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*** The Program is used for PCM2024&GNN2024 Academic Exchange Only**

Part I Conference Schedule Summary

Monday, August 19, 2024

Time	Session
14:00-20:00	Early Registration
15:00-17:00	MS Teams Testing

Tuesday morning, August 20, 2024

Time	Session
08:30-08:40	Welcome Speech
08:40-09:20	Keynote Speech 1
09:20-10:00	Keynote Speech 2
10:00-10:30	Group Photo & Coffee Break
10:30-11:10	Keynote Speech 3
11:10-11:30	Invited Speech 1
11:30-11:50	Invited Speech 2
12:00-14:00	Lunch Break

Tuesday afternoon, August 20, 2024

Time	Session
14:00-16:45	Session 1: Invited and Oral Speeches
16:50-18:00	Poster Presentation
18:00-20:00	Welcome Banquet

Wednesday morning, August 21, 2024

Time	Session
09:00-09:40	Keynote Speech 4
09:40-10:20	Keynote Speech 5
10:20-10:40	Coffee Break
10:40-11:20	Keynote Speech 6
11:20-11:40	Invited Speech 9
11:40-12:00	Invited Speech 10
12:00-14:00	Lunch Break

Wednesday afternoon, August 21, 2024

Time	Session
14:00-17:20	Session 2: Oral Speeches

Thursday afternoon, August 22, 2024

Time	Session
08:30-17:00	Field Visit

Monday, August 19, 2024		
14:00-20:00	Physical Registration	1F, Lobby of Aoxiang International Conference Center
15:00-17:00	MS Teams Testing	https://www.academicconf.com/teamslink?confname=PCM2024

Notice (for offline participants):

1. **Please show us the acceptance letter or paper ID for registration;**
2. **Please take the name card during conference, meal tickets for meals and field visit tickets while joining the field visit.**

Tuesday morning, August 20, 2024

Location: Juya Ting (聚雅厅), 5F, Aoxiang International Conference Center

Online Teams Link: https://www.academicconf.com/teamslink?confname=PCM2024

Host	***Prof. Tingkai Zhao, School of Materials Science and Engineering, Northwestern Polytechnical University, China***
08:30-08:40	**Welcome Speech** *Prof. Tingkai Zhao, School of Materials Science and Engineering, Northwestern Polytechnical University, China*
08:40-09:20	**Keynote Speech 1: *Overview of Korea Nanotechnology Initiative and the K-Semiconductor Belt*** *Prof. Haiwon Lee, Jeonju University, South Korea*
09:20-10:00	**Keynote Speech 2: *Turning Weaknesses into Strengths: Printing Orthotropic Components Using Fused Filament Fabrication (FFF)*** *Prof. Alois K. Schlarb, Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU), Germany*
10:00-10:30	Group Photo & Coffee Break
10:30-11:10	**Keynote Speech 3: *Novel Accelerator-based Techniques to Advance Materials Investigation*** *Prof. Ishaq Ahmad, Director General and Chief Scientist of CoE Physics, National Center for Physics, Pakistan*
11:10-11:30	**Invited Speech 1 (GNN1271): *Molecular Engineering on Fiber Surfaces and Functional Fibers: Pioneering Sustainable Development*** *Prof Xuqing Liu, Northwestern Polytechnical University, China*
11:30-11:50	**Invited Speech 2 (GNN1272): *Preparation and Optoelectronic Properties of Novel 2D BiOX Semiconductors*** *Prof. Liping Feng, College of Materials Science and Engineering, Northwestern Polytechnical University, China*
12:00-14:00	Lunch Break (Heyan Ju 和筵居, 2F)

Tuesday afternoon, August 20, 2024

Location: Juya Ting (聚雅厅), 5F, Aoxiang International Conference Center

Online Teams Link: https://www.academicconf.com/teamslink?confname=PCM2024

Session 1: Invited and Oral Speeches

Session Chair: Dr. Bo Zhao, China Special Equipment Inspection and Research Institute, China

14:00-14:20	**Invited Speech 3 (GNN1270): Biomass-based Porous Carbon Materials for Lithium-sulfur Batteries** *Prof. Yuanzhen Chen, School of Materials Science and Engineering, Xi'an Jiaotong University, Xi'an, China*
14:20-14:40	**Invited Speech 4 (GNN1273): Theoretical Study on Electroreduction of CO_2 by Copper Based Catalysts** *Prof. Haiyan Zhu, Institute of Modern Physics, Northwest University, China*
14:40-15:00	**Invited Speech 5 (GNN1269): Structural Design and Potential Application of Two dimensional Material based Electrode** *Assoc. Prof. Alei Dang, Northwestern Polytechnical University, China*
15:00-15:20	**Invited Speech 6 (GNN1263): Computational Insights into Schottky Barrier Heights: Graphene and Borophene Interfaces with H- and Ḣ-XSi_2N_4 (X = Mo, W) Monolayers** *Assoc. Prof. Abdul Jalil, Allama Iqbal Open University, Pakistan*
15:20-15:35	Coffee Break
15:35-15:55	**Invited Speech 7 (GNN1264): A Neural Network Approach to Estimate the Particle Shape Distribution of Nanorods Using Depolarized Dynamic Light Scattering** *Assoc. Prof. Paul Briard, School of Physics. Xidian University, China*
15:55-16:15	**Invited Speech 8 (PCM3372): Introduction to High Temperature Resistant Polymers Used in Drilling Fluid for Deep and Ultra-deep Well Drilling** *Assoc. Prof. Xianbin Huang, School of Petroleum Engineering, China University of Petroleum (East China), China*
16:15-16:30	**Oral Speech (PCM3397): Analyzing Tetrahedron Lattice Structures Computationally for Their Post-yielding Behavior** *Dr. Reza Shamim, School of Aeronautics, Northwestern Polytechnical University, China*
16:30-16:45	**Oral Speech (PCM3403): A Study on the Influence of Indenter Shape for Small Punch Test of Non-metallic Materials** *Dr. Bo Zhao, China Special Equipment Inspection and Research Institute, China*
16:50-18:00	**Poster Presentation**
18:00-20:00	**Welcome Banquet (Heyan Ju 和筵居, 2F)**

Wednesday morning, August 21, 2024 Location: Juya Ting (聚雅厅), 5F, Aoxiang International Conference Center Online Teams Link: https://www.academicconf.com/teamslink?confname=PCM2024	
Host	***Prof. Christophe Len, PSL Research University, Chimie ParisTech, France***
09:00-09:40	**Keynote Speech 4**: ***Continuous Flow Synthesis and Upgrading of Selected Biobased Chemicals*** *Prof. Christophe Len, PSL Research University, Chimie ParisTech, France*
09:40-10:20	**Keynote Speech 5:** ***Bio-inspired Graphene-decorated Surfaces with Switchable Adhesion*** *Prof. Zhenhai Xia, University of New South Wales, Australia*
10:20-10:40	Coffee Break
10:40-11:20	**Keynote Speech 6:** ***The Use of Carbon-based Composite Coatings for Main Shaft Bearings in Wind Generators*** *Prof. Esteban Broitman, SKF Research & Technology Development Center, The Netherlands*
11:20-11:40	**Invited Speech 9 (PCM3366):** ***Robust Biodegradable Fiber Silk Composites for Load-bearing Bone Graft*** *Assoc. Prof. Juan Guan, School of Materials Science and Engineering, Beihang University, China*
11:40-12:00	**Invited Speech 10 (PCM3367):** ***Composite Materials for Perioperative Tumor Diagnosis/Treatment by Coupled Control of Cascade Reaction Flow and Transfer at Interface*** *Prof. Jixi Zhang, College of Bioengineering, Chongqing University, China*
12:00-14:00	Lunch Break (Heyan Ju 和筵居, 2F)

Wednesday afternoon, August 21, 2024

Location: Juya Ting (聚雅厅), 5F, Aoxiang International Conference Center

Online Teams Link: https://www.academicconf.com/teamslink?confname=PCM2024

Session 2: Oral Speeches

Session Chair: Assoc. Prof. Juan Guan, School of Materials Science and Engineering, Beihang University, China

Dr. Liang Tong, School of Chemistry and Chemical Engineering, Jiangxi University of Science and Technology, China

14:00-14:15	**Oral Speech (PCM3370): Boundary Equivalent Model and Optimization of Glass Fiber Reinforced Composite Storage Tanks Based on Theory of Plates and Shells** *Dr. Dong Chen, School of Mechanical and Power Engineering, Zhengzhou University, China*
14:15-14:30	**Oral Speech (PCM3373): Uncovering the Screening-enhanced Behaviour of poly (hexamethylene biguanide) (PHMB) in Overcoming Charge Screening Limitations** *Dr. Wenyi Wang, Department of Applied Biology and Chemical Technology, Hong Kong Polytechnic University, China*
14:30-14:45	**Oral Speech (PCM3378): Enhancing PLA/PBAT Blends Properties with High Epoxy-functional Polymer as a Compatibilizer** *Dr. Hao Duan, Department of Materials Science, Fudan University, China*
14:45-15:05	**Oral Speech (PCM3392): Nanostructural Control of Block Copolymers Consisting of Fluorine-containing Block and Polyvinylpyrimidine** *Dr. Liang Tong, School of Chemistry and Chemical Engineering, Jiangxi University of Science and Technology, China*
15:05-15:20	**Oral Speech (PCM3393): Preparation and Electromagnetic Performance of Graphene Oxide/Polyaniline/Bamboo Composites as a Substitute for Conductive Plastics** *Dr. Jin Wang, Key Laboratory of Bamboo Research of Zhejiang Province, Zhejiang Academy of Forestry, China*
15:20-15:35	**Oral Speech (PCM3408): Amino-silane Modified Zeolite Particles Blended into 6FDA-based Polyimides for Gas Separation** *Dr. Yongsheng Liu, Jiangxi University of Science and Technology, China*
15:35-15:50	Coffee Break
15:50-16:05	**Oral Speech (PCM3359): Improved Breakdown Strength at High Temperatures Through Annealing of Syndiotactic Polystyrene** *Mr. Xudong Wu, Department of Materials Science and Engineering, Guangdong Technion-Israel Institute of Technology, China*
16:05-16:20	**Oral Speech (PCM3371): Optimization of Thermoplastic Composites Process Parameters Based on Robotic Fiber Placement** *Mr. Mingyu Liu, School of Mechatronics Engineering, Harbin Institute of Technology, China*

16:20-16:35	**Oral Speech (PCM3407): Molecular Composition of Isotropic High Softening Point Pitch by MALDI FT-ICR MS** *Dr. Fang Zheng, Petrochemical Research Institute of PetroChina Company Limited, China*
16:35-16:50	**Oral Speech (PCM3410): Composite Energetic Materials Constructed by Metal Nitrates and Nitro-substituted Polymers** *Dr. Yiran Shi, Faculty of science and technology, University of Debrecen, Hungary*
16:50-17:05	**Oral Speech (PCM3398): Photopyroelectric Techniques for Thermo-optical Characterization of SiO_2 Nano-spheres** *Dr. Balderas-López José Abraham, Instituto Politécnico Nacional-UPIBI, México*
17:05-17:20	**Oral Speech (PCM3355): The Effects of Different Curing Conditions on the Polypropylene Fibre Reinforcement Concrete** *Dr. Dada Opeoluwa, Department of Civil Engineering, College of Science, Engineering and Technology, University of South Africa, South Africa*

Thursday, August 22, 2024	
08:30	**Gather at the Lobby of Aoxiang International Conference Center, Set off on time at 08:30**
08:30-17:00	**One Day Field Visit of Xi'an (with Field Visit Ticket)**
17:00	**Set off on time at 16:00, Back to Aoxiang International Conference Center**

Part II Oral Presentations Instructions

General Guidelines

- All presentation times are shown in China Standard Time (GMT+8:00);
- Duration for Keynote Presentation: 40 Minutes of Presentation including 3-5 Minutes of Q&A;
- Duration for Invited Oral Presentation: 20 Minutes of Presentation including 3-5 Minutes of Q&A;
- Duration for Regular Oral Presentation: 15 Minutes of Presentation including 2-3 Minutes of Q&A;
- All presenters are requested to reach the Session Room 15 minutes prior to the schedule time and complete their presentation on time;
- Presenters should prepare Power Pointer or PDF Files for Presentation with Paper ID (**PCM****or GNN******) marked in the last page;
- Signed and stamped presentation certificate would be issued after presentation.

Offline Oral Presentation Guidelines

Devices Provided by the Conference Organizer:

- Laptops (with MS-Office & Adobe Reader)
- Projectors & Screen: Ratio 4:3
- Laser Sticks
- Microphones
- Please send us the PowerPoint once it is ready and have the PPT back up in a U-disk. For presenters who do not send the PowerPoint, please save it in the laptop of the corresponding session 15 mins in advance. Kindly tell the Session Chair (before the start of your session) that you are presenter.

Online Oral Presentation Guidelines

- Online Oral Presentation will be conducted via Microsoft Teams Meeting.
- If a presenter cannot show up on time or has problem with internet connection, the session chair has the right to rearrange his/her presentation, and let the next presentation start.

Best Oral Presentations Selection Guidelines

Selection Criteria:

ONE best presentation will be selected from EACH session based on the following criteria:

- ✓ Research Quality
- ✓ Presentation Performance
- ✓ Presentation Language
- ✓ Interaction with Listeners
- ✓ PowerPoint Design
- ✓ Effective Communications

Selectin Procedure:

- ✓ An assessment sheet will be delivered to listeners before the session.
- ✓ Write the numbers of two best presentations and submit the filled assessment sheet (with the

listener's name and signature) to the Session Chair before the session termination.

- ✓ The Session Chair will count the votes for each presentation and name the winner based on the maximal number of votes. The Session Chair has three votes but can use only one in favor of his/her own presentation (if any). To avoid any conflict of interests, only registered listeners are entitled to vote.

Nature of the Award:

- ✓ This award consists of free registration to the next conference PCM 2024 & GNN 2024 and a certificate.
- ✓ The awards will be announced at the official website after the conference.

Assessment Sheet Sample

PCM2024&GNN2024 Oral Presentation Assessment

Dear participants,

After carefully listening to the presentations of this session, please kindly recommend two excellent Oral Presentations with reference to the following evaluation criteria.

The Session Chair will count the votes from each presentation and select ONE Best Oral Presentation in this session. If there is a tie, the Session Chair will make the final decision.

The winner will be announced at the official website after the conference.

You can refer to the following Criteria:

Items	Assessment
Content	Right, Logical, Original, Well-Structured
Language	Standard, Clear, Fluent, Natural
Performance	Spirited Appearance, Dress Appropriately, Behaves Naturally
PPT	Layout, Structure, Typeset, Animation, Multimedia
Reaction	Build a Good Atmosphere, Speech Time Control Properly

Please write down paper ID and give reasons for your recommendation:

Paper ID	Reasons

Evaluated by: _____ (Paper ID: _____)

Note: When the session finished, please fill it out and give it to the Session Chair so that the Best Oral Presentation in this session can be selected.

Part III Keynote Speeches

Keynote Speech 1: Overview of Korea Nanotechnology Initiative and the K-Semiconductor Belt

Prof. Haiwon Lee

Distinguished Professsor, Jeonju University, South Korea

Biography: Prof. Haiwon Lee received his Ph.D. in Chemistry from the University of Houston. Dr. Lee has published more 220 technical papers in the area of chemistry and materials. His research has focused on functional materials for nanostructured devices, nanolithography, biosensors and microfluidic system. Dr. Lee was a Research Associate in the Department of Chemistry at the University of Texas-Austin (1986-1988). His experience in Korea includes: Principal researcher at Korea Research Institute of Chemical Technology (KRICT) (1988-1993); Professor of Chemistry Dept. at Hanyang University (1993-2019); Research Advisor of Frontier Research System at the Institute of Physical and Chemical Research (RIKEN) in Japan (2000-2004); Visiting Professor at Max-Planck-Institute for Polymer Research in Germany (1997); Co-chairman of AsiaNANO conference (2002-2012); Visiting Professor at Pennsylvania State University in USA (2002-2003); President of Industry-University Cooperation Foundation and Dean of Colleage of Natural Sciences at Hanyang University (2006-2010); Adjunct Professor of Chemistry Department at the University of Texas-Dallas (2008-2010); Distinguished Professor of Hanyang University (2008~2029): President of Korea Nanotechnology Research Society (2014-2016); Editor-in-Chief of Nano Convergence (2016-2018); Specially Appointed Professor at Tokyo Institute of Technology (2019-2021); Special Advisor at Alliance of Internatioal Science Organizations (2020-2022). Currently he is Emeritus Professor of Hanyang University since 2019, Distinguished Professsor of Jeonju University since 2023, President of Asian Research Network Korea since 2012 and Member of the National Academy of Engineering of Korea since 2011, Policy Advisor for Jeonbuk State since 2023, Vice President of Jeonju University since 2024. Dr. Lee is the recipient of Doyak Medal from the Order of Science and Technology Merit of Korean Government in 2016.

Abstract: This presentation will delve into the current status of the Korea Nanotechnology Initiative, highlighting its key achievements, and future directions. The initiative's impact on various industries and its contribution to the field of nanotechnology will be discussed. By examining the initiative's objectives, strategies, and success stories, this presentation aims to provide valuable insights into Korea's advancements in nanotechnology and their implications for the global research and development landscape. For instance, The NANO KOREA, one of the world's top three events in the field of nanoscience and nanotechnology, has been held annually since 2003 for the purpose of exchanging the latest research results and promoting industrialization. The world’s largest semiconductor supply chain, the K-Semiconductor Belt, will be built in Korea by 2030. A brief plan of the K-Semiconductor Belt will be introduced.

Keynote Speech 2: Turning Weaknesses into Strengths: Printing Orthotropic Components Using Fused Filament Fabrication (FFF)

Prof. Alois K. Schlarb

Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau (RPTU), Kaiserslautern, Germany; State Research Center OPTIMAS, Kaiserslautern, Germany

Biography: Professor Alois K. Schlarb currently serves as Senior Research Professor at the RheinlandPfälzische Technische Universität (RPTU), is a member of the State Research Center OPTIMAS at RPTU, and a visiting professor at Qingdao University of Science and Technology (QUST), PR China.

Alois K. Schlarb studied mechanical engineering at the University of Kaiserslautern, specializing in production engineering and company organization. After his graduation in 1984 he relocated to the University of Kassel, working as a scientific assistant to Prof. Dr.-Ing. Dr. e.h. Ehrenstein. He was awarded a doctorate in 1989 for his thesis on polymer processing. From 1988 until 1989 he was also head engineer at the university's Institut fuer Werkstofftechnik (Institute of Materials Technology). In the following 13 years Professor Schlarb held different positions in the industry, e.g. the polymer laboratory of BASF SE as material scientist and project manager researching composites, last as Vice President and head of marketing, research and development with B. Braun Medical AG, Switzerland. In November 2002 Alois Schlarb was appointed to a full professorship for "Composite Materials" at the Technische Universität Kaiserslautern (now RPTU Kaiserslautern-Landau) and held this position until March 31, 2022. From 2002 to 2008 he served in parallel as Chief Executive Officer of the Institut für Verbundwerkstoffe GmbH (Institute of Composite Materials). Since 2018 Alois Schlarb also holds a visiting professorship at Qingdao University of Science and Technology, Qingdao, PR China.

Professor Schlarb served as Spokesman of the Scientific Alliance of Polymer Technology (WAK) from 2009 - 2015 and as President of the Society for the Advancement of Materials and Processing Engineering SAMPE Deutschland e.V. from 2003 - 2015. He is on the editorial board or scientific advisory board of several journals and has more than 150 publications in peer-reviewed journals. He is also the editor/author/co-author of several books and book chapters. The focus of his research activities is on process-structure-property-relations and tribology of polymer-based hybrid materials.

Abstract: Since the patents expired a few years ago, the application of 3D printing has been developing at a highly dynamic pace. By using thermoplastics as the printing material, functional parts can be produced with various properties such as strength, flexibility and heat resistance. However, it is important to note that FFF has its limitations, such as limited accuracy and surface quality. An additional challenge is the limited strength and stiffness of printed parts compared to traditional manufacturing methods. This applies in particular to the mechanical properties perpendicular to the direction of printing, which are often not at the level of injection-molded components. In addition, the quality of the components depends on the component geometry, i.e. the properties vary greatly over the component volume. As plastics are inferior to metallic materials in

terms of their mechanical properties, 3D-printed components are often only suitable as demonstration objects. They cannot even be used in semi-structural applications.

Reinforcement with fibers, known from composite material technology, can provide a remedy. Nowadays, glass, carbon, aramid, or even natural fibers are combined with polymer matrix materials for this purpose. In combination with 3D printing, new possibilities open up here, as the fiber orientation and thus the mechanical properties can be specifically influenced by the choice of deposition paths, i.e. the fiber orientation can be specifically adapted to the load path.

The talk will describe the opportunities and challenges in the manufacturing of thermoplastic materials, in particular fiber-reinforced composites, using fused filament fabrication. In this process, components are manufactured by depositing a continuously extruded molten strand along pre-planned paths. The component is therefore not subjected to the same process conditions throughout its volume, particularly during cooling, crystallization, or solidification. Rather, the local deformation and solidification processes during strand deposition, comparable to welding, lead to local gradients in morphology and ultimately to anisotropy of properties. Consequently, the properties of the component transverse to the strand deposition direction are ultimately determined by the quality of the weld between the strands (and layers), which is usually a flaw. Overall, the aim is to exploit the material properties of fiber-reinforced thermoplastics in the fiber direction fully, but on the other hand, this must not be at the expense of transverse strength, i.e. perpendicular to the fiber direction; a challenge that can be overcome with suitable process control. In addition to classic fiber-reinforced plastics, material adequate process control is applied to fully recyclable plastic fiber-reinforced plastics. This allows direction-dependent (orthotropic) properties to be specifically adjusted in the component, thus enabling the material- and energy-efficient use of materials modelled on nature.

Keynote Speech 3: Novel Accelerator-based Techniques to Advance Materials Investigation

Prof. Ishaq Ahmad

Director General and Chief Scientist of CoE Physics, National Center for Physics, Islamabad, Pakistan;
Co-Director of NPU-NCP Joint International Research Center on Advanced Nanomaterials and Defects Engineering, Northwestern Polytechnical University Xian China

Biography: Dr. Ishaq Ahmad currently hold the positions of Director General and Chief Scientist of CoE Physics, National Center for Physics, Islamabad, Pakistan and Co-Director of NPU-NCP Joint International Research Center on Advanced Nanomaterials and Defects Engineering Northwestern Polytechnical University Xian China. He is a Chief Scientific Investigator of International Atomic energy Agency (IAEA), Vienna, Austria under CRP-G42008. He obtained his PhD in Nuclear techniques and applications, especially in ion beam accelerator applications in materials science from Shanghai Institute of Applied Physics, Graduate University of CAS (Chinese Academy of Science), Beijing, China. He has co-authored over more than 240 research papers in international reputed journals and contributed to 8 books and 19 book chapters in reputed publishers. He supervised several Master, PhD and Postdoctoral local and abroad students. His research interests are focused on ion beam applications in materials/nanomaterials, synthesis of nanomaterials/thin films and ion beam analysis of materials. He is a senior fellow of UNESCO UNISA AFRICA Chair in Nanosciences /Nanotechnology, iThemba LABS (Laboratory for Accelerator based Sciences), South Africa. He initiated many bilateral/trilateral science and technology cooperation around the world especially with Chinese, Russian and Malaysian universities in the form of MoUs and Joint research centers. He has many awards and honors on his credit.

Abstract: In the field of advanced materials exploration, researchers have traditionally relied on conventional methods and have been hesitant to adopt advanced approaches to uncover new knowledge and insights. However, accelerator-based techniques offer significant benefits in terms of research data and a deeper understanding of scientific issues in materials science. This presentation will briefly discuss the various accelerator-based techniques that can benefit material characterizations using synchrotron radiation, neutron, ion, and electron beams, and will compare these with conventional techniques.

The primary aim of this presentation is to raise awareness of these advanced accelerator-based techniques for materials investigation and to identify opportunities for worldwide access to these techniques, thereby driving innovation in materials research.

Keynote Speech 4: Continuous Flow Synthesis and Upgrading of Selected Biobased Chemicals

Prof. Christophe Len

PSL Research University, Chimie ParisTech, Paris, France

Biography: Prof. Dr. Christophe Len received his Ph.D. in 1995 from the Université de Picardie Jules Verne followed by a post-doctoral fellow at the University of Hull (UK). In 1997, he became assistant Professor at UPJV and was promoted to full Professor in 2004 at the Université de Poitiers (France). In 2010, he moved as full Professor to the Université de Technologie de Compiègne – UTC (France). Since 2017, he has developed his research at Chimie ParisTech (France). He has published ~ 250 original publications and review articles, 11 book chapters, and 12 patents (H 48, 7162 citations, Scopus). Among recent awards and recognition to his scientific career, he was promoted Honorary Professor of the University of Hull, England (2012–2018), Honorary Professor at the University of Delhi, India (2022), Honorary Professor at the Xi'an Jiaotong University, China (2022-2025) and Fellow of the Royal Society of Chemistry (FRSC, 2015). In 2017, he was honored with the 2017 Glycerine Innovation Award sponsored by the American Cleaning Institute and the National Biodiesel Board. His current research explores organic chemistry and continuous flow.

Abstract: The principles of sustainable development, the bio-economy, and the circular economy are increasingly being applied to the synthesis of industrially relevant molecules. In this context, furfural and glycerol, which serve as platform molecules, are the subject of diverse research approaches aimed at improving their conversion into valuable compounds. Given the current momentum in promoting green chemistry for sustainable development, chemists have recently pioneered catalytic reactions utilizing innovative technologies, such as continuous flow processes.

This study highlights recent advancements in the continuous production of derivatives obtained from furfural and glycerol. Among the noteworthy molecules of interest are furfuryl alcohol, levulinic acid and its esters, gamma valerolactone, acrolein, quinoline-type derivatives, solketal, triacetin, and glycerol oligomers. These derivatives are synthesized from biomass or carbohydrates, utilizing both homogeneous and heterogeneous catalysts. Various reaction parameters, including temperature, catalyst and feedstock loadings, and solvent types, have been meticulously fine-tuned with a focus on time efficiency. The conceptualization, synthesis, and detailed examination of the physicochemical properties of these derivatives will be comprehensively addressed [1-6].

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Keynote Speech 5: Bio-inspired Graphene-decorated Surfaces with Switchable Adhesion

Prof. Zhenhai Xia

University of New South Wales, Australia

Biography: Professor Zhenhai Xia is the Deputy Director of the Australian Carbon Materials Centre at the University of New South Wales, Australia. His research interests encompass multiscale and multi-physics modeling of clean energy conversion and storage, as well as biological and bioinspired materials. He has authored one book, seven book chapters, and over 220 publications in peer-reviewed journals, including those in the Science and Nature series. His work has garnered over 28,500 citations with an h-index of 62 (Google Scholar). Dr. Xia has received numerous awards, including the 1997 Humboldt Scholarship from the Alexander von Humboldt Foundation, the 2015 Nanoscience Research Leader Award from Science Letters, USA, and the 2019 Somiya Award from the International Union of Materials Research Societies. He is also an associate editor for Frontiers in Energy Materials and a Fellow of the Royal Society of Chemistry.

Abstract: "Smart surfaces" can modify their properties (e.g., wettability, stickiness, optical appearance, and bioactivity) spontaneously under natural or provoked stimuli. In particular, smart surface with switchable adhesion render them appealing for engineering applications in climbing robots, reusable tapes, smart tires, advanced drug-delivery, protein separation, etc. Nature have created smart surfaces with switchable adhesion. Geckos, for example, have the extraordinary ability to keep their sticky feet from fouling while running on dusty walls and ceilings. Inspired by Nature, we have fabricated hierarchical carbon nanotube arrays that show strong and anisotropic adhesion and micro/nano-pad-terminated artificial spatulae and micromanipulators that show similar effects, and that provide a new way to manipulate microparticles in dry and aqueous environments. By simply tuning the pull-off velocity, our gecko-inspired micromanipulators, made of synthetic microfibers with graphene-decorated micro-pads, can easily pick up, transport, and drop off microparticles for precise assembling. Furthermore, this nano-textured surface can dramatically alter its adhesion by applying an electric bias, and precisely manipulate and assemble various micro/nano-objects. Modeling and simulation at different scales were performed to understand the switchable adhesion. This work should open the door to the development of novel highly-efficient biomimetic self-cleaning adhesives, smart surfaces, MEMS, tunable micromanipulators, biomedical devices, and more.

Keynote Speech 6: The Use of Carbon-based Composite Coatings for Main Shaft Bearings in Wind Generators

Prof. Esteban Broitman

SKF Research & Technology Development Center, The Netherlands

Biography: Esteban Broitman holds a Ph.D. in Physics from the University of Buenos Aires (Argentina), and a Docent (Habilitation) degree in Tribology from Linköping University (Sweden). He has been doing research and teaching at the University of Buenos Aires (Argentina), The College of William & Mary (USA), Carnegie Mellon University (USA), Linköping University (Sweden), and Invited Professor at University of Sao Pablo (Brazil), and the Chinese Academy of Sciences (CAS - China). He is presently a Senior Scientist in the area of Coatings at the SKF Research and Technology Development Center in Netherlands. He has published more than 200 per-reviewed articles and book chapters, and presented numerous Plenary, Keynote and Invited Lectures. His activities focus on the use of advanced surface engineering to control friction and wear at the macro-, micro-, and nano-scales of coatings like DLC, nanocomposites, and softer materials like soft metals and polymers.

Abstract: During the last three decades, carbon-based composite coatings have enjoyed a growing interest in several industrial applications. By tuning the carbon sp3-to-sp2 atomic bonding ratio and by alloying the carbon with other elements, the researchers have been able to tailor unique physical, mechanical, and tribological composite properties in order to satisfy an increased technological demand.

In the first part of the talk, we will show how carbon-based composite coatings can be deposited at industrial scale onto steel bearings using Physical Vapor Deposition (PVD) and Plasma Assisted Chemical Vapor Deposition (PACVD) techniques at low temperatures. The main deposition methods will be reviewed.

In the second part of the talk, we will explain how is possible to deposit films with different amount of sp2-sp3 bonding ratios by just changing fundamental deposition parameters, leading to six different microstructures: graphite, non-hydrogenated a-C (amorphous) and ta-C (tetrahedral) carbon coatings, hydrogenated a-C:H and ta-C:H films, and soft polymeric coatings. Furthermore, the mechanical and tribological properties of the different microstructures will be discussed.

In the last part of the talk, we will describe the main applications of SKF's NoWear® carbon-based composite coated bearings to extend maintenance and life expectancy of specialized bearings in the wind-energy area.

Part IV Invited Speeches

Invited Speech 1

GNN1271 Molecular Engineering on Fiber Surfaces and Functional Fibers: Pioneering Sustainable Development

Prof Xuqing Liu

Northwestern Polytechnical University, China

Biography: Professor Xuqing Liu is serving as a full professor at Northwestern Polytechnical University and national leading talent in China, with a specific focus on funcational fibre and composites. He spearheads the Shaanxi Provincial Science and Technology Innovation Team and holds the prestigious position of Chief Scientist at the Shandong Provincial Laboratory of Advanced Materials and Green Manufacturing in Yantai. Additionally, he contributes as a committee member at the Ministry of Education's Key Laboratory of Functional Textile Materials and Products. Educated as a PhD at the Hong Kong Polytechnic University's Institute of Textiles and Clothing, Professor Liu furthered his research at the University of Manchester's School of Materials and the Aerospace Research Centre in the UK, where he has led numerous research groups since 2015. His career is adorned with fellowships from illustrious bodies such as the UK's Higher Education Academy, Royal Society of Arts, Royal Society of Chemistry, Textile Institute, and the International Textile Institute.

Professor Liu's research is dynamic and multifaceted, focusing on high-performance fibers and fiber-reinforced lubrication materials under the mentorship of Academician Liu Weimin. His leadership extends to significant projects like the National Science Foundation of China's leading talent project, the "Science and Technology Innovation 2030 – Major Project," and key industrial research initiatives in Xianyang. His editorial roles in journals like "Surface Technology," "Advanced Fiber Materials," and "Energy & Environmental Materials" highlight his influence in advancing research on aerospace lubrication materials, high-performance fiber materials, smart wearable devices, and biomedical fibers. His commitment to pushing the boundaries of material science aligns with global sustainability and innovation goals, making him a vanguard in his field.

Abstract: This presentation delves into the cutting-edge realm of fiber surface molecular engineering, exploring various modification strategies that enhance the functional attributes of fibers. The focus is on leveraging covalent bond modifications, pi-pi interactions, topographical alterations, and van der Waals force modifications on fiber surfaces to achieve functionalization. These engineered fibers demonstrate promising applications in diverse fields such as wearable devices, composite materials, and electrocatalysis. The session will detail the processes and technologies

involved in these modifications, outlining their potential to revolutionize traditional materials and introduce innovative solutions in high-performance applications. The discussion will also highlight recent breakthroughs and practical applications, illustrating how these engineered fibers can be effectively integrated into next-generation materials and devices.

Invited Speech 2

GNN1272 Preparation and Optoelectronic Properties of Novel 2D BiOX Semiconductors

Prof. Liping Feng

College of Materials Science and Engineering, Northwestern Polytechnical University, China

Biography: Feng Liping, with a Ph.D. in engineering, is a professor and doctoral supervisor at Northwestern Polytechnical University. She obtained bachelor's, master's, and doctoral degrees from Northwestern Polytechnical University from 2001 to 2006. She received funding from the National Center for Scientific Research (CNRS) in France and went to the Department of Materials Physics at the University of Franche Comt é in France as a postdoctoral fellow from 2010 to 2011. Mainly engaged in the preparation of low dimensional nano-materials and semiconductor materials, as well as research on the design, microstructure, theoretical calculations, and other aspects of optoelectronic devices. As the project leader, she has presided over more than 20 scientific research projects, including sub projects of the National Key Research and Development Program, 5 projects of the National Natural Science Foundation of China, doctoral funding from the Ministry of Education, and key projects of the Shaanxi Provincial Natural Science Foundation. As a key member, participated in and completed national high-tech "863" projects, defense basic research projects, defense pre research projects, and the French National Center for Scientific Research (CNRS) projects. In recent years, more than 130 SCI indexed papers have been published in international important journals such as Nature Communications, Advanced Materials, Advanced Functional Materials, and Advanced Science. Authorized and publicly disclosed 11 national invention patents as the first author. Currently serving as an editorial board member for international academic journals such as Nanotechnology and Sensors. Also serving as the Vice President of Science and Technology at Jinlun Technology Co., Ltd. in Haimen City, Jiangsu Province.

Abstract: Two-dimensional (2D) semiconductors have great potential for application in low power, high-performance and flexible optoelectronic devices, such as tunnelling transistors, light-emitting diodes, photodetectors and photovoltaic cells. Recently, the novel 2D semiconductors of BiOI, BiOBr, and BiOTe have been prepared via space-confined chemical vapor deposition (SCCVD) method and the new optoelectronic devices based on BiOI, BiOBr, and BiOTe have been fabricated.

Two types of synthesis mechanism are proposed for these BiOX crystals: (1) 2D nucleation and growth for BiOX sheets (bottom−up); (2) layer-by-layer oxidation and exfoliation for BiOX sheets and ribbons (up−bottom). Here, we report the synthesis of millimeter-size single-crystal 2D BiOI sheets and ribbons for the first time by using a sacrifice strategy to optimize the O_2 partial pressure in an atmospheric-pressure growth system. The photodetectors based on the as-grown BiOI nanosheets demonstrate high sensitivity to 473 nm light. The Ion/Ioff ratio and detectivity of BiOI photodetectors can reach up to 1 × 105 and 8.2 × 1011 Jones at 473 nm, respectively. It is demonstrated that a moderate amount of H_2O molecules in the SCCVD system greatly promote the formation of high-quality 2D BiOBr crystals because of the strong polarity of H_2O molecules. The BiOBr-based photodetector was fabricated, exhibiting excellent performances with a responsivity of 12.4 A W−1 and a detectivity of 1.6×1013 Jones at 365 nm. The synthesis of nonlayered BiOTe with a 2D morphology was optimized by a machine learning (ML) strategy. The resultant 2D β-BiOTe flakes with a large domain size (~120 μm) and ultrathin thickness (~9.5 nm) indicate promising applications of ML in guiding the CVD synthesis of 2D nonlayered materials. Compared with the bulk BiOTe with an antiglass structure, the as grown 2D BiOTe shows a unique cation-ordering superstructure. In addition, the 2D BiOTe-based photodetector shows a prominent responsivity of 79.5 A W−1 at 375 nm. This work shows an efficient strategy for preparing 2D layered and nonlayered materials, and provides a brand-new platform to study the properties and applications of 2D materials.

Invited Speech 3

GNN1270 Biomass-based Porous Carbon Materials for Lithium-sulfur Batteries

Prof. Yuanzhen Chen

School of Materials Science and Engineering, Xi'an Jiaotong University, Xi'an, China

Biography: Yuanzhen Chen received his Ph.D. in materials science and engineering from Xi'an Jiaotong University in 2012 and worked for one year (2016) as a visiting research fellow in the Institute for Superconducting & Electronic Materials (ISEM) at the University of Wollongong Australia. He is now working as a professor at Xi'an Jiaotong University. His research interests mainly focus on the synthesis of carbon materials and their application in electrochemical energy storage devices.

Abstract: The severe shuttle effect of polysulfides（LiPSs） is the main cause of capacity fading in lithium-sulfur (Li-S) batteries. Therefore, numerous researchers are currently investigating effective strategies to mitigate the shuttle effect of polysulfides. Our research focuses on employing physical and chemical approaches to enhance the performance of lithium-sulfur batteries. Given sulfur's

insulating nature, it is imperative to establish a highly conductive network within the battery system. To address this issue, we have chosen pine-derived carbon materials with uniform and abundant pore sizes as interlayer materials for lithium-sulfur batteries. These materials not only provide a three-dimensional interconnected conductive network but also facilitate the growth of graphite whiskers inside the graphitized wood carbon pores, thereby offering additional reaction sites for sulfur cathodes and significantly enhancing battery performance. Building upon this foundation, we have incorporated Lewis acid-type perovskite materials with oxygen vacancies into the wood carbon pores to investigate their adsorption and catalytic mechanisms towards Lewis base-type polysulfides. The results demonstrate exceptional electrochemical performance without any degradation even after 500 cycles. However, due to its inherent brittleness, practical applications of wood carbon face challenges. Consequently, we have further developed porous carbon sieve/carbon sheet materials using cellulose as a raw material that can serve as both carriers for sulfur and membrane modification agents while still achieving outstanding electrochemical performance. Moreover, loading catalytic materials onto these carbon sheets enables more efficient conversion rates of polysulfides while maintaining a specific capacity of 493 mAhg-1 at a current density of 10C. Biomass resources are abundantly available and can be processed into porous materials suitable for various applications; furthermore, advancements in biomass-based carbon materials lay a solid foundation for lithium-sulfur battery applications.

Invited Speech 4

GNN1273 Theoretical Study on Electroreduction of CO_2 by Copper Based Catalysts

Prof. Haiyan Zhu

Institute of Modern Physics, Northwest University, China

Biography: Prof. Haiyan Zhu is a Distinguished Professor in Institute of Modern Physics at Northwest University. She received her Ph. D. in Materials Science and Engineering from Xi'an Jiaotong University. She also served as Program Director at the National Science Foundation and as Research Fellow and Senior Research associate at Nanyang Technological University, Singapore and City University of Hong Kong, respectively. Dr. Haiyan's research covers a wide range of topics in nano-structured materials, condensed matter Physics, chemistry, and materials Science. She is the author of more than 70 papers including 1 edited book.

Abstract: In the present era, CO_2 emissions are at record levels and are likely to be even higher in the coming decades due to the accelerated depletion of fossil fuels. Electrochemical CO_2 reduction reactions, powered by clean electricity generated from renewable energy sources, are an attractive route to CO_2 utilisation and sustainable, valuable chemical production. Highly efficient catalysts with

unique geometrical and electronic properties have been developed for the production of a wide range of C_1 and multicarbon carbons (C_{2+}) chemicals. Cu is the only metal with negative adsorption energy for *CO and positive adsorption energy for *H. It is easier to stabilise the adsorption of *CO, and CO has a suitable binding energy on Cu. Although metal Cu has unique catalytic properties for CO_2, it still suffers from high reduction overpotential, slow kinetics, low energy conversion efficiency, poor selectivity, insufficient stability, and obvious competitive hydrogen precipitation side reactions for the electrochemical conversion of CO_2. The introduction of a second metal into a copper-based catalyst to form a bimetallic catalyst is an effective method to modulate the selectivity and reactivity as the synergistic interaction between the two metals can modulate the binding strength and configuration of the intermediates on the catalyst surface.

Invited Speech 5

GNN1269 Structural Design and Potential Application of Two dimensional Material based Electrode

Assoc. Prof. Alei Dang,

Northwestern Polytechnical University, China

Biography: Alei Dang is an Associate Professor of School of Material Science and Engineering at Northwestern Polytechnical University. He received his PhD in Material Science from Northwestern Polytechnical University. He was a Joint PhD student at Carnegie Mellon University (2011-2013) and a Post-doctoral Fellow at University of Pennsylvania from 2016 to 2018. In 2015, he joined Northwestern Polytechnical University as an Assistant Professor and started his independent academic career. Currently, he is mainly engaged in the research of self-assembly, preparation process, structural design and potential applications of nanomaterials. He has published 90+ publications (h-index 35, total citation 3800+) in high impact journals, such as Nature, Advanced Materials, ACS sensors, Macromolecules, and Biosensors and Bioelectronics, et al. He is also a member of the Academic Committee of Shaanxi Graphene New Carbon Materials and Application Engineering Laboratory.

Abstract: Freestanding and bendable film fabricated by 2D materials has demonstrated great potential as an electrode for energy storage devices, owing to their paramount flexibility, structural stability and high conductivity. Nevertheless, the unavoidable restacking of 2D material sheets substantially limits their electrochemical performance. Here, two dimensional-based film electrodes were fabricated through the different methods with mechanically shearing 2D Material sheets that are in liquid crystalline discotic lamellar phase assembly of liquid crystal, and intercalating 2D material interlayers with spacers/dopant methods. The introduced active materials provide abundant active sites to augment the electrode storage capacity. The enlarged interlayer spacing facilitates the

transport of electrolyte ions. As a result, the optimized film electrodes exhibit a high specific capacitance, impressive rate capability and ultrastable cycling. Those works provide the effective routes for assembling 2D material sheets for high-performance energy storage devices.

Invited Speech 6

GNN1263 Computational Insights into Schottky Barrier Heights: Graphene and Borophene Interfaces with H- and Ḣ-XSi_2N_4 (X = Mo, W) Monolayers

Assoc. Prof. Abdul Jalil

Allama Iqbal Open University, Pakistan

Biography: Dr. Abdul Jalil, a distinguished scholar with a PhD from the University of Science and Technology of China (USTC), has dedicated his career to pioneering advancements in materials science. His research focuses on the computational simulation and design of spintronics materials, (photo) catalytic materials for energy applications, and other low-dimensional functional materials. With 58 publications in prestigious journals, JACS, Carbon, JCE, i.e, Alongside his research, he brings over 13 years of teaching experience at the graduate level, nurturing future generations of scientists and engineers.

Abstract: The two-dimensional (2D) semiconducting family of XSi2N4 (X = Mo and W), an emergent class of air-stable monolayers, has recently gained attention due to its distinctive structural, mechanical, transport, and optical properties. However, the electrical contact between XSi_2N_4 and metals remains a mystery. In this study, we inspect the electronic and transport properties, specifically the Schottky barrier height (SBH) and tunneling probability, of XSi_2N_4-based van der Waals contacts by means of first-principles calculations. Our findings reveal that the electrical contacts of XSi_2N_4 with metals can serve as the foundation for nano electronic devices with ultralow SBHs. We further analyzed the tunneling probability of different metal contacts with XSi_2N_4. We found that the H-phase XSi_2N_4/metal contact shows superior tunneling probability compared to that of Ḣ-based metal contacts. Our results suggest that heterostructures at interfaces can potentially enable efficient tunneling barrier modulation in metal contacts, particularly in the case of $MoSi_2N_4$/Borophene compared to $MoSi_2N_4$/graphene and WSi_2N_4/graphene in transport-efficient electronic devices. Among the studied heterostructures, tunneling efficiency is highest at the H and Ḣ-$MoSi_2N_4$/Borophene interfaces, with barrier heights of 2.1 and 1.52 eV, respectively, and barrier widths of 1.04 and 0.8 Å. Furthermore, the tunneling probability for these interfaces was identified to be 21.3 and 36.4%, indicating a good efficiency of carrier injection. Thus, our study highlights the potential of $MoSi_2N_4$/Borophene contact in designing power-efficient Ohmic devices.

Invited Speech 7

GNN1264 A Neural Network Approach to Estimate the Particle Shape Distribution of Nanorods Using Depolarized Dynamic Light Scattering

Assoc. Prof. Paul Briard

School of Physics. Xidian University, China

Biography: He obtained his PhD from the INSA school in Rouen, France, in 2012. His research work, conducted at the CORIA laboratory under the supervision of Prof. Gerard Grehan, involved estimating characteristic information such as the size, 3D positions and refractive index of a group of spherical particles illuminated by a plane wave, which scatter the light toward a camera. This work caused him to become interested in the Lorenz-Mie theory (LMT), which describes the interaction between a plane wave and a spherical particle. This in turn sparked his interest in how the LMT has been extended to the generalized Lorenz-Mie theory (GLMT), which describes the interactions between arbitrarily shaped beams and particles of regular shape (for instance aggregated spherical particles, spheroidal particles, particles with inclusion, and so on).
After two years of postdoctoral studies at Xidian University (2013–2015), he undertook postdoctoral studies at the University of Shanghai for Science and Technology (USST) under the supervision of Prof. Xiaoshu Cai (2016–2018). While at USST, he became interested in the field of optical metrology of nanoparticles.
Since 2018, when he returned to Xidian University to work with Prof. Yiping Han and Prof. Jiajie Wang, his main interests have involved the descriptions of light scattering by regular particles in the framework of the GLMT and the optical metrology of particles. His lectures at Xidian University focus on university physics, optical metrology, and light scattering by small particles.

Abstract: In a depolarized dynamic light scattering setup, particles undergoing Brownian motion scatter the light toward a photodetector with two polarization geometries: vertical-vertical (VV) and vertical-horizontal (VH). If the particles are nanorods (i.e., they have a cylindrical shape described by a diameter and a length), an analysis of the fluctuations of the light recorded in the VV and VH geometries permits information to be retrieved about the translational and rotational diffusion of the particles, thus allowing their mean diameter and length to be estimated. In this study, we estimate the mean diameter, the mean length, the variance of the diameters, and the variance of the lengths of nanorods using a generalized regression neural network (GRNN). To train the GRNN, training samples are randomly generated around an initial guess estimated using a Tikhonov regularization. The predictors of the GRNN are the normalized electric field autocorrelation functions of the scattered light recorded by the photodetector at multiple scattering angles. The translational and rotational diffusion coefficients of a nanorod are described using the bead-shell model. In the present

work, the bivariate probability density function (PDF) of the diameters and lengths is Gaussian and unimodal. The possibility of extending this approach to estimate other characteristic information about a multimodal PDF will be also discussed.

Invited Speech 8

PCM3372 Introduction to High Temperature Resistant Polymers Used in Drilling Fluid for Deep and Ultra-deep Well Drilling

Assoc. Prof. Xianbin Huang

School of Petroleum Engineering, China University of Petroleum (East China), China

Biography: Dr. Xianbin Huang is an associate professor and a graduate supervisor in the School of Petroleum Engineering at China University of Petroleum (East China). He graduated from China University of Petroleum (Beijing) in 2017, majoring in oil and gas well engineering. His research interests include drilling fluids, polymers for high-temperature resistant drilling fluids, and materials for wellbore stabilization. He actively participates in product industrialization and engineering practice. Several high-temperature-resistant materials were industrialized and field applied in the drilling engineering. He is the leader of two National Nature Science Foundation of China (NSFC) research projects and six industry projects. It is a great honor for him to participate in the research of key technologies for China's 10,000-meter deep wells. In 2022, he was honored as an Engineer of Excellence in Shandong Province, China. He is Youth Editorial Board Members for Petroleum Science and several Chinese academic journals.

Abstract: With the gradual depletion of shallow oil and gas resources, deep (>4,500m) and ultra-deep (>6,000m) oil and gas have become the main sources of oil and gas resources in China. With the advancement of technology, the drilling depth has been gradually increased. Two extra-deep wells with a design depth of over 10,000 m are being drilled in China. One of the wells has exceeded 10,000 m. However, the high temperature in the deep formation poses a great challenge to the temperature resistance of drilling fluids. Water-based drilling fluids (WBDF) are multistage dispersion systems of clay, weighting agent and a variety of chemical materials in water. Drilling fluid serves as “drilling blood” and plays a vital role in carrying and suspending drill cuttings, stabilizing wellbores, and lubricating and cooling drill bits during drilling-based engineering. Water-soluble polymers mainly regulate rheology and control filtration in drilling fluids, but their performance fails under high-temperature and high-salt conditions, which is a serious problem for drilling safety and efficiency. This presentation will focus on the topic of high temperature resistant polymers used in the drilling fluid. It will cover the technical challenges of deep well drilling, the challenges for polymers and the current status of research on high temperature resistant polymers.

Finally, some research results on high temperature resistant polymers from our team will be presented.

Invited Speech 9:

PCM3366 Robust Biodegradable Fiber Silk Composites for Load-bearing Bone Graft

Assoc. Prof. Juan Guan

School of Materials Science and Engineering, Beihang University, China

Biography: Dr Juan Guan is a polymer scientist by training. She obtained her bachelor's degree in polymer science and engineering from Tianjin University (one of China's oldest and prestigious universities), then obtained a Master's degree in macromolecular chemistry and physics from Fudan University, and then studied at the University of Oxford for Doctor of Philosophy (PhD). After obtaining her degree in 2013, she returned to China and joined Prof. Robert Ritchie's lab at Beihang University in Beijing. Since 2014, she has been an Associate Professor at the School of Materials Science and Engineering of Beihang University. Her research interest focuses on the glass transition behaviour of biopolymers using silk proteins as a model material, design and fabrication of natural silk fibre reinforced composites and the toughening mechanisms in natural polymer based composite materials. She has published over 60 peer-reviewed journal articles in Nature Communications, Advanced Materials, Matter, Advanced Healthcare Materials, ACS Applied Materials & Interfaces, Acta Biomaterialia, Composites Part A and etc.

Abstract: Degradable biomaterials have emerged as a viable alternative to permanent materials for regenerative bone medicine. Although Polycaprolactone (PCL) exhibits remarkable extensibility and toughness, its low elastic modulus and strength, hydrophobicity, and excessively slow degradation rate limit its application in orthopedics. Natural silk fibers with macroscopic continuity and highly ordered morphology are selected to reinforce PCL to satisfy the mechanical and biological requirements for bone grafts. In this talk, we discuss the design, fabrication, and bone graft application of fiber silk-PCL biocomposites.

Silk-PCL composites with 20%/40%/60% silk was fabricated via layer-by-layer assembly and hot-pressing, allowing facile incorporation of drugs. The fiber silk composites exhibited compatible modulus (1GPa) to the majority of bone tissues, high compressive strength (150MPa), high toughness, hydrophilicity, and water adsorption behavior. The 6-month in vitro degradation experiment showed that passive surface erosion and bulk hydrolysis of the silk-PCL composite by the aqueous environment is negligible, and the fiber-matrix interfaces remained robust. In the in vivo rat subcutaneous model, the degradation of silk composites is significantly accelerated via inflammatory cells mediated PCL dissolution from the surface. Fiber silks are proposed to modulate

the inflammatory responses toward synchronized material degradation and tissue reconstruction. A rabbit tibial defect model shows a strong tissue-composite implant bonding, suggesting sufficient mechanical function and the regeneration of new bone.
The silk-PCL composites bring forward exceptional comprehensive mechanical performance and desirable degradation behavior in vivo through the coupled inflammatory modulation effects of silk and PCL. This work may herald the advent of a novel biomaterial for load-bearing bone repair.

Invited Speech 10

PCM3367Composite Materials for Perioperative Tumor Diagnosis/Treatment by Coupled Control of Cascade Reaction Flow and Transfer at Interface

Prof. Jixi Zhang

College of Bioengineering, Chongqing University, China

Biography: Dr. Jixi Zhang got his bachelor's/Ph. D. degree in Chemical Engineering/Materials Science and Engineering from Shanghai Jiao Tong University in 2007/2012 and did his post-doc research at Åbo Akademi University from 2012 to 2014. He is now presently a Professor/Vice Dean at College of Bioengineering, Chongqing University. His research focuses on bioactive composites for tumor adjuvant therapy, and pathological detection technologies based on nanosensor systems. Dr. Zhang published over 70 SCI articles/book chapters and was selected in National Talent Program of China. He is also a director of Chongqing Biomedical Engineering Society and an editorial board member of international journals like Materials Science & Technology.

Abstract: Perioperative diagnosis and residual focus clearance are difficult problems for solid tumors such as triple negative breast cancer. Polymer-based composite nanoparticles can drive or assist physicochemical reactions and biological effects in diagnostic processes, but multiphase reaction flow transfer and kinetic control are important challenges to improve response efficiency and specificity. Our group makes full use of melanin-like materials with synergistic molecular mode (based on phenol-quinone redox) and optical mode (based on electromagnetic effects of conjugated structures) to develop new composite materials. Aimed at two key scientific problems of " response modulation method for interface coupling and distance constraint of diagnosis and treatment elements" and "balancing engineering mechanism of confined activation and cascade transformation of active species", biochemical identification-response-amplification mechanisms and balancing engineering of active species are cross-fused in function transfer-synergy systems of composite nanomaterials. Homogeneous photoelectrochemical sensors for the detection of miRNA markers in tumor interstitial fluid with high reproducibility were developed by employing electron transfer

cascade constrained by interface collision. Complex catalytic structures empowered with elementary transfer and efficient pore diffusion were designed to achieve a catalytic oxidation therapy system that efficiently overcomes tumor cell resistance. An interface-oriented control model and regulation paradigm for oxidative polymerization of melanin-like nanoparticles was established to develop a "contradiction complex" material that meets ROS balance engineering and inflammation control after phototherapy. The activity of infiltrated immune cells after activation and the efficiency of metastasis and recurrence inhibition was effectively enhanced. Finally, the key technical problem of "high-performance biosensor and combined ablation therapy driven by endogenous microenvironment and active materials" was broken through, and functional material construction strategies that accurately adapted to the complex response network modulation of the diagnosis and treatment process were formed. The above perioperative tumor auxiliary diagnosis and treatment materials with high efficiency and specificity, transmission coupling and material energy conversion flow synergy provide innovative solutions for the construction of intelligent nano-diagnosis and treatment systems.

Keywords: Composite Nanoparticles; Tumor Theranostics; Interfacial Processes; Catalysis Control; Cell Response

Acknowledgements: The work was supported in part by the National Natural Science Foundation of China (NSFC, grant nos. 22175027 and 21734002), the Natural Science Foundation of Chongqing (cstc2021jcyj-cxttX0002 and cstc2021jcyj-msxmX0178), project no. 2023CDJXY-051 supported by the Fundamental Research Funds for the Central Universities, and the 100 Talents Program of Chongqing University (J.Z.). The Analytical and Testing Center of Chongqing University is greatly acknowledged for helping with the characterization of materials.

Part V Poster Session

Materials Provided by the Conference Organizer:

✧ X Racks & Base Fabric Canvases (60cm×160cm, see the figure)

✧ Adhesive Tapes or Clamps

Materials Provided by the Presenters:

✧ Home-made Posters

✧ Posters printed by PCM2024&GNN2024 Committee

Requirements for the Posters:

✧ Materials: not limited, can be posted on the Canvases

✧ Size: 60cm×160cm

✧ Horizontal Head: please make the conference name 'PCM2024 or GNN2024' and the paper number '**PCM**** or GNN******' as the head of the poster in order to make all the posters unified.

Poster Presentations

Time: 16:50-18:00 Tuesday, August 20, 2024

Conference Room: Juya Ting (聚雅厅), 5F, Aoxiang International Conference Center

List of Posters

PCM3369	**Regulating Long-range Travelling Electrons for Simultaneous Electromagnetic Absorption and Interference Shielding of Co@C Nanofibers** *Assoc. Prof. Min Zhang, Department of Physics, Beijing Technology and Business University, China*
PCM3387	**Effect of Plasticizer and Filler on the Mechanical and Thermal Properties of Carboxymethyl Cellulose Films from Corn Husk** *Dr. Usarat Ratanakamnuan, Faculty of Science, Maejo University, Thailand*
PCM3390	**Liquid-Crystal Elastomers Based on Supramolecular Dynamic Covalent Networks for Ultrastrong and Reprogrammable Soft Actuators** *Mr. Jian Ding, School of Biomedical Engineering, Shanghai Jiao Tong University, China*
PCM3394	**Thermo-Optical Properties of Mesoporous Silica Nanoparticles Colloids Using Photopyroelectric Techniques** *Dr. Yesenia Sánchez Fuentes, Basic Science Department, Instituto Politécnico Nacional-UPIBI, México*
PCM3395	**Preparation and Study of Polysiloxane Core-Shell Nanoparticles (CSP)** *Assoc. Prof. Shizhuo Xiao, Key Laboratory of Photochemical Conversion and Optoelectronic Materials, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China*
PCM3412	**The Formation Behaviors of CO_2 Hydrate for Cold Energy Storage Enhanced by Silica Nanoparticles** *Dr. Qi Jikai, Huaneng Shandong Power Generation Co., Ltd, China*

PCM3413	**Dynamic Leakage Control Performance for CO_2 Storage Safety Using Smart Gel System** *Dr. Qi Jikai, Huaneng Shandong Power Generation Co., Ltd, China*

Part VI Conference Venue

Aoxiang International Conference Center (翱翔国际会议中心)
Address: Northwestern Polytechnical University Youyi Campus, Innovation Building, Laodong South Road, Beilin District, Xi'an, China
Tel.: +86-29-89563366/ +8618710932474

Brief Introduction

Aoxiang International Convention Center is located on Laodong South Road in Xi'an city. It borders the Northwestern Polytechnical University campus to the north, sits within the Datang West Market cultural tourism business district, and is close to the Xi'an High-Tech Industrial Development Zone. Strategically situated at the interchange station for Subway Lines 5 and 6, it enjoys convenient transportation and boasts a prime location.

Access to Venue

1. Xi'an Xianyang International Airport — Aoxiang International Conference Center

(A)Taxi: about 40 min drive, 90 RMB

(B)Public Transportation (1.5-2h):

*Take shuttle bus (West High-Tech Business Express Line) -- Xiyaotou Station -- -Xiyaotou Subway Station-- Take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

*Take subway line 14 from Airport West (T1, T2, T3) Station--Xi'an North Station--Take line 4 to University of Architecture and Technology · Lijiacun Station--Take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

*Take subway line 14 from Airport West (T1, T2, T3) Station--Xi'an North Station--Take line 4 to Dachashi Station--Take line 6 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

2. Xi'an Railway Station — Aoxiang International Conference Center

(A)Taxi: about 25min drive, 25MB

(B)Public Transportation (0.5 h)

*Take Subway line 4 to University of Architecture and Technology · Lijiacun Station--Take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

*Take Bus 206 to Laodong nanlu nankou Station--3 minutes' walk to Aoxiang International Conference Center

*Take Bus 201 to Xigongda Ximen Station--3 minutes' walk to Aoxiang International Conference Center

3. Xi'anbei Railway Station — Aoxiang International Conference Center

(A)Taxi: about 40min drive, 60MB

(B)Public Transportation (1 h)

*Take Subway line 2 to Nanshaomen Station--Take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

*Take Subway line 2 to Zhonglou Station-- Take line 6 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

4. Xi'annan Railway Station — Aoxiang International Conference Center

(A)Taxi: about 50min drive, 65MB

(B)Public Transportation (1-1.5 h)

*Take bus 732/343--Xitai Road (International Medical Center) -- Take line 6 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

5. Xi'anxi Railway Station — Aoxiang International Conference Center

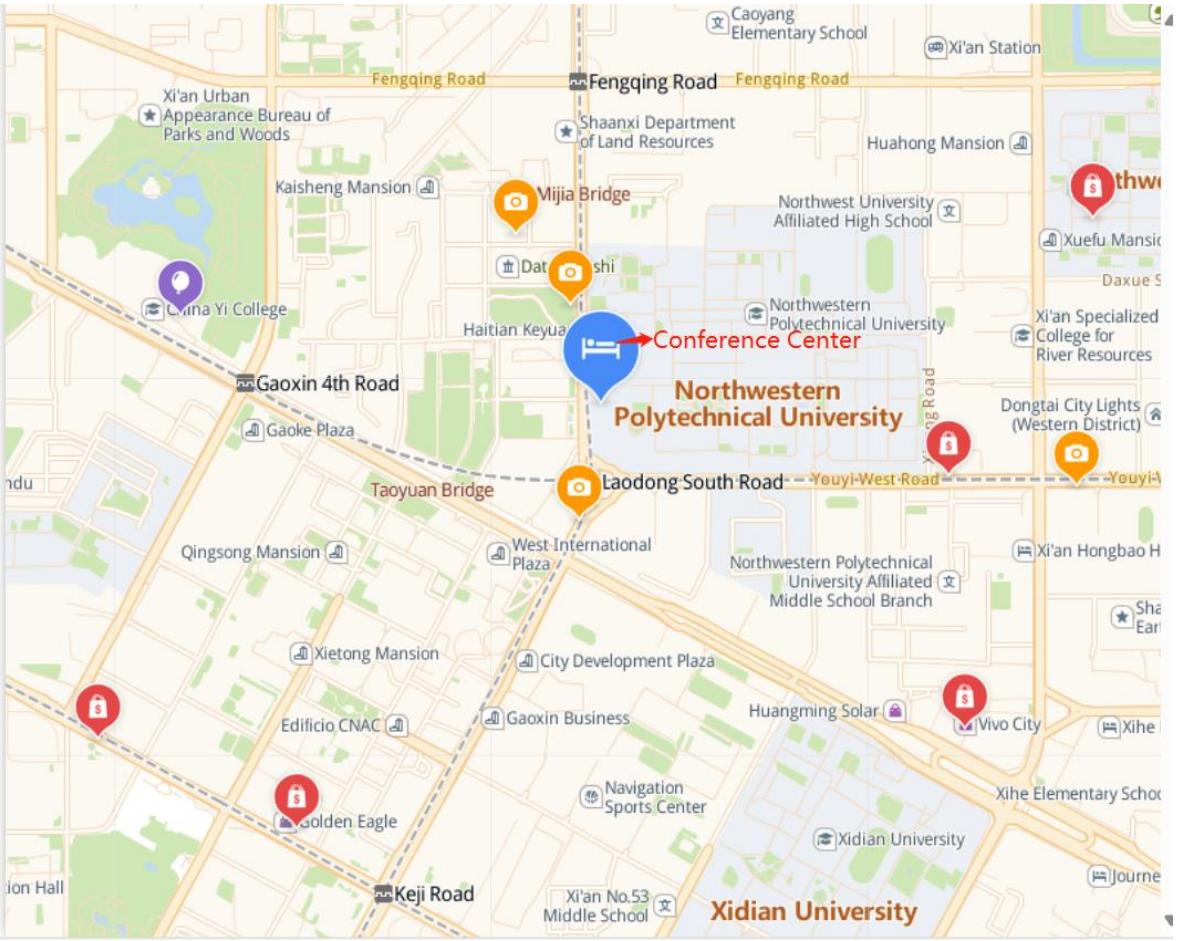
(A)Taxi: about 35min drive, 45MB

(B)Public Transportation (1-1.5 h)

*Take bus 821 -- Kunming Road Fuyuan Erlukou Station—Walk to Shiqiaolijiao Subway Station and take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

*Take bus K1--Fuxing Avenue Nanditie Station-- Take line 5 to Northwestern Polytechnical University Station (Exit E) --3 minutes' walk to Aoxiang International Conference Center

Map



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Please take me to: Northwestern Polytechnical University Youyi Campus, Innovation Building, Laodong South Road, Beilin District, Xi'an, China (劳动南路西工大创新大厦翱翔国际会议中心)

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Qing song wo dao/Please take me to

翱翔国际会议中心

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Aoxiang Guoji Huiyi Zhongxin /Aoxiang International Conference Center

Part VII Field Visit

Schedule

Depart from Aoxiang International Conference Center (8:30 am) →Xi'an Museum and the Small Wild Goose Pagoda (9:00 am to 11:00 am) →Lunch (11:00 am to 12:00 am) →Terracotta Army (2:00 pm to 5:00 pm) → Back to Aoxiang International Conference Center

Xi'an Museum

Xi'an Museum is composed of three parts including museum, site of Jianfu Temple in Tang Dynasty and Historical and Cultural Park of Small Wild Goose Pagoda, with museum, tower, temple and park enhancing each other's beauty and bringing out the best in each other, being distinctive among museums in China and the rare national grade I museum integrating world cultural heritage, historical and cultural relics under state protection, ancient architectural complex and modern exhibition hall.

Xi'an Museum contains more than 110,000 pieces of cultural relics, including bronze wares, jade wares, gold and silver wares, porcelains, stone sculptures, inscription on tablet, seals, earthenwares, three-color glazed wares, painting and calligraphy, sutra, rubbings, ancient and rare books, miscellaneous wares, including 10441 pieces of valuable cultural relics at no lower than grade III. The museum has collected more than 100,000 volumes of ancient books, with 37 volumes of books having been selected into Catalogue of National Rare Books in China and the collections complete in sequence and category to create a system of their own. The exhibition hall of Xi'an Museum designed under the direction of Master Zhang Jinqiu as an academician of Chinese Academy of Engineering has a built-up area of more than 16000sqm and a show area of more than 5500sqm, having more than 2000 pieces of cultural relics on display, the exhibition hall has had a display pattern with focus on fundamental display of Xi'an as an ancient capital, together with special display of compassion and fascination—Chang'an Buddhist Statues Art and spirit of the universe—

Selected Ancient Jade wares and various temporary exhibitions as expansion and extension thereof having shown historical features of Xi'an as a capital and cradle of Chinese civilization in various fields including politics,economy and culture etc. since Zhou Dynasty, Qin Dynasty, Han Dynasty and Tang Dynasty. Exhibition of Small Wild Goose Pagoda-Jianfu Temple History on central axis of Small Wild Goose Pagoda Scenery Spot shows value of Small Wild Goose Pagoda in heritage as well as historical fact and experience in exchange and innovation between orient and west in terms of culture along Silk Road in those days.



Small Wild Goose Pagoda in scenic spot is cloud kissing, with ancient trees reaching to the sky, green grass and zigzag lake therein, time-honored ancient music in Chang'an to underline the excellent location with lingering melodious rhythm, folk cultural relics that could be found everwhere in those days such as hitching posts and various folklore art exhibition open a window for tourists to understand Chinese traditional culture. Well-arranged and delightful park and garden around water enable tourists to enjoy cultivation of temperament in tranquil and relaxed environment in downtown area.

Terracotta Army

Terracotta Army, also namely Terracotta Warriors and Horses, is known as the Eighth Wonder of the World. It is a super large collection of life-size terra cotta sculptures in battle formations, reproducing the mega imperial guard troops of Emperor Qin Shi Huang (259 - 210BC), the first emperor of the first unified dynasty of Imperial China. The great archeological excavation of Qin (221BC-206BC) Terra Cotta Warriors and Horses unfolded a strong army of altogether 7,000 life-size pottery soldiers, horses, chariots and weapons arranged in battle formations symbolically, guarding the tomb of Emperor Qin Shi Huang. Being the most significant archeological excavations of the 20th century and a UNESCO World Heritage Site, the Terracotta Army is no doubt a must-see for every visitor to Xi'an.


Part VIII Abstract Proceedings

Abstract for Poster Presentation

PCM3369

Regulating Long-range Travelling Electrons for Simultaneous Electromagnetic Absorption and Interference Shielding of Co@C Nanofibers

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Abstract. Multifunctional electromagnetic nanofibers are potential in wearable wireless devices. Manipulating the electromagnetic response of a material is a reasonable strategy for developing diversified electromagnetic functions. Herein, a multifunctional electromagnetic nanofiber (Co@C) is proposed. Due to the intrinsic local π-bonds, residual defects/groups, heterogeneous interfaces, and magnetic multiresonance, Co@C nanofibers show excellent electromagnetic attenuation performance. More importantly, a long-rang travelling electron regulation strategy is proposed to switch the electromagnetic function of the Co@C composites between electromagnetic absorption and interference shielding. The optimal electromagnetic wave absorption performance reaches -48.79 dB, and the maximum average electromagnetic interference shielding performance reaches 30 dB. As the simultaneous acquisition of electromagnetic absorption and shielding functions is of great significance for practical applications, patterned design is performed on the surface of the Co@C composites. A perfect electromagnetic resonant absorption band with an absorption coefficient near 1 appears. The patterned Co@C composite features frequency-selective absorption by customizing the geometric parameters of the pattern. This work breaks through the limitations of the single function of traditional electromagnetic nanomaterials and inspires the development of electromagnetic materials towards multiple functions.

Keywords: Co@C nanofiber, Electromagnetic absorption, Electromagnetic shielding, Electrospinning

PCM3387

Effect of Plasticizer and Filler on the Mechanical and Thermal Properties of Carboxymethyl Cellulose Films from Corn Husk

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Abstract. In this study, microcrystalline cellulose was extracted from corn husk by a pretreatment process using a sodium hydroxide solution to remove lignin. A hydrogen peroxide and sodium

hydroxide solution are then used in the bleaching process, and hydrolysis with sulfuric acid is performed. Carboxymethyl cellulose (CMC) was then synthesized using monochloroacetic acid as a modifier. FTIR analysis confirmed that the microcrystalline cellulose from corn husk had undergone carboxymethylation. Subsequently, carboxymethyl cellulose films were fabricated utilizing the solvent casting method. The study investigated the influence of different additive types (glycerol, propylene glycol, sorbitol, and calcium carbonate) and additive concentrations (0-20% (w/w) based on CMC content) on the mechanical and thermal characteristics of the CMC films. It was observed that the tensile strength and Young's modulus of the CMC film decreased with higher plasticizer content, whereas the elongation at break increased with increasing plasticizer concentration. CMC film with 20% (w/w) of glycerol and propylene glycol showed the highest elongation at break value. On the other hand, CMC film filled with $CaCO_3$ reduces the elongation property but improves the stiffness of the film, as confirmed by the increasing modulus. Adding plasticizer resulted in a decrease in the CMC film's thermal stability.

PCM3390

Liquid-Crystal Elastomers Based on Supramolecular Dynamic Covalent Networks for Ultrastrong and Reprogrammable Soft Actuators

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Abstract. The attainment of high-energy actuation and reprogrammable shape are vital requirements for soft actuators to meet the demands of advanced applications. As an important class of soft actuators, liquid crystal elastomers (LCEs) can perform untethered, large-strain, and reversible deformation; however, their actuation work capacity and reprogrammability are mutually exclusive, so it is hard to attain both in the same material. For the first time, we resolve this conflict through the design of a loosely crosslinked LCE comprising high-density hydrogen bonds (H-bonds) and dynamic covalent bonds (DCBs). The covalent network is significantly strengthened by H-bonds so that the LCE achieves a decent work capacity (440 kJ/m^3) more than ten times higher than skeletal muscles. Meanwhile, the H-bonds can serve as physical crosslinks to fix the temporary shape based on the alignment network, while the covalent crosslinks can fix the permanent shape. The dynamic nature of H-bonds and DCBs allows for post-synthesis reprogramming of both shapes in a do-it-yourself manner. Hence, this study provides a structural design principle for resolving the existing conflict, opening the way for the development of readily reprogrammable soft actuators with high-energy actuation capacity.

Keywords: Liquid Crystal Elastomers; Supramolecular Polymers; Covalent Adaptable Networks; Soft Actuators; Artificial Muscles

PCM3394

Thermo-Optical Properties of Mesoporous Silica Nanoparticles Colloids Using Photopyroelectric Techniques

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Sánchez
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Abstract. Nanomaterials have become one of most applicable materials for adsorption, due to their versatility and nano scale properties, which's made them one of most useful materials. Mesoporous Silica Nanoparticles (MSN) have important applications as therapeutic agents due to its characteristics that make them optimal for medical use, such as morphology and size controllable, biocompatibility alone or in complex with other materials. Therefore, it is possible to modify their optical and thermal properties. Photopyroelectric Techniques for thermal and optical characterization are introduced for measuring thermal diffusivity and optical absorption coefficient of colloidal suspensions of MSN. Thermal diffusivity and Optical absorption coefficients in infrared region (904 nm, 940 nm and 980 nm) were measured for spherical MSN colloidal suspensions of 95 ± 5 nm average size, in a range of 1, 5, 10, 15 and 20 mg/mL. UV-Vis spectroscopy was employed with the purpose of comparing absorbance measurements. It was found that a linear increment of optical absorption coefficient with MSN concentration, it was not possible to obtain with conventional UV-Vis spectroscopy. Similarly for thermal diffusivity, a slight increment of this thermal property with increasing concentration of MSN was observed. The direct measurement of optical absorption coefficients of colloidal suspensions of MSN allowed the knowledge of their absorptivity at the selected wavelengths.

Keywords: Photopyroelectric Techniques; Mesoporous Silica Nanoparticles (MSN) ; Thermal Diffusivity and Optical Properties

PCM3395

Preparation and Study of Polysiloxane Core-Shell Nanoparticles (CSP)

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Abstract. Photopolymerization 3D printing has been widely used in many fields due to its personalized design, high molding accuracy, fast printing speed, smooth surface and non-contact characteristics of printed models. However, there are still certain shortcomings in the performance of photocurable 3D printing materials, such as the limited scratch resistance of the surface of the printed model, which may not withstand repeated friction and pressure from the outside world, thus losing the accuracy and precision of the model. Therefore, it is of great significance to study and improve the scratch resistance of the surface of photopolymerization 3D printed models to promote the wide application of photopolymerization 3D printing technology. Based on this, we used octamethylcyclotetrasiloxane (D_4) ring-opening polymerization with methyl vinyldimethoxysilane (DMDMVS) to obtain a polysiloxane core with double bonds, and then copolymerized with the shell monomer methyl methacrylate (MMA) for free radicals to prepare polysiloxane core-shell nanoparticles (CSP) scratch-resistant agents. The effects of ring-opening polymerization temperature, ring-opening catalysts and DMDMVS addition on D_4 conversion rate and molecular weight of

polysiloxane were studied. The results showed that with the increase of ring-opening polymerization temperature, the conversion rate of D_4 gradually increased, while the molecular weight of polysiloxane gradually decreased. The catalytic effect of the acidic ring-opening catalyst 4-dodecylbenzene sulfonic acid (p-DBSA) was better than that of sulfuric acid (H_2SO_4), trifluoromethanesulfonic acid (TfOH) and p-toluenesulfonic acid (PTSA). DMDMVS can be added together with D_4 to boost D_4 conversions. Finally, a product with high conversion rate (87.3%) and high molecular weight (10.9×10^4) was obtained, and the particle size was 215 nm.

Keywords: Polysiloxane; Core-shell; Photopolymerization 3D printing

PCM3412

The Formation Behaviors of CO_2 Hydrate for Cold Energy Storage Enhanced by Silica Nanoparticles

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Abstract. Cold energy storage technology has many advantages, including improving energy utilization efficiency, reducing energy consumption peak, balancing energy supply and demand, and reducing energy costs. It can be used in building air conditioning system, industrial refrigeration, solar water heater, power system peak balancing and other fields. CO_2 hydrate serve as a kind of excellent materials for cold storage due to their capacity to release and absorb a significant amount of energy during both formation and decomposition. Meanwhile, it is also can reduce CO_2 emissions with using CO_2 hydrate as the cold energy storage medium. Nevertheless, long induction times and slow formation rates inhibit large-scale industrial application of the cold energy storage technology based on CO_2 hydrate. Hence, it is crucial to shorten induction times and accelerate formation rates. In this work, the influencing factors on the kinetics of hydrate formation, such as initial pressure, stirring rate, nanoparticle size, and concentration, are investigated. The results indicate that increasing the initial pressure, enhancing the stirring rate, and reducing the nanoparticle size can shorten the induction time and promote hydrate formation. Among the four selected types of nanoparticles, ZnO exhibits the most favorable effect on induction time reduction, with the shortest induction time of 42min at a concentration of 0.10 wt%, which is 92% shorter than that of the pure water system. MWCNT shows the best promotion effect on gas storage capacity and gas reaction ratio, with a concentration of 0.04 wt%, the gas storage capacity and gas reaction ratio are 112% and 112% higher than those of the pure water system.

Keywords: CO_2 Hydrate; Cold Energy Storage; Silica Nanoparticles; Dynamic Behaviors

PCM3413

Dynamic Leakage Control Performance for CO_2 Storage Safety Using Smart Gel System

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Abstract. CO_2 geological storage technology has become one of the research priorities worldwide in recent years, which can reduce greenhouse gas emission. During CO_2 storage process, existed or newly generated leakage channels are inevitable because of natural and man-made geologic activities. Hence, the storage safety in terms of CO_2 leakage has always been an eminent issue for concerns and questions. In this work, the leakage blocking methods based on CO_2 smart gel system were proposed. The related features of gel system, which include CO_2 sensitivities, reaction mechanisms, blocking capability, and feasibility of field application, were studied through a series of studies. The study on the feasibility of blocking leakage using smart gel system showed that modified polyacrylamide-methenamine-resorcinol system is an effective blocking system. With the presence of CO_2, increase of temperature can shorten the gelling time with advantageous viscosity-temperature characteristics. Meanwhile, pressure increase was beneficial for the gelation process. Compared with other kinds of smart blocking systems, this system had much better blocking performance and scouring resistance with relatively robust temperature resistance and salts tolerance. Reactive flow simulation results showed that gel can form and be absorbed more easily near the injection point which may limit the CO_2 leakage to a small range. Feasibility and effectiveness of this method for selectively blocking leakage were also demonstrated in field-scale simulation work.

Keywords: CO_2 Smart Gel System; CO_2 Geostorage; Leakage Control; Blocking Performance

Abstract for Oral Presentation

PCM3397

Analyzing Tetrahedron Lattice Structures Computationally for Their Post-yielding Behavior

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Abstract. Recent investigations have focused on the production of lattice cores through three-dimensional (3D) printing, demonstrating their versatility across sectors such as aerospace, bioengineering, and automotive industries. Lattice structures are valued for their high specific strength, lightweight nature, and exceptional energy absorption capabilities. However, assessing their mechanical response experimentally is resource-intensive. Finite element analysis (FEA) offers a cost-effective alternative to predict the mechanical behavior of diverse lattice configurations. This study employs Acrylonitrile Butadiene Styrene (ABS), chosen for its strength and durability, ideal for examining 3D-printed lattice structures. Specifically, the research investigates the post-yielding response of hierarchical tetrahedron lattice cores simulated with hexahedral elements. FEA simulations provide insights into failure mechanisms, stress distribution patterns, and the impact of lattice design parameters on post-yielding deformations. Key findings include the optimization of structural performance, where specific dimensions and infill densities significantly enhance post-yielding strength under compression. Insights into stress distribution and failure modes contribute to predicting structural limits and designing more resilient 3D-printed materials. This research advances the understanding of how lattice designs perform under load, providing valuable data to optimize structural engineering applications and material design.

PCM3403

A Study on the Influence of Indenter Shape for Small Punch Test of Non-metallic Materials

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Abstract. Small punch test (SPT) is a type advanced method for material mechanical property obtain with small-invasive test, which has a good application prospect for judging the mechanical properties of materials at the local position of service components. However, at present, there is a lack of data and engineering basis for the applicability of the two commonly used pressure ball and hemispherical indenters of the SPT method to flexible non-metallic materials, resulting in the lack of universal adaptability standards for the SPT method of non-metallic materials, which is one of the core shackles of the current engineering application of this method. Therefore, based on the results of the traditional uniaxial tensile test, the SPT of polyamide (PA) was carried out by using two types of pressure heads, ball type and hemispherical type indenter, and the differences between material deformation and fracture caused by the two types of pressure heads were analyzed by the methods of material mechanical properties, macro and micro fracture morphology and numerical simulation. The experimental results show that the top of the indenter has obvious friction with the material during the small punch bar test, and the maximum deformation position of the material occurs at the diameter of the indenter rounding. Due to the viscoelastic characteristics of high flexibility and large deformation of PA, the shaped part of the indenter is bonded due to plastic deformation rebound during the fracture process. For the spherical indenter, the maximum deformation of the material can wrap the gap formed between the spherical indenter and the punch bar platform, which will cause the maximum deformation position of the specimen to change during continuous loading, which will affect the authenticity of the data. The maximum deformation position of the hemispherical indenter remains stable, which has a more accurate positioning for evaluating the performance of the material. The test results screen out the SPT indenter shape suitable for flexible non-metallic materials, which provides theoretical guidance and basis for the formulation of SPT test method standards.

Keywords: Small Punch Test; Indenter Shape; Test Method; Fracture Morphology

PCM3370

Boundary Equivalent Model and Optimization of Glass Fiber Reinforced Composite Storage Tanks Based on Theory of Plates and Shells

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Abstract. Glass fiber reinforced composites are widely used in storage tanks for corrosive liquids such as hydrochloric acid. In order to solve the leakage problem of a certain factory's storage tanks. The type and failure region were located through investigation, sampling, and mechanical testing. By considering the specific conditions, a boundary equivalent model was proposed and derived from the theory of plates and shells. It can locate and measure the cause of failure accurately, without complex numerical modelling process. By focusing on the three key parameters that can avoid failure, the tank design was optimized and the bending stress in the failure region was reduced by 43% without changing the production cost and anti-dumping ability.

Keywords: Composite Material; Thin-walled Tank; Glass Fiber; Theory of Plates and Shells

PCM3373

Uncovering the Screening-enhanced Behaviour of poly (hexamethylene biguanide) (PHMB) in Overcoming Charge Screening Limitations

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Abstract. It is still a challenge to effectively bypass the negative influences of charge screening caused by inorganic salts by using appropriate polymeric materials. We found that poly(hexamethylene biguanide) (PHMB) exhibits an extraordinary screening-enhanced effect which makes it effectively overcome the charge screening limitations in flocculating colored dyeing wastewater. It was found that the optimal dosage of 20~50 mg/L PHBM can effectively remove two model anionic dyes over a wide range of pH value with both rather higher color removal efficiency and lower turbidity. The effect of pH value on the flocculation performance of PHMB mainly lies in the lower dosage (＜60 mg/L), whereas it does not affect the higher dosage of PHMB (＞60 mg/L), suggesting that PHMB is pH-tolerant in the removal of anionic dyes at higher dosage. More interestingly, the addition of inorganic salts was found to enhance the flocculation performance of PHMB, particularly sodium chloride and sodium sulphate, which indicates that the flocculation performance of PHMB increases with increasing ionic strength, i.e., screening-enhanced effect. This suggests that PHMB possesses remarkable screening-enhanced effect which makes PHMB effectively overcome charge screening limitations, thereby reducing the dosages and cost of wastewater treatment. The preliminary study based on density functional theory and molecular simulations showed that the driving force lies in a weak-interaction-dependent mechanism, governed by hydrogen bonds and van der Waals forces.

Keywords: PHMB; Deby Screening; Screening-Enhanced Effect; Cationic Polyelectrolyte

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PCM3378

Enhancing PLA/PBAT Blends Properties with High Epoxy-functional Polymer as a Compatibilizer

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Abstract. In this work, a novel functional polymer with an abundance of epoxy groups (SMG) was tested as a compatibilizer to improve the compatibility of polylactic acid/1,4-butanediol terpolymer (PLA/PBAT) blends. The effect of additive dosage on the morphology, crystallization, and mechanical properties of PLA/PBAT blends was thoroughly investigated. The results showed that as little as 0.3 wt% of SMG could significantly improve the processability, compatibility, and mechanical properties of PLA/PBAT blends. In addition, SMG can be effectively applied to different ratios of PLA/PBAT blends to improve compatibility through in-situ reactions, thereby improving the strength and toughness of the blends. This modification processing technology is expected to facilitate the development and industrialization of biodegradable plastic materials based on PLA/PBAT blends.

Keywords: PBAT/PLA Blends; High Epoxy Groups Polymer; Compatibilizer; Chain Extender

PCM3392

Nanostructural Control of Block Copolymers Consisting of Fluorine-containing Block and Polyvinylpyrimidine

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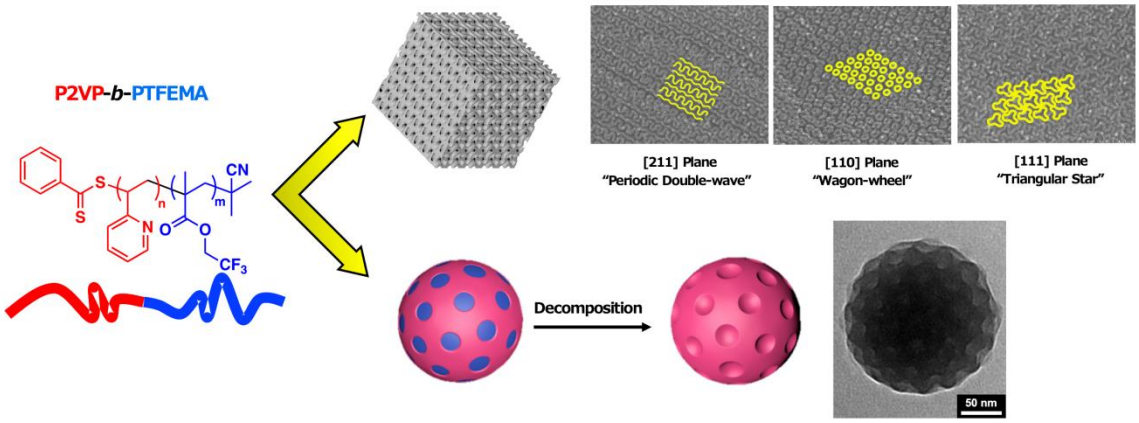
Abstract. With the rise of Ai technology, the demand for higher computing power has higher requirements for the refinement and customization of nanostructure fabrication techniques. One of the potential options to realize it is the bottom-up forming of nanostructures with different multivariate controllable nanostructures using block copolymers with microphase-separation. In this research, various controllable nanocomposite structures were prepared by focusing on block copolymers consisting of fluorine-based blocks and polyvinylpyrimidine-based blocks using different self-assembly techniques. Fluorine groups are mainly used to increase the interaction factor between the blocks of the block copolymer, which is beneficial for the fabrication of microphase-separated structures with higher isolation between the blocks. Poly(vinylpyrimidines) provide high resistance to electrostatic charges and remain structurally stable after electroetching, as it is also convenient for the coordination of a variety of metal ions. A variety of two-dimensional nanostructures, including rare double-gyroid structures, and three-dimensional porous nanospheres with pore diameters in the range of 15-25 nm were successfully fabricated by different self-assembly

techniques, which have promising applications in next-generation lithography, drug-loading, and organic photonic crystals, and so on.



Keywords: Fluorine-based Material; Block Copolymer; Confined Assembly; Nanopatterning; Porous Nanoparticle

Acknowledgements: This study was supported by NSF Jiangxi (Grant No. GJJ2200821), JST SPRING (Grant No. JPMJSP2106), Japan Science and TechnologyAgency (Grant No. 20H02785), and JSPS Kakenhi (Grant No.JP23KL0918).

PCM3393

Preparation and Electromagnetic Performance of Graphene Oxide/Polyaniline/Bamboo Composites as a Substitute for Conductive Plastics

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Abstract. Most conductive polymers, such as plastics, are difficult to degrade. With the continuous implementation of the policy of replacing plastic with bamboo, the development of biodegradable bamboo based conductive composite materials is of great significance. Bamboo timber was carbonized and further modified via an environmentally friendly synthesis process to prepare absorbing materials. Microwave absorption composites were prepared by in situ polymerization of (1R)-(−)-10-camphorsulfonic acid (L-CSA)-doped graphene oxide/polyaniline (GO/PANI layers) on the surface of the carbonized bamboo (CB). The conductivity of GO/PANI/CB reached 2.17±0.05 S/cm under the optimized process conditions. The chemical composition and morphology of GO/PANI/CB were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), scanning electron microscope (SEM), energy dispersive spectroscopy (EDS), and thermogravimetric analysis-differential scanning calorimetry (TGA-DSC). The GO/PANI particles covered the surface of the CB in the form of disordered aggregation by generating a CB encapsulation. The microwave absorption performance of GO/PANI/CB was investigated by using a vector network analyzer (VNA). The lowest reflection loss (RLmin) of GO/PANI/CB was -49.83 dB at 7.12 GHz with a thickness of 3.5 mm. The effective

absorption bandwidth (<-10 dB) was up to 4.72 GHz with a frequency range of 11.68-16.40 GHz and a thickness of 2 mm. Compared with PANI/CB, GO/PANI/CB offered improved microwave absorption performance while maintaining a high absorption bandwidth. GO/PANI/CB exhibited the advantages of easy preparation, low price, renewability, light texture, thin thickness, wide absorption band, and strong wave absorption capacity and can be a candidate for new microwave absorption composites.

Keywords: Bamboo; Polyaniline; Graphene Oxide; Microwave Absorption; Conductivity

Acknowledgements: The work was financially supported by the Zhejiang Provincial Science and Technology Project (Grant NO. 2024F1065-2).

PCM3408

Amino-silane Modified Zeolite Particles Blended into 6FDA-based Polyimides for Gas Separation

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Abstract. Polymer membrane is the most studied membrane material for gas separation, due to its advantages of low price, strong plasticity, easy processability and high reproducibility. However, the natural structure of the polymer membranes results in the trade-off between permeability and selectivity (Robeson upper bound line). Blending inorganic porous particles such as zeolite into the polymer could improve the separation performance of polymer membranes. The formed new type membranes are the so-called mixed matrix membranes (MMMs). The polyimide (PI) membranes exhibit the gas separation performance closest to the Robertson upper bound line among numerous polymer membranes. The pore size of CHA zeolite is 0.38 nm×0.38 nm. Hence, the CHA-PI MMMs have the potential for the gas separation of CO_2 (0.33 nm) and CH_4 (0.38 nm). However, the poor affinity between polymer and zeolite would result in the defects such as “sieve-in-a-cage”. It would reduce the gas selectivity of the MMMs.

In this study, commercial CHA zeolite particles were dispersed into the polyimides, which were made by the reaction of 4,4’- (hexafluoroisopropylidene)diphthalic anhydride (6FDA) with 2,6-diaminotoluene (mDAT), to prepare the MMMs for CO_2/CH_4 separation. The zeolite particles were modified by phenyl-3-amino-propyltrimethoxysilane (PhAPTMS) and other amino-silane coupling reagents to improve the affinity between zeolite particles and polymer matrix to reduce the defects of sieve-in-a-cages. The PhAPTMS amino-silane was effective on the improvement of separation performance of the CHA-PI MMMs in this study.

Keywords: Gas Separation; Mixed Matrix Membrane; Zeolite; Polyimide; Silane Coupling Reagent

PCM3359

Improved Breakdown Strength at High Temperatures Through Annealing of Syndiotactic

Polystyrene

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Abstract. The improvement of the breakdown strength of polymer films is an essential scientific and applied research topic for high-voltage electrical power applications. Here, syndiotactic polystyrene (sPS) is annealed at different temperatures above the glass transition temperature so as to achieve dielectric improvement in both breakdown strength and dielectric loss. The breakdown strength of the annealed film can be increased by about 19.6% at 120℃ compared with the original one. The dielectric loss is reduced by nearly 50% at high temperatures. It demonstrates a generalized phenomenon of annealing treatment of polymer films in facilitating further crystallization through chain packing or orientation, which limits the movement of charge carriers and polarization at high temperatures.

PCM3371

Optimization of Thermoplastic Composites Process Parameters Based on Robotic Fiber Placement

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Abstract. In robot-driven composite manufacturing, managing the temperature field is crucial for determining the strength of the molding. This paper presents a process simulation analysis of the temperature field during the robot placement of thermoplastic composite materials on curved surfaces. The paper establishes an optimized temperature field model for the lay-up process on curved surfaces. Innovatively considering the influence of different plys on the heating temperature, this model can calculate the optimal heating temperature parameters for various ply layers. A two-dimensional heat transfer model is created using APDL command flow in ANSYS, and the mesh is partitioned. Transient thermal analysis is then conducted utilizing the "birth and death" element technique. Analyzing the effects of mold temperature, robot placement speed, and heating temperature on the temperature field of the first ply helps to understand their impact on multiple plys in the placement of curved surfaces. This analysis provides insights into how these factors influence the overall process.

PCM3407

Molecular Composition of Isotropic High Softening Point Pitch by MALDI FT-ICR MS

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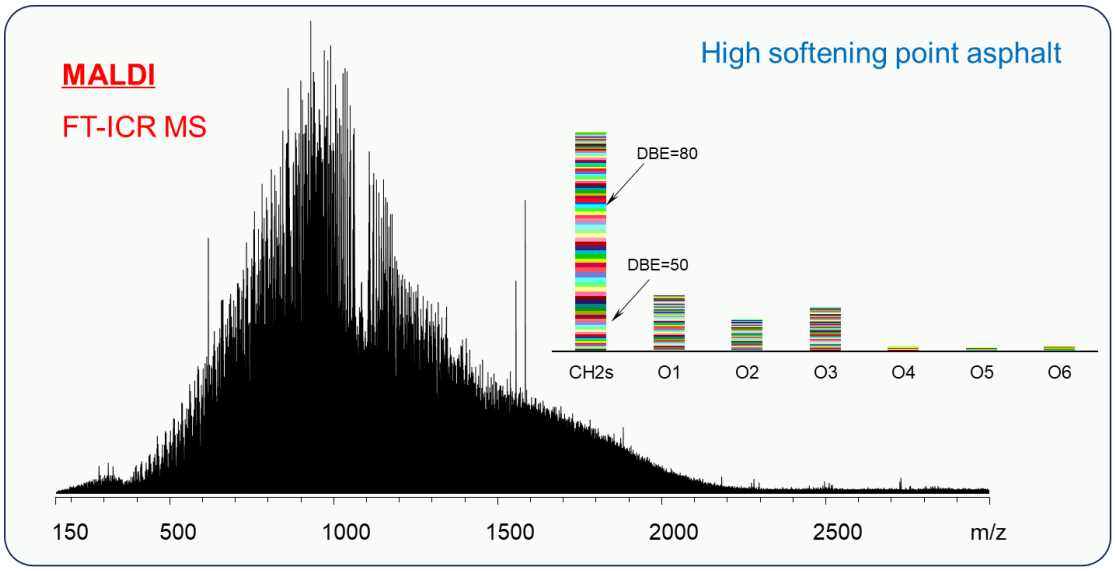
Abstract: High-performance pitches are extensively utilized in the production of high-performance carbon fibers and electrode materials. The high-softening point pitch derived from heavy petroleum sources, such as ethylene tar, through pre-oxidation and carbonization, is known for its superior performance. However, molecular-level characterization of these pitches remains insufficiently documented.

In this study, the isotropic high-softening point pitch was characterized using Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) equipped with a matrix-assisted laser desorption/ionization (MALDI) source. The molecular weight distribution was obtained, and the molecular composition distribution characteristics were analyzed with the ultra-high resolution of FT-ICR MS. Herein, the laboratory-made isotropic high-softening point pitch prepared from ethylene tar was used as the research object. The characterization results showed that hydrocarbons are still the most abundant molecules in the pitch. However, after pre-oxidation, it contains a considerable amount of oxygen-containing compounds. And it has a clear odd-even distribution, that is, compounds containing odd oxygen atoms are more abundant than compounds containing even oxygen atoms, which indicates that oxygen-containing bridge bonds play an important role in the cross-linking process. Our results show that MALDI FT-ICR MS technology provides a molecular-level characterization method for the technical upgrading of pitch preparation process.

Keywords: Molecular Composition; Isotropic High Softening Point Pitch; MALDI FT-ICR MS



Mass spectrum and relative abundance of detected compounds assigned from negative-ion MALDI FT-ICR of isotropic high softening point pitch

PCM3410

Composite Energetic Materials Constructed by Metal Nitrates and Nitro-substituted Polymers

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Abstract. Biphenyl-dichlorobenzyl homopolymers (Bhp) were synthesized using dichloroethane as the solvent, anhydrous ferric chloride as the catalyst. The best surface area of the polymers obtained is 3068 m2/g. By the nitration of Bhp with mixed sulfuric and nitric acids, the nitro-substituted polymers (NBhp) was synthesized and characterized by elemental analysis and IR spectra. Different kinds of transition metal (Fe, Co, Ni, Cu) nitrates were loaded on the NBhp by impregnation method. The thermal decompositions of the composite energetic materials (CEMs) have been carried out through DSC and TG-DTG analyzes at a heating rate of 10℃/min. The results indicate that the CEMs have high heat-resistant stability.

PCM3398

Photopyroelectric Techniques for Thermo-optical Characterization of SiO_2 Nano-spheres

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Abstract. In this work Photopyroelectric Techniques for thermal and optical characterization are introduced for measuring thermal diffusivity and optical absorption coefficient of colloidal suspensions of SiO_2. Thermal diffusivity and Optical absorption coefficients at 904 nm, 940 nm, 980 nm and 1550 nm were measured for spherical SiO_2 colloidal suspensions of 61 and 673 nm average size, in a range of 1 mg/mL to 26 mg/mL. It was found a linear increment of this optical property with SiO_2 nano-spheres concentration, which was not possible to obtain by means of absorbance measurements with conventional UV-Vis spectroscopy; in relation with thermal diffusivity it was found a slightly increment of this thermal property with increasing concentration, however this increment was not as large as the one reported for similar samples but using experimental techniques involving the optical properties of the samples. The direct measurement of optical absorption coefficients of colloidal suspensions allowed the knowledge of their absorptivity at the selected wavelengths. The presented methodology could be useful for measuring this optical property for colloidal suspensions in general at other wavelengths and as function of other variables of interest, such as size particle.

Keywords: Photopyroelectric Technique; Optical Absorption Coefficient; Thermal Difussivity; Silica Nanoparticles

PCM3355

The Effects of Different Curing Conditions on the Polypropylene Fibre Reinforcement Concrete

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Abstract. Due to technological advancements, the utilization of fibres and composites in improving the quality and serviceability of concrete structures has gained attention in recent years. Materials such as steel, glass and organic polymers have been used recently to produce short fibres deemed

suitable for use in concrete production due to their ability to improve slab durability and prevent cracks in concrete. However, information about their ability to function under different curing conditions is still limited. This research examines using synthetic polypropylene fibre (Sika-Fibre 408X) of length 40 mm in concrete by subjecting the concrete to four (4) different curing conditions. The curing conditions are ambient temperature, extreme heat of 165oC, extreme cold of -4oC and concrete cured under water temperature of 22oC. The control samples were prepared with no fibre while fibre concrete was made with 5% synthetic polypropylene fibre (Sika-Fibre 408X). Compressive and split tensile strength tests were performed on the samples after being cured under the said curing conditions for 14, 28 and 56 days. It was observed that the average compressive strength of fibre-reinforced concrete cured under the four various conditions for 14 days and 56 days is higher than the control sample. However, the result obtained at 28 days of curing for all the curing conditions is contrary. The maximum compressive strength of 45.51 MPa was obtained for fibre-reinforced concrete cured under water at 22oC for 56 days. Likewise, the split tensile test results showed that fibre-reinforced concrete has better strength as compared to plain concrete under the four curing conditions. Furthermore, fibre-reinforced concrete cured at the extreme cold of -4oC for 56 days has the highest tensile strength of 2.93 MPa. However, for both the plain and fibre-reinforced concrete, irrespective of the curing condition and duration, the minimum compressive strength obtained for this research surpasses the compressive strength minimum requirement of 20 MPa for cubic concrete according to the SANS 5863:2006.

Keywords: Concrete; Compressive Strength; Curing Conditions; Fibre-Reinforced Concrete; Polypropylene Fibre; Split Tensile Strength

Part IX Acknowledgements

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