted of flower-like structures were formed. After curing for 28 days, the surface became more smooth and dense. The experiment of the reaction between $BiOBr@SiO_2$ and $Ca(OH)_2$ was carried out to investigate the composition of the gels.

C-S-H gels were proved to be formed by the energy dispersive spectroscopy and X-ray photoelectron spectroscopy. BiOBr@SiO_2 core-shell structures endowed the excellent photocatalytic property and maked surface smooth and dense decreasing the pore structures.

Keywords: photocatalytic property; cement paste; C-S-H gel; pore structure.

D12 (Invited)

Research and Application of Iron Ore Tailings Resource for Functional Materials

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Iron ore tailings as waste residue generated from iron ore processing after extracting the concentrate is a major industrial solid wastes, which has the great strategic significance and practical significance of industrial transformation upgrade and ecological civilization construction on its functional utilization to China. This paper gives a detailed introduction to the domestic functional utilization of iron ore tailings based on the development trend of iron ore tailings disposal and utilization. It is considered that the high performance functional ceramics can be prepared using iron ore tailings as the major raw materials which have wide application prospects in energy saving, biological effect, environment protection, and health protection. For instance, the heat insulating materials made of iron ore tailings can replace the traditional wall materials, iron ore tailings are used as trace-element fertilizers can improve soil condition, porous ceramics are prepared by iron ore tailings can be used for purifying and decontaminating waste water and for activating potable water, antibacterial health ceramics for daily use are prepared using iron ore tailings for its excellent far infrared emission properties. This paper also offers proposals and outlooks of iron ore tailings functional utilization, which will provide a reference for the functional utilization of iron ore tailings.

Keywords: iron ore tailings, functional ceramics, application

D13 (Invited)

Construction of Novel Three Dimensionally Ordered Macroporous Carbon Nitride for Highly Efficient Photocatalytic Activity

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The construction of multi-porous nanostructured g-C_3N_4 photocatalyst is an efficient strategy to separate charge carriers and enhance the photocatalytic activity in the visible light region. Here we utilized a simply thermal condensation-assisted colloidal crystal template method to construct the novel and highly efficient three dimensionally ordered macroporous (3DOM) g-C_3N_4 photocatalyst for the photocatalytic oxidation of pollutants. The effects of microstructure, crystallinity, textural properties and optical absorption ability on the photocatalytic activity of 3DOM g-C_3N_4 have been systematically probed. Characterization and photocatalytic test results showed that the 3DOM architecture has the uniquestructure sensitive property to light trapping, reactant transfer and photoreaction, and this property leads3DOM g-C_3N_4 to produce a narrowed electronic band gap (2.65 eV) and own superior photocatalytic performance for the degradation of organic dye. Compared to pure g-C_3N_4 (lamellar structure), 3DOM g-C_3N_4 shows approximately 5.3 times higher catalytic activity. A possible mechanism of the photoactivity enhancement was proposed based on the photocurrent measurement, photoluminescence analysis and the quenching experiments. This work highlights that the construction of 3DOM architecture could provide a useful strategy to design and fabricate highly efficient g-C_3N_4 photocatalysts.

D14

Novel Ag-rGO–bismuth Vanadate ($BiVO_4$) (AgGB) Ternary Composite with Enhanced Photocatalytic Activity

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Graphene (GR) and reduced graphene oxide (rGO) have emerged as attractive candidates for constructing graphene–based materials because it has several valuable characteristics. First, GR materials exhibit high electron mobility (200, 000 cm^2/V) and extended π-electron conjugation,

and thus, GR is a good material for transporting electrons and stabilizing extraneous electrons. In addition, GR has a high specific surface area (2630 m^2/g) and the unique flexible sheet-like structure of the GR component.

Recently, rare-earth-doped upconversion (UC) nanophosphors have attracted a tremendous amount of interest because of special properties that are relevant to extending the absorption range of TiO_2. â-$NaYF_4$:Ho^{3+}@TiO_2–rGO ternary composites photocatalysts were prepared via a three-step method and used for cleanup of Rhodamine B (RhB) aqueous solution under visible light irradiation. X-ray diffraction, scanning electron microscopy, energy-dispersive X-ray spectroscopy, fluorescence spectrometries, ultraviolet-visible diffuse reflectance spectroscopy, and electron spin resonance were used to characterize the photocatalyst. The results revealed that rGO as an excellent platform and successfully to load â-$NaYF_4$:Ho^{3+}@TiO_2 core–shell microcrystals. In this photocatalyst, the loading of UC microcrystals is expected to emit UV (290 nm) light after absorbing Vis (450 nm) light of the solar spectrum and the optical response of the rGO is enhanced from UV to Vis. It was found that add to rGO can efficient charge separation, extended light absorption range (red-shifted to 402.6 nm), enhanced adsorption performance, and improve photocatalytic activity. Understanding the visible-light-responsive photocatalytic mechanism will help to improve the structural design and functionality of this new type of catalytic material.

A novel Ag-rGO–bismuth vanadate ($BiVO_4$) (AgGB) ternary composite was successfully synthesized via a one-step method. The prepared composite was characterized by X-ray diffraction, X-ray photoelectron spectroscopy, scanning electron microscopy, energy dispersive X-ray, Brunauer–Emmett–Teller surface area measurement, Raman scattering spectroscopy, and ultraviolet-visible diffuse-reflection spectroscopy. The results showed that bulk monoclinic needle-like $BiVO_4$ and Ag nanoparticles with a diameter of approximately 40 nm formed microspheres (diameter, 5–8 μm) with a uniform size distribution that could be loaded on rGO sheets to facilitate the transport of electrons photogenerated in $BiVO_4$, thereby reducing the rate of recombination of photogenerated charge carriers in the coupled AgGB composite system. Ag nanoparticles were dispersed on the surface of the rGO sheets, which exhibited a localized surface plasmon resonance phenomenon and enhanced visible light absorption. The removal efficiency of RhB dye by AgGB (80.2%) was much higher than that of pure $BiVO_4$ (51.6%) and rGO-$BiVO_4$ (58.3%) under visible light irradiation. Recycle experiments showed that the AgGB composite still presented significant photocatalytic activity after five successive cycles. Finally, we propose a possible pathway and mechanism for the photocatalytic degradation of RhB dye using the composite photocatalyst under visible light irradiation.

D15

Facile Synthesis Route for MoS_2-polyvinylpyrrolidone Aerogels Via Frozen-drying

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Aerogels with low density, high porosity and large surface area have attracted increasing attention in many field. However, the materials types of aerogels are still very limited due to the difficulty to form hydrogels. Herein, we report a facile synthesis route to prepare MoS_2-polyvinylpyrrolidone (PVP) aerogels via direct frozen-drying. PVP plays a key role to obtain aerogels that the good wettability both on water and oil of PVP makes it easily cover on the surface of MoS2 nanosheets, which promotes the sheets connection with each other. The density of the obtained MoS_2-PVP aerogels can be tuned from 9.2 to 33.8 mg/cm^3 via simply changing the concentrations of the precursors. Importantly, our current approach has been successfully applied to prepare other 2D or 1D material-PVP aerogels, taking boron nitride-PVP and carbon nanotubes-PVP aerogels as examples and extends the material types of aerogels.

Keywords: Semiconductors; Aerogels; MoS_2-PVP; Nanocomposites

D16 (Invited)

Solar-driven Photocatalytic Materials for Air Pollution Control

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Recently, Bi-based photocatalysts have attracted much attention in photocatalysis. Our group have made much research on $(BiO)_2CO_3$, $BiOIO_3$ and Bi. Depending on the types of precursors, the molar ratio of precursors and reaction temperature, hollow/solid microspheres, flower-like, pinon-like and nanoplates $(BiO)_2CO_3$ can be achieved. Nitrogen/Carbon-doping, Ag

decoration and graphene compositing were employed to modify $(BiO)_2CO_3$. The modified $(BiO)_2CO_3$ exhibited highly efficient and durable visible light photocatalytic activity toward removal of NOx in air.

Most recently, we have prepared Bi nanoparticles and excitingly found that Bi element exhibited an admirable photocatalytic activity for NOx removal benifiting form the UV-mediated surface plasmon resonance. Interestingly, we observed the noble metal-like behavior of Bi nanoparticles as a cocatalyst to enhance the photocatalytic activity of other semiconductors like $(BiO)_2CO_3$, TiO_2 and g-C_3N_4, and Bi_2MoO_6.The discovery of Bi element as a direct plasmonic photocatalyst or an alternative cocatalyst is of great significance as it is expected to shed new light on the understanding and application of plasmonic photocatalysis mediated by non-noble metals.

We have designed and synthesized g-C_3N_4 nanosheets and g-C_3N_4-based materials by various methods. For instance, we systematically investigated the unique effects of thermal exfoliation, precursors mass, water, and discovered that these factors exert significant influence on governing the morphology structure, tuning the band architecture, the enhancing the photocatalytic performance of g-C_3N_4. Graphene-like porous g-C_3N_4 nanosheets were synthesized via direct pyrolysis of thiourea followed by a thermal exfoliation and exhibited enhanced visible light photocatalytic activity and oxidation ability. we also found that as thiourea mass decreased, g-C_3N_4 with thinner nanosheets, higher surface area and elevated conduction band maximum was triumphantly achieved. Thermal condensation of urea with water, honeycomb-like g-C_3N_4 with abundant porous and high S_{BET} was synthesized, which demonstrated that water performed pivotal role in governing the nanostructures as well as the photocatalytic capability.

Furthermore, we designed Type I and Type II g-C_3N_4/g-C_3N_4 metal-free isotype heterojunctions by facile methods. For g-C_3N_4/g-C_3N_4 heterostructures from dicyandiamide and urea are Type II heterostructure, while the Type I heterostructure will be constructed when from the precursors thiourea and urea or melamine and urea. The intrinsic drawback of fast charge recombination of pristine g-C_3N_4 was overwhelmed by formation of Type I and Type II g-C_3N_4/g-C_3N_4 heterostructures. For NOx removal at ppb-level in air, the Type I and Type II g-C_3N_4 based heterostructures demonstrated highly enhanced photocatalytic performance and stability compared with the pristine g-C_3N_4 alone. The rational design and construction of Type I and Type II isotype heterojunction was general and potential for developing excellent visible-light photocatalysts. Besides, we wrote a review which not only summarized the success of fabrication methods, heterojunction structure and multifunctional application of

the g-C_3N_4-based nanocomposites, but also elaborated on the underlying mechanisms in enhancing the photocatalytic activity of g-C_3N_4-based nanocomposites.

D17

Application and Development of Biomass Polymer Fabric Finishing Agents

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As an important part of renewable resources, material has the advantages of wide raw material sources, low cost and low environmental hazards etc. And, it plays an important role in the field of polymer materials. According to the domestic and foreign research status of biomass polymer fabric finishing agents, the analyses were conducted regarding current situation and future development trend of biomass materials including chitosan and its derivatives, cyclodextrin, cellulose, chitin and casein in polymer multifunctional fabric finishing agents synthesis application status and development trend in the future.

Keywords: Biomass, Polymer Materials, Finishing Agents

D18

Selective Removal of Cationic Dyes from Aqueous Solution by Natural Materials

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In this work, a novel adsorbent - oleic acid modified vermiculite (O-VMT) was created by simple modified methods for removal of cationic dyes (Methylene blue) from water and the raw materials (VMT and oleic acid) were derived from nature. The surface modification of VMT with oleic acidwas measured by using the FTIR spectra and XRD analysis. The adsorption kinetics, isotherms, thermodynamics and pH were examined under a batch adsorption technique. For kinetics and isotherms study, the adsorption process was fitting pseudo-second-order kinetics model and Langmuir isotherm model better. The higher adsorption capacity was obtained at lower temperature and acid environment for thermodynamics and pH, respectively. The maximum adsorptive capacity of O-VMT was up to 120.2 mg/L at adsorption equilibrium. The results also indicated that O-VMT could have the potential to become a selective

adsorbent to remove the cationic dyes from mixed solution in wastewater treatment.

D19 (Invited)

Development and Application of “Longevity Village” Healthy Housing

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Elaborated the concept of health and Healthy Housing residential health assessment criteria, focusing on the “Longevity Village” Healthy Housing development and application. “Longevity Village” Healthy Housing in the original basis of healthy housing, and further enrich the connotation of the health concept, its 8 advantages, making it competitive with other types of housing in good stead. The rational use of new technologies and new materials, will bring its more extensive and broad space for development.

Keywords: Healthy Housing; evaluation criteria; Living environment

D20 (Invited)

Preparation of Nano-alumina Membranes and Their Enhanced Adsorption Performance Towards Cr(VI)

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Due to its carcinogenicity to human and high toxicity to living organisms, Cr(VI) pollutant has become a serious environmental issue. In recent years, Al-based powder adsorbents, including aluminum oxide, aluminum hydroxide and aluminum oxyhydroxide for removing Cr(VI) from wastewater have been widely studied because of their unique physicochemical properties which are suitable for heavy metal ions removal. However, there exist some defects, including the agglomeration of fine particles, complicated separation process and expensive recovery equipment cost in actual application occasion for the powder adsorbent. Moreover, residual sludge with heavy metal ions species may result in the secondary pollution. In order to extend the application of nano-alumina in the adsorption of heavy metal ions, amino-modified mesoporous alumina membranes with enhanced affinity towards Cr(VI) were successfully prepared by impregnation and grafting process. The physicochemical properties of membranes were characterized by XRD, SEM, Elements Analyzer, FT-IR and Zeta potential. The results indicated that amino silane was successfully graftied on the surface of the alumina membranes by Al-O-Si covalent bonds form, the membranes were completed and without defect. The specific surface area, pore size, pore volume, surface acid-base and N-element content properties of the membranes were affected by the amino modifier types and added amount. Adsorption behavior of Cr(VI) on amino-modified mesoporous alumina membranes were described by kinetic and isotherm model. 0.5 g N-[3-(Trimethoxysilyl)-propyl]ethylenediamine adding amount of alumina membrane (F-Al_2O_3-TS-0.5) showed excellent adsorption performance for Cr(VI). The equilibrium adsorption capacity of F-Al_2O_3-TS-0.5 toward Cr(VI) from the langmuir isotherm model can be reached 64.6 mg/g at an optimal pH=3. It is much higher than other alumina adsorption materials of Cr(VI). The sample of F-Al_2O_3-TS-0.5 can maintain stable cycle adsorption performance by using 200 ml 0.005 mol/L NaOH solution regeneration. Besides, this sorbent can be used to selective separate Cr(VI) from multicomponent mixted solution include Ni(II), Cu(II), Zn(II) and Cd(II). This unique membranes with an easily separated characteristic after adsorption has high potential for removal of Cr(VI) from aqueous solution, and other fields of environmental remediation.

Keywords: alumina membrane, amino modification, Cr(VI) adsorption, mechanism, interference

D21

Immobilizing Water into Crystal Lattice of Calcium Sulfate for its Separation from Water-in-Oil Emulsion

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We report a facile approach to efficiently separate surfactant-stabilized water (droplet diameter of around 2.0 μm) from water-in-oil emulsion via converting liquid water into solid crystal water followed by removal with centrifugation. The liquid-solid conversion is achieved through the solid-to-solid phase transition of calcium sulfate hemihydrate ($CaSO_4.0.5H_2O$, HH) to dihydrate ($CaSO_4.2H_2O$, DH), which could immobilize the water into crystal lattice of DH. For emulsion of 10 $mgmL^{-1}$ water, the immobilization-separation process using polycrystalline HH nanoellipsoids could remove 95.87 wt% water at room temperature. The separation efficiency can be further improved to 99.58 wt% by optimizing the HH dosage, temperature, HH size and crystalline structure. Propertyexamination of the recycled oil confirms that our method has neglectable side-effect on oil quality.The byproduct DH was recycled to alpha-HH (a valuable cemetitious material widely used in construction and binding field), which minimizes the risk of secondary pollution and promotes the practicality of our method. With the high separation efficiency, the “green” feature and the recyclability of DH by-product, the HH-based immobilization-separation approach is highly promisingin purifying oil with undesired water contamination.

D22

Adsorption of Heavy Metals from Aqueous Solution on Amino Functionalized Mesoporous Alumina

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Several kinds of amino organosilane were successfully grafted on mesoporous alumina through a facile, clean and time-saving method. Fourier transform infrared spectroscopy (FT-IR) and X-ray photoelectron spectroscopy (XPS) confirmed the success of functionalization. The adsorption behavior of Cr(VI) was investigated in batch experiments. The adsorption rates were faster than the unmodified ones and the adsorption capacity was tripled. The as-prepared adsorbents were able to remove 100% of Cr(VI) anion from aqueous solution less than 50 mg/L, meeting drinking water standard. After several times of circulation the adsorption capacity still reached over 85% of the initial value. The adsorption behavior of metal cation environment containing Cu^{2+}, Cd^{2+}, Ni^{2+}, Zn^{2+}, and ion competitive environment in batch experiments were also investigated, revealing multi-adsorption capability and selectivity, which is vastly superior to the

unmodified ones. Therefore, the as-prepared adsorbent exhibited potential and promising application in water pollution control.

D23

Application of Starch-based Functional Materials in Water Treatment

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Starch is an abundant natural polymer. Research, production and application of starch-based functional materials have been rapidly developed in recent few years. As a important chemical additives, it is broadly applied in industrial wastewater treatment as well as domestic wastewater treatment. Characteristics and common preparation methods of starch-based functional materials were briefly described. And, application of starch-based functional materials in water treatment were explained. Finally, the prospects for the application of starch-based functional materials in the future were predicated.

Keywords: starch-based functional materials; water treatment; preparation; application

D24 (Invited)

Porous Functional Materials for Efficient Removal of Micropollutant from Water

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Water shortage and poor water quality are near crises in many parts of the world due to the rapid growth of world population, abuse of water resources, and water pollution. Two kinds of porous functional materials, UF membrane and Porous nano-adsorbent/catalyst, were developed for efficient removal of micropollutant from water. The synthesis, structure characterization and performance evaluation were investigated in detail. The results indicated that the 2 challenges in ultrafiltration(UF) membrane area, permeability/selectivity trade-off and anti-biofouling, can be regulated. In-situ formed different nanoparticles (ZrO_2,Al_2O_3,ZnO,Ag,TiO_2) in membrane matrix can essentially enhanced the antifouling performance. Various mesoporous hollow spheres with

tunable composition, structure and size can be synthesized via modified Stöber approach. Nitrobenzene and phenol were chosen as the model pollutant for reduction and Fenton catalysis by resultant mesoporous hollow spheres catalysts. The application experiments confirm that enhanced degradation and separation properties can be achieved. Both UF membranes and porous nano-adsorbent/catalyst are promising candidates for efficient removal of micropollutant from water.

D25

A Novel Preparation Method of Polyaluminum Chloride/Polyacrylamide Composite Coagulant: Composition and Characteristic

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Composite coagulants have drawn a widely attention through the years owing to its superior coagulation behavior.

In this study, an inorganic-organic composite flocculant, polyaluminium chloride (PAC)/polyacrylamide (PAM) was synthesized by ultraviolet (UV) irradiation by using PAC and AM as raw materials, urea as solubilizer, and V-044 as initiator. The paper focuses on studying the effect of total monomer mass fraction, solubilizer dosage and initiator dosage on the viscosity and molecular weight of polymer characteristics.

The results suggest that the composite coagulant with intrinsic viscosity of 1483 ml/g and molecular weight of 7.38 million could be obtained when the total monomer mass fraction of 40%, urea dosage of 1.5% and initiator dosage of 0.6%, and the prepared composite coagulant could achieve superior coagulation performance. The Thermal gravimetric analysis, Fourier Transform infrared Spectrum and 1H Nuclear Magnetic Resonance Spectroscopy suggest that the composite coagulant with high polymerization degree was exhibited high thermal stability and synthesized successfully.

It is a potential preparation method of composite coagulant with low energy consumption, high preparation efficiency and high coagulation efficiency.

Key words: Composite coagulant, Ultraviolet initiation, Polyaluminium chloride, Polyacrylamide

D26

Application and Development Trend of Cellulose-based Functional Material

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Cellulose is the natural biopolymer originated from extensive raw material sources including cotton, linen and acetic acid bacterial capsule and featured with good bio-friendliness, biodegradation and ideal mechanical strength. Cellulose-based Functional materials refer to the new material manufactured with biological, chemical and physical methods on the basis of cellulose. Integrated with both the overseas and domestic research status, the condition and the development trend of various kinds of cellulose-based functional material were introduced.

Keywords: cellulose, functional materials, biological, chemical, physical