SMSE SISED ICCST

SMSE

SISED
International Symposium on
Intelligent System, Electronic and Optical Devices

The 3rd World Symposium on Materials Sciences and Engineering
The 2nd World Symposium on Intelligent System and Electronic Devices
The 2nd International Conference on Catalysis, Chemical Science and Technology

Time: Nov. 5th-8th, 2024

Place: Hilton Nagoya, Japan

Format: Hybrid

Conference Book

SMSE 2025

SMSE

The 4th World Symposium on Materials Sciences and Engineering

Singapore
2025
Dec. 2-4 (Tue-Thu)

Main Topics

3D Materials and Printing Technology
Advanced Materials
Advanced Metals and Alloys
Biomaterials and Biomedical Manufacturing
Carbon Nanotubes and Graphene
Composite Materials and Fiber Composites
Electronic Materials and Applications
Energy Storage and Conversion Materials
Functional Materials for Specific Applications
Intelligent Materials and Intelligent Systems
Materials Engineering and Sustainability
Materials for Architecture and Civil Engineering
Materials Property and Characterization
Nanomaterials and Nanotechnology
Optoelectronic Materials and Engineering
Plenary Forum
Polymer Materials and Science
Smart Sensors

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The 3rd World Symposium on Materials Sciences and Engineering

The 2nd World Symposium on Intelligent System and Electronic Devices

The 2nd International Conference on Catalysis, Chemical Science and Technology

Time: Nov. 5th-8th, 2024

Place: Hilton Nagoya, Japan

Check Conference Photos: Scan the QR Code after the Conference Date

SMSE 2024

SISED 2024

ICCST 2024

Committee

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Welcome Remark

Dear Friends and Colleagues,

On behalf of the organizing committee, we warmly welcome you to join in the 3rd World Symposium on Materials Sciences and Engineering (SMSE-2024), the 2nd World Symposium on Intelligent System and Electronic Devices (SISED-2024), and the 2nd International Conference on Catalysis, Chemical Science and Technology (ICCST-2024), which are held during Nov. 5th-8th in Hilton Nagoya (Japan) with hybrid format.

SMSE 2024 and SISED 2024 include plenary forum, 7 breakout streams, as well as poster exhibition in the three-day scientific program. The topics will focus on Nanomaterials and Nanotechnology; Materials Property, Characterization and Optimization; Electronic Materials and Optoelectronic Engineering; Biomaterials and Biomedical Manufacturing; Materials for Architecture and Civil Engineering; Intelligent Systems and Applications, etc.

ICCST 2024 includes plenary forum, 4 breakout streams, as well as poster exhibition in the three-day scientific program. The topics will focus on Chemical Mechanisms and Engineering; Cutting-edge Research of Catalysis; Energy Conversion, Electrocatalysis and Sustainable Chemistry; Medicinal Chemistry, etc.

Each conference brings together the best professionals and scientists from universities, research institutes and industries worldwide to share exciting results and to build new collaborations. We hope you can join your peers in a highly interesting and engaging hybrid event with online and offline. Your presence and deliberation will make this event remarkably successful.

Organizing Committee of SMSE-2024 & SISED-2024 & ICCST-2024

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Posters of ICCST

Profile

Mr. Chenjia Liang

Schedule of SMSE-2024 & SISED-2024 & ICCST-2024

Time: Nov. 5th-8th, 2024

Venue: Hilton Nagoya, Japan

Day 1, Nov. 5th, 2024 (Tuesday), Time Zone: GMT+9

Time	Sessions
Morning Session	
09:00 - 11:35	Hybrid Session: Plenary Forum of SMSE & SISED (Room Fuji, 4F, Hilton Nagoya)
Afternoon Session	
13:30 - 15:15	SMSE Hybrid Session: Electronic Materials and Optoelectronic Engineering (Room Fuji, 4F, Hilton Nagoya)
15:30 - 16:50	SMSE Hybrid Session: Nanomaterials and Nanotechnology (Room Fuji, 4F, Hilton Nagoya)

Day 2, Nov. 6th, 2024 (Wednesday), Time Zone: GMT+9

Time	Sessions
Morning Session	
09:00 - 10:05	ICCST Hybrid Session: Plenary Forum of ICCST (Room Fuji, 4F, Hilton Nagoya)
10:20 - 11:40	SMSE Hybrid Session: Materials Property, Characterization and Optimization (Room Fuji, 4F, Hilton Nagoya)
Afternoon Session	
13:00 - 14:20	SISED Hybrid Session: Intelligent Systems and Applications (Part 1) (Room Fuji, 4F, Hilton Nagoya)
14:35 - 16:45	ICCST Hybrid Session: Chemical Mechanisms and Engineering (Room Fuji, 4F, Hilton Nagoya)

Day 3, Nov. 7th, 2024 (Thursday), Time Zone: GMT+9

Time	Sessions
Morning Session	
09:00 - 10:20	SMSE Hybrid Session: Biomaterials and Biomedical Manufacturing (Room Fuji, 4F, Hilton Nagoya)
10:35 - 12:10	SISED Hybrid Session: Intelligent Systems and Applications (Part 2) (Room Fuji, 4F, Hilton Nagoya)

Afternoon Session	
13:30 - 14:25	SMSE Hybrid Session: Materials for Architecture and Civil Engineering (Room Fuji, 4F, Hilton Nagoya)
14:40 - 15:35	ICCST Hybrid Session: Cutting-edge Research of Catalysis (Room Fuji, 4F, Hilton Nagoya)

Day 4, Nov. 8th, 2024 (Friday), Time Zone: GMT+9

Time	**Sessions**
Morning Session	
09:00 - 10:20	ICCST Hybrid Session: Energy Conversion, Electrocatalysis and Sustainable Chemistry (Room Fuji, 4F, Hilton Nagoya)
10:35 - 11:55	ICCST Hybrid Session: Medicinal Chemistry (Room Fuji, 4F, Hilton Nagoya)

Program

Time: Nov. 5th-8th, 2024
Venue: Hilton Nagoya, Japan

Hybrid Session: Plenary Forum of SMSE & SISED

On-site Moderator: **Dr. Thomas Geiger,** Senior Scientist, Empa - Swiss Federal Laboratories for Materials Science and Technology, Laboratory Cellulose and Wood Materials, Switzerland

Online Moderator: **Dr. Zack Buck,** Staff Physicist, National Institute of Standards and Technology, USA

Time: 09:00-11:35 (Morning), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
09:00-09:05	Moderator's Introduction
09:05-09:35	**Title:** Transforming Carbon Industry by Configuring Nano Functionalities **Dr. Mohini Sain,** Professor, Mechanical Engineering; Director, Centre for Biocomposites and Biomaterials Processing; Ford PERDC Chair in Sustainable Materials, Department of Mechanical & Industrial Engineering, University of Toronto, Canada
09:35-10:05	**Online Speech:** Ferroelectric Topology Rout to Nanoelectronics: Negative Capacitance **Dr. Valerii Vinokur,** Chief Technology Officer US, Terra Quantum AG, Switzerland
10:05-10:35	**Online Speech:** Trustworthy AI Aiding Clinical Diagnosis in Real World **Dr. Qin Zhang,** Professor of Institute of Nuclear and New Energy Technology and Department of Computer Science and Technology, Tsinghua University, China
10:35-11:05	**Online Speech:** 2D Materials for Electronics: Computing, Sensing, and Beyond **Dr. Bin Yu,** Director of FSRI and Distinguished Professor, Zhejiang University, China
11:05-11:35	**Online Speech:** Effects of Tensile Loading in Air and in Hydrogen on 4130 Steel Microstructure **Dr. Zack Buck,** Staff Physicist, National Institute of Standards and Technology, USA

SMSE Hybrid Session: Electronic Materials and Optoelectronic Engineering

Chaired by **Dr. Tai Fei,** Interim Professor of Computer Vision and Robotics, Dortmund University of Applied Sciences and Arts, Germany

Time: 13:30-15:15 (Afternoon), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters

13:30-13:35	Chair's Introduction
13:35-14:00	**Online Speech:** Design and Development of Magnetic Field Gradient Detection Sensor Using Piezoelectric and Magnetoelectric Materials **Dr. Vishwas N. Bedekar,** Associate Professor, Department of Engineering Technology, Middle Tennessee State University, USA
14:00-14:25	**Online Speech:** Interference Mitigation in Automotive Radar: Current Techniques, Comparative Analysis, and Future Trends **Dr. Tai Fei,** Interim Professor of Computer Vision and Robotics, Dortmund University of Applied Sciences and Arts, Germany
14:25-14:50	**Title:** Investigations of Charge-Transfer Plasmons in Different Systems **Dr. Aleksandr Fedorov,** Senior Research Fellow, Kirensky Institute of Physics, Federal Research Center KSC Siberian Branch Russian Academy of Sciences, Russia
14:50-15:15	**Online Speech:** Ferroelectric-defined Reconfigurable Photodetectors for In-memory Sensing and Computing **Dr. Guangjian Wu,** Researcher, Fudan University, China
15:15-15:30	**Coffee Break**

SMSE Hybrid Session: Nanomaterials and Nanotechnology

Chaired by **Dr. Hung-Wing Li,** Associate Professor, Department of Chemistry, The Chinese University of Hong Kong, Hong Kong, China

Time: 15:30-16:50 (Afternoon), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	**Presentations and Presenters**
15:30-15:35	Chair's Introduction
15:35-16:00	**Title:** Highly Porous and High-Density Structures of Cellulose Nanofibrils and Their Applications **Dr. Thomas Geiger,** Senior Scientist, Empa - Swiss Federal Laboratories for Materials Science and Technology, Laboratory Cellulose and Wood Materials, Switzerland
16:00-16:25	**Title:** Hybrid Membrane-coated Nanomotor for Immunotherapy and Chemotherapy of Breast Cancer **Dr. Hung-Wing Li,** Associate Professor, Department of Chemistry, The Chinese University of Hong Kong, Hong Kong, China
16:25-16:50	**Title:** The Effect and Application of PEG Antibody in Nanomedicine **Dr. Zui Zhang,** Associate Professor, Department of Pharmacy, School of Basic Medical Sciences, Fudan University, China

ICCST Hybrid Session: Plenary Forum of ICCST

Chaired by **Dr. Shunli Wang**, Professor, Inner Mongolia University of Technology, China

Time: 09:00-10:05 (Morning), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
09:00-09:05	Chair's Introduction
09:05-09:35	**Online Speech:** The Neuroanatomical Crosstalk Network Topology Mapping of Brain Aging **Dr. Rongling Wu,** Researcher, Beijing Institute of Mathematical Science and Applications, China **Dr. Shing-Tung Yau,** Professor, Dean of Qiuzhen College, Tsinghua University, China
09:35-10:05	**Online Speech:** Smart Energy Storage System Safety Monitoring and Mangement with Industrial Application **Dr. Shunli Wang,** Professor, Inner Mongolia University of Technology, China
10:05-10:20	**Coffee Break**

SMSE Hybrid Session: Materials Property, Characterization and Optimization

Chaired by **Dr. Pierre Jousset,** Professor at the OST, Eastern Switzerland University of Applied Sciences, Switzerland

Time: 10:20-11:40 (Morning), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
10:20-10:25	Chair's Introduction
10:25-10:50	**Title:** Development of a New Method for the Design and Optimization of Laser-Welded Plastic Components **Dr. Pierre Jousset,** Professor at the OST, Eastern Switzerland University of Applied Sciences, Switzerland
10:50-11:15	**Online Speech:** Light-Weight Lattice Structures: Manufacturability, Testing for Property, and Design for Protective Applications **Dr. Mohammad Reza Vaziri Sereshk,** Assistant Professor, Department of Engineering, Central Connecticut State University, USA
11:15-11:40	**Title:** Electrochemical and Mechanical Characterization of Waste Biomass-Based Activated Carbon Coated Carbon Fiber Fabrics for Potential Applications in Structural Supercapacitors **Dr. Isil Gurten Inal,** Assistant Professor, Department of Chemical Engineering, Faculty of Engineering, Ankara University, Turkey

SISED Hybrid Session: Intelligent Systems and Applications (Part 1)

Chaired by **Dr. Souad Bezzaoucha Rebai,** Associate Professor, EIGSI - La Rochelle, France

Time: 13:00-14:20 (Afternoon), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
13:00-13:05	Chair's Introduction
13:05-13:30	**Online Speech:** Advanced Control and Observer Design via LMIs **Dr. Souad Bezzaoucha Rebai,** Associate Professor, EIGSI - La Rochelle, France
13:30-13:55	**Online Speech:** Development of Extended Reality-based Invasive Medical Procedure Training Platform **Dr. Kai-Sheng Hsieh,** Professor, China Medical University Children's Hospital, Taiwan
13:55-14:20	**Online Speech:** Optimal Metaheuristic State-Dependent Parameter Proportional-Integral-Plus Control: Alternative to Gain-Scheduled Controller for Control of a Nonlinear Continuous Stirred Tank Reactor **Dr. Behrouz Kiani Talaei,** Chemical Engineer, University of Sistan and Baluchestan, Iran
14:20-14:35	**Coffee Break**

ICCST Hybrid Session: Chemical Mechanisms and Engineering

Chaired by **Dr. Akira Naito,** Emeritus Professor, Yokohama National University, Japan

Time: 14:35-16:45 (Afternoon), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
14:35-14:40	Chair's Introduction
14:40-15:05	**Title:** Thermal and Nonthermal Microwave Effects of Ethanol and Hexane-Mixed Solution as Revealed by In Situ Microwave Irradiation Nuclear Magnetic Resonance Spectroscopy **Dr. Akira Naito,** Emeritus Professor, Yokohama National University, Japan
15:05-15:30	**Title:** Variation of Physical Properties Across the Mineralogical System: Data, Results, Takeaways **Dr. Milan Rieder,** Professor, VSB-Technical University Ostrava, Czech Republic
15:30-15:55	**Title:** Possibility of Metallofoldamer as a Cross-Linked Reagent for Polymeric Material **Dr. Hiroto Achira,** Chief Researcher, Hyogo Prefectural Institute of Technology, Japan
15:55-16:20	**Title:** Measurements of Thermodynamic Properties and Activity Coefficients at Infinite Dilution of Selected Organic Solutes and Water in a Deep Eutectic Solvent (Choline Chloride + 1,3 Propanediol) **Dr. Peterson Thokozani Ngema,** Senior Lecturer, the Durban University of Technology, South Africa

16:20-16:45	**Online Speech:** Chemical and Opto-Mechanical Kinetics of $CaCO_3$ at a Single-Particle Level **Dr. Andrei Ushkov,** Senior Researcher, Moscow Center for Advanced Studies, Russia

SMSE Hybrid Session: Biomaterials and Biomedical Manufacturing

Chaired by **Dr. Yongmei Chen,** Professor, College of Bioresources Chemical and Materials Engineering, Shaanxi University of Science & Technology, China

Time: 09:00-10:20 (Morning), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
09:00-09:05	Chair's Introduction
09:05-09:30	**Online Speech:** The Development of a Support Matrix as a New Option for the Tissue Regeneration of Mastectomized Women **Dr. Rosa Alicia Saucedo Acuna,** Professor, Institute of Biomedical Sciences, Autonomous University of Ciudad Juarez, Mexico
09:30-09:55	**Title:** Polysaccharide-Based Injectable and Self-Healing Hydrogels with Multiple Functions **Dr. Yongmei Chen,** Professor, College of Bioresources Chemical and Materials Engineering, Shaanxi University of Science & Technology, China
09:55-10:20	**Title:** Clinical Applications of Biopolymers in Neurosurgery: The in vivo Cranial Bone Reconstruction **Dr. Tomaz Velnar,** Doctor, Department of Neurosurgery, University Medical Centre Ljubljana, Slovenia
10:20-10:35	**Coffee Break**

SISED Hybrid Session: Intelligent Systems and Applications (Part 2)

Chaired by **Dr. Yunxia Zhang,** Lecturer, Shaanxi University of Science & Technology, China

Time: 10:35-12:10 (Morning), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
10:35-10:40	Chair's Introduction
10:40-11:05	**Title:** Tough, Rapid Self-Recovery and Responsive Organogel-Based Ionotronic for Intelligent Continuous Passive Motion System **Dr. Yongmei Chen,** Professor, College of Bioresources Chemical and Materials Engineering, Shaanxi University of Science & Technology, China
11:05-11:30	**Online Speech:** Intelligent Modulation Recognition for Communication Signals Based on Hybrid Artificial Features **Dr. Hui Chen,** Associate Professor, University of Electronic Science and Technology of China, China

11:30-11:55	**Title:** Blind Image Super-Resolution Using Dual-Camera Capture and Deep Learning Registration **Dr. Arnaud Pauwelyn**, Engineer, NT2I, France
11:55-12:10	**Title:** Nanocatalysts Induced Self-Triggering Leather Skin for Human–Machine Interaction **Dr. Yunxia Zhang,** Lecturer, Shaanxi University of Science & Technology, China

SMSE Hybrid Session: Materials for Architecture and Civil Engineering

Time: 13:30-14:25 (Afternoon), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
13:30-13:35	Chair's Introduction
13:35-14:00	**Title:** An Investigation of Rut Performance on Permeable Road Pavement **Mr. Chung-Lin Lin,** General Manager, Yu Chen Construction Consultant Co., Ltd.; National Pingtung University of Science and Technology, Taiwan
14:00-14:25	**Online Speech:** Electromigration of Nanosilica as a New Technology for Concrete Retrofitting, Results and Expectations **Dr. Fausto B. Mendonca,** Postdoctoral Researcher, Technological Institute of Aeronautics - ITA, Brazil
14:25-14:40	**Coffee Break**

ICCST Hybrid Session: Cutting-edge Research of Catalysis

Time: 14:40-15:35 (Afternoon), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
14:40-14:45	Chair's Introduction
14:45-15:10	**Online Speech:** Single Atom Co-Catalysts in Photocatalytic H_2 Generation: Maximizing SA Stability and Efficiency **Dr. Patrik Schmuki,** Professor, FAU University of Erlangen, Germany
15:10-15:35	**Online Speech:** Function-oriented Bifunctional Mg & MoP Modified Polymeric Carbon Nitride for Selective Photoreduction of CO_2 to CH_4 **Dr. Junying Tang,** Assistant Professor, School of Energy and Power Engineering, University of Shanghai for Science and Technology, China

ICCST Hybrid Session: Energy Conversion, Electrocatalysis and Sustainable Chemistry

Chaired by **Dr. Kanta Ogawa,** Postdoctoral Research Fellow, Tokyo Institute of Technology, Japan

Time: 09:00-10:20 (Morning), Nov. 8th, 2024 (Friday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
09:00-09:05	Chair's Introduction
09:05-09:30	**Title:** Multi-hierarchy Design Strategy of Electrocatalysts for DMFCs **Mr. Chenjia Liang,** Nanjing University, China **Dr. Weiping Ding,** Professor, Nanjing University, China
09:30-09:55	**Title:** Band Gap Narrowing by Suppressed Lone-Pair Activity of Bi^{3+} **Dr. Kanta Ogawa,** Postdoctoral Research Fellow, Tokyo Institute of Technology, Japan
09:55-10:20	**Title:** Eco-Friendly Green Synthesis of Co^{2+} and Mn^{2+} ion Doped ZnO Nanoparticles for Silicon Solar cell Applications **Dr. Shelan M. Mustafa,** Lecturer, Erbil Polytechnic University, Iraq
10:20-10:35	**Coffee Break**

ICCST Hybrid Session: Medicinal Chemistry

Chaired by **Dr. Dae Dong Sung,** Professor, Korea University, Samse Medical Center, Republic of Korea

Time: 10:35-11:55 (Morning), Nov. 8th, 2024 (Friday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Time	Presentations and Presenters
10:35-10:40	Chair's Introduction
10:40-11:05	**Title:** Application of Nucleophilic Substitution Reaction Mechanism of Aniline Derivatives to Biomedicine Developments **Dr. Dae Dong Sung,** Professor, Korea University, Samse Medical Center, Republic of Korea
11:05-11:30	**Title:** Development of Efficient Glycosides Synthesis Strategies and Application for Drug Discovery **Dr. Jiang Wang,** Researcher, Lin Gang Laboratory, China
11:30-11:55	**Title:** Stereoselective Synthesis of the Novel Anti-Influenza Medicine: Baloxavir Marboxil using Photocatalyst **Dr. Kazuya Okamoto,** Manager, Shionogi Pharma & Co., Ltd., Japan

Hybrid Session: Plenary Forum of SMSE & SISED

On-site Moderator: **Dr. Thomas Geiger,** Senior Scientist, Empa - Swiss Federal Laboratories for Materials Science and Technology, Laboratory Cellulose and Wood Materials, Switzerland
Online Moderator: **Dr. Zack Buck,** Staff Physicist, National Institute of Standards and Technology, USA

Time: 09:00-11:35 (Morning), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time
Place: Room Fuji, 4F, Hilton Nagoya

Moderators

On-site Moderator

Dr. Thomas Geiger, Senior Scientist, Empa - Swiss Federal Laboratories for Materials Science and Technology, Laboratory Cellulose and Wood Materials, Switzerland

Thomas Geiger works at Empa, Dübendorf, Switzerland, in the Cellulose & Wood Materials Laboratory. He received his diploma in 1995 and his Ph.D. in 1998 from the Johannes Gutenberg University, Mainz, Germany. In 1998 he joined Empa's Laboratory for Corrosion and Surface Protection. From 2003 to 2015 he was Group Leader at Empa's Laboratory for Functional Polymers. His research interests lie in the development, synthesis and characterization of functional materials based on cellulose as well as other biomasses. He is involved in several development projects for multifunctional sustainable bio-composites for industrial applications.

Online Moderator

Dr. Zack Buck, Staff Physicist, National Institute of Standards and Technology, USA

Dr. Zachary Buck received his Ph.D. in condensed matter physics with an emphasis in neutron scattering from the University of Missouri - Columbia in 2018. He has since completed two postdoctoral research appointments, one at the China Spallation Neutron Source, and the other as a National Research Council Postdoc at the National Institute of Standards and Technology (NIST). Zack is now a Staff Physicist at NIST's fatigue and fracture group investigating hydrogen-assisted failure mechanisms in steel and pipeline welds.

Title: Transforming Carbon Industry by Configuring Nano Functionalities

Mohini Sain*, Viktoriya Pakharenko, Jimi Tjong, Vijay Kumar, and Otavio Dias
Professor and Director
Centre for Biocomposites and Biomaterials Processing
University of Toronto
Canada

Abstract

The novel development of multi-functional materials continues to be one of the most difficult problems to solve, not only because of the size of the functional materials that need to be explored but also because each application targeted for innovative desired applications. Discovery of new functional materials with enhanced properties provides an opportunity to meet the growing demand for various sectors from energy to medical applications. Explorations of new pathways gave an opportunity to identify unique nanoscale structures, morphological features and atomistic changes resulting in reactivity of components. The biotransformation process turns natural materials into promising isolated compounds. These compounds have been studied as important building blocks of natural substances that can be used to prevent certain types of cell damage and important components of therapy. The structural peculiarities of the material during the reactivity of components tend to geometrical transformations based on dihedral and angles energy. The structural geometry of nanoscale materials and their atomistic transformations play an important role in the production of multifunctional composites from new materials ranging from energy systems to medical devices.

Biography

Dr. M. Sain, Former Dean of University of Toronto and a Fellow of Royal Society of Canada and Professor and PERDC FORD Motor Canada Endowed Chair at the University of Toronto with extensive experience in biological, nanocellulose materials, composites, electronics. He is currently a Professor at the Department of Mechanical and Industrial Engineering and Director of the Center for Biocomposites and Biomaterials Processing at the University of Toronto, Canada. Professor Sain is Founding Director of CBBP Centre in Sustainable Materials for the past 22 years due to his reputation for scientific excellence in the worldwide auto industry. He has contributed to the development of innovative product designs and more than 75 technology transfers to other industries, including advancements in biomedical devices, packaging options, flexible electronics, and building and transportation materials. Together with other top-tier industry partners, including Ford Motor, Hutchinson Canada, and TOTAL North America, he has also created and patented novel technology. He is a Hi-Cited Professor and has H-index 83 and google citation over 38,000.

Title: Ferroelectric Topology Rout to Nanoelectronics: Negative Capacitance

I. Lukyanchuk[1], Y. Tikhonov[2], S. Kondovich[3], A. Razumnaya[4], and V. M. Vinokur[5]*

1 Professor, Dr., University of Picardie, Laboratory of Condensed Matter Physics, France

2 Mr., University of Picardie, Laboratory of Condensed Matter Physics, France

3 Dr., Institute for Theoretical Solid State Physics, IFW Dresden, Germany

4 Professor, Jožef Stefan Institute, Slovenia

5 Professor, Dr., Chief Technology Officer US, Terra Quantum AG, Switzerland

Abstract

Ferroelectrics forming complex topological patterns carrying tunable electric polarization provide a novel platform for information storage devices. Existing ferroelectric memory cells utilize a two-level storage capacity carrying standard binary logic that reached its fundamental limitations. We propose ferroelectric multibit cells carrying multistable states of polarization that are symmetry-protected against information loss and realize novel topologically controlled access memory, enabling novel neuromorphic functionalities. Multiple nanodots disposed between two electrodes and coated by the dielectric material realize topologically configurable non-binary logic [1]. Controlling the charge of the gate provides various topological switching routes between different polarization configurations achieved by variations of external fields and temperature. The ferroelectric multilevel devices implement novel topologically controlled discrete synaptic states in neuromorphic computing enabling a platform for many-valued, non-Boolean information technology targeting challenges posed by quantum and neuromorphic computing needs [2].

Keywords: ferroelectrics, multilevel logic, non-von Neumann computing, field-effect transistor

References:

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Biography

From 1972, Valerii Vinokur worked for the Institute of Solid State Physics Academy of Sciences of the USSR. From September 1990 to December 2020, he worked at the U.S. Department of Energy's Argonne National Laboratory, focusing his research on solid state physics, nonequilibrium physics of disordered and dissipative systems, and superconductivity. In January 2021, he joined Terra Quantum AG as Chief Technology Officer. Valerii Vinokur oversees the Terra Quantum project hardware portfolio with a lead on developing topological quantum matter and superconductivity. Valerii is an Adjunct Professor at the City College of the City University of New York since February 2021. Valerii Vinokur is a Foreign Member of the National Norwegian Academy of Science and Letters and a Fellow of the American Physical Society. Valerii's scientific achievements have been acknowledged numerous times, especially, by one of the most prestigious prizes in physics, the Fritz London Memorial Prize, in 2020.

Title: Trustworthy AI Aiding Clinical Diagnosis in Real World

Qin Zhang
Professor
Institute of Nuclear and New Energy Technology and Department of Computer Science and Technology
Tsinghua University
China

Abstract

Medical AI needs to be trustable. However, the current AI such as Deep Learning and Large Language Models is black-box without explainability. DUCG (Dynamic Uncertain Causality Graph) is a newly developed trustworthy medical AI for clinical diagnosis in general practice and beyond. It graphically represents the medical knowledge and makes probabilistic reasoning with explainability, transparency and inherent invariance in different application scenarios. It is causality-driven instead of data-driven, so that it does not have problems such as data collecting, labeling, training, hallucination, generalization, privacy, bias, high cost and high energy consumption, etc. Cooperated with clinical experts deeply, 54 chief complaint models covering more than 1,500 diseases have been constructed, retrospectively verified by third-party high-grade hospitals and applied in the real-world in China. The verified diagnostic precisions of the 54 models are no less than 95%, in which the precision for every disease including the uncommon one is no less that 80%. More than 2 million real diagnosis cases have been performed, in which the prospective study was executed to some extent. Only 17 cases have been identified as wrong. The mistakes in DUCG were found and corrected. Same mistakes have no longer been reported. Statistics show that DUCG can improve the ability of general practitioners to diagnose diseases several times more than without DUCG. The 54 chief complaints are: cough sputum, dyspnea, abdominal pain, diarrhea, hematemesis, nasal congestion, nasal bleeding, blood in the stool, nausea and vomiting, joint pain, hemoptysis, fever, chest pain, jaundice, anemia, edema, obesity, emaciation, sore throat, palpitation, fever in children, dizziness, headache, constipation, rash, difficulty swallowing, enlargement of lymph nodes, cyanosis, limb numbness, vaginal bleeding, abnormal vaginal discharge, pruritus vulvae, reduced menstruation or amenorrhea, abdominal distension, syncopation, tinnitus, deafness, earache, acid reflux, heartburn, hiccup, belching, mass, oliguria or no uria, lower urinary tract symptoms (frequent urination, urgency of urination, pain in urine, dysuria, polyuria, gross hematuria, and urine leakage), neck and low back pain (neck pain, waist pain and back pain).

Keywords: Trustworthy AI, Causality, Diagnosis, Explainability, Probabilistic Reasoning

Reference:

Zhan Zhang, Qin Zhang, et al. Methodology and real-world applications of dynamic uncertain causality graph for clinical diagnosis with explainability and invariance, Artificial Intelligence Review, (2024) 57:151, DOI: 10.1007/s10462-024-10763-w.

Biography

Qin Zhang graduated from Tsinghua University, Beijing, China, with B.S., M.S. and Ph.D. Degrees in nuclear engineering in 1982, 1984 and 1989 respectively. He was a Visiting Scholar with University of Tennessee, Knoxville, TN, USA, and University of California, Los Angeles, CA, USA, from 1987 to1989, working on system reliability engineering and intelligent fault diagnoses. He is a Professor of Institute of Nuclear and New Energy Technology and Department of Computer Science and Technology, Tsinghua University, Emeritus Member of China Association for Science and Technology, Member of International Nuclear Energy Academy, Fellow of China Association for Artificial Intelligence (CAAI) and Director of the specialized committee for causality and uncertainty in AI of CAAI, Consultant of the specialized committee for wise medical care of CAAI, Chief Scientist of Beijing Yutong Intelligence Technology, Ltd. He originally developed a new AI model called Dynamic Uncertain Causality Graph for fault diagnoses and disease diagnoses.

Title: 2D Materials for Electronics: Computing, Sensing, and Beyond

Bin Yu
Fellow of IEEE and Fellow of NAI
Director of FSRI and Distinguished Professor
Zhejiang University
China

Abstract

Discovered twenty years ago, graphene and its derivative materials have received significant amount of interests from both academia and industry. These emerging 2D nanostructures and their heterosystems exhibit unique electrical, optical, and mechanical properties, attributed to their distinctive atomically-thin physical configurations, band structures, and quantum phenomena. The atomically-thin nanosheets could be potentially assembled by the common thin-film techniques. While graphene has been explored as both active and passive elements in the imaginary “all-carbon electronics”, its gap-less nature implies fundamental limits that promote innovations in novel device principle and material engineering. This talk will introduce the research in material preparation and device demonstration for various applications, including post-silicon logic device, non-volatile memory, interconnects, photodetectors, and artificial neurons and synapses, based on emerging 2D materials. Major challenges and near-future research opportunities in the respective fields will be also highlighted.
Keywords: nanoelectronics, post-Moore device, nanosensor, 2D materials

Biography

Dr. Yu is Fellow of IEEE and Fellow of National Academy of Inventors. He is Director of FSRI and Distinguished Professor at Zhejiang University with research field in nanoelectronics and nanomaterials. Specific interests include brain-inspired computing, post-Moore electronic devices, nanosensors, and other emerging technology. He has authored/co-authored 8 book/book chapters, 300+ research papers, and was the speaker of 200+ invited speeches around the world. A prolific inventors in nanotechnology, he has more than 300 international patents. Dr. Yu is/was Executive Co-Chair of CSTC, Consulting Professor at Stanford University, and served on invited panels and advisory/organizing committees of 50+ international conferences. He was Editor of IEEE Electron Devices Letters, Associated Editor of IEEE Transactions on Nanotechnology, Editor of Nano-Micro Letters, and Guest Editor of IEEE Transactions on Electron Devices and IEEE Transactions on Nanotechnology. Dr. Yu received Ph.D. degree from University of California at Berkeley.

Title: Effects of Tensile Loading in Air and in Hydrogen on 4130 Steel Microstructure

Zachary N. Buck[1]*, May L. Martin[1], Jason Killgore[1], Damian Lauria[2], Peter Bradley[1], Yan Chen[3], Ke An[3], and Matthew J. Connolly[1]

1 Applied Chemical and Materials Division, NIST - Boulder, USA

2 Office of Information Systems, NIST - Boulder, USA

3 Neutron Scattering Division, Oak Ridge National Laboratory, USA

Abstract

Understanding hydrogen-assisted failure mechanisms and the effects of deformation on ferritic steels is of great interest, particularly as it relates to pipeline infrastructure, hydrogen storage vessels, and the energy sector. Interrupted tensile tests performed at the National Institute of Standards and Technology on an AISI 4130 steel in air and gaseous hydrogen reveal interesting changes to the microstructure. Analysis of neutron diffraction patterns collected from interrupted tensile tests of 4130 suggest a partitioning of BCC and BCT phases as a function of applied strain and hydrogen pressure. Dislocation densities of the two phases were extracted by analyzing the broadening of their Bragg peaks using a Williamson-Hall approach, which do not appear to be dependent on hydrogen. However, neutron diffraction results reveal a loss in tetragonality of the BCT phase when 4130 samples were strained in air; but this effect appears to be suppressed when deformation occurs in hydrogen. Electron Backscatter Diffraction (EBSD) and Scanning Kelvin Probe Force Microscopy (SKPFM) were used to characterize the microstructure associated at specific applied strains. These results agree well with those obtained from neutron diffraction and demonstrate the utility of SKPFM to distinguish similar crystal structures that may be difficult to detect using conventional methods.

Keywords: hydrogen embrittlement, neutron diffraction, Kelvin Probe Microscopy

Biography

Dr. Zachary Buck received his Ph.D. in condensed matter physics with an emphasis in neutron scattering from the University of Missouri - Columbia in 2018. He has since completed two postdoctoral research appointments, one at the China Spallation Neutron Source, and the other as a National Research Council Postdoc at the National Institute of Standards and Technology (NIST). Zack is now a Staff Physicist at NIST's fatigue and fracture group investigating hydrogen-assisted failure mechanisms in steel and pipeline welds.

SMSE Hybrid Session: Electronic Materials and Optoelectronic Engineering

Chaired by **Dr. Tai Fei,** Interim Professor of Computer Vision and Robotics, Dortmund University of Applied Sciences and Arts, Germany

Time: 13:30-15:15 (Afternoon), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Design and Development of Magnetic Field Gradient Detection Sensor Using Piezoelectric and Magnetoelectric Materials

Vishwas N. Bedekar
Associate Professor
Department of Engineering Technology
Middle Tennessee State University
USA

Abstract

The magnetoelectric (ME) effect, which converts a magnetic field-induced stress in a magnetostrictive material into an electrical voltage via a neighboring piezoelectric material, offers significant potential for energy-efficient sensing and energy harvesting. This study presents the design and development of ME gradiometer sensors based on Terfenol-D and Lead Zirconate Titanate (PZT) ceramic composites, as well as nickel. A ring-dot electrode configuration was used to create a piezoelectric transformer structure operating near resonance, achieving high magnetic field sensitivity. Terfenol-D, known for its high magnetostriction, and nickel, chosen for its compatibility with PZT during co-firing, were key materials in optimizing device performance. Voltage measurements across 90 – 92 kHz for the PZT – Terfenol-D gradiometer and 234 – 251 kHz for the PZT – Nickel gradiometer showed high efficiency near electromagnetic resonance. This work demonstrates the potential of low-power ME gradiometers for magnetic field gradient sensing, particularly in applications requiring low bias fields (0 – 100 Oe).

Biography

Dr. Vishwas N. Bedekar is an Associate Professor in Department of Engineering Technology at Middle Tennessee State University. He received his B.E. degree in Mechanical Engineering from University of Bombay, India; M.S. in Mechanical Engineering and Ph.D. in Materials Science and Engineering from University of Texas at Arlington. After finishing his Ph.D., Dr. Bedekar was appointed as Post-Doctoral Associate in Virginia Tech and later was appointed as Research Assistant Professor at University of Arkansas before joining MTSU. Dr. Bedekar has authored over 30 publications/presentations in research related to energy harvesting materials and devices. He is a Reviewer for 10 internationally circulated journals and a panelist for federal funding agencies related to materials and manufacturing. Dr. Bedekar won the MTSU Outstanding Teaching Award for the academic year of 2018-2019. He is a member of Society of Manufacturing Engineers (SME) and has won the SME Distinguished Faculty Advisor Award in 2022.

Title: Interference Mitigation in Automotive Radar: Current Techniques, Comparative Analysis, and Future Trends

Tai Fei
Interim Professor of Computer Vision and Robotics
Dortmund University of Applied Sciences and Arts
Germany

Abstract

This speech reviews recent advancements in interference mitigation for automotive radar, focusing on the distinct interference patterns in different radar modulation schemes. Strategies are categorized into four main groups for comparative analysis. It aims to enhance understanding and bridge gaps in current research. Along with discussing implementation challenges, the speech provides insights for engineering and industry, emphasizing the role of regulatory agencies and cross-disciplinary collaboration in tackling interference issues.

Keywords: Interference mitigation, automotive radar, sparse signal, deep learning

References (representative):

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Biography

Tai Fei (Senior Member, IEEE) is an Interim Professor in Computer Vision and Robotics at Dortmund University of Applied Sciences and Arts, Germany. He earned his B.Eng. from Shanghai Maritime University in 2005 and Dipl.-Ing. and Dr.-Ing. degrees from Darmstadt University of Technology in 2009 and 2014. Dr. Fei has extensive research experience in sonar imaging and automotive radar. He worked on underwater mine detection at Hochschule Bremen and the University of Bremen and was a Development Engineer at HELLA GmbH from 2014 to 2023, focusing on radar signal processing. He has authored over 60 publications and serves as Associate Editor for IEEE Sensors Journal and IEEE Access, and has chaired sessions at IEEE Radar Conference 2023 and IEEE SAM 2024.

Title: Investigations of Charge-Transfer Plasmons in Different Systems

A.S. Fedorov[1]*, E. V. Eremkin[2], and V. S. Gerasimov[3]

1 Kirensky Institute of Physics, Federal Research Center KSC SB RAS, Russia

2 International Research Center of Spectroscopy and Quantum Chemistry, Siberian Federal University, Russia

3 Institute of Computational Modeling, Federal Research Center KSC SB RAS, Russia

Abstract

The report is devoted to modeling and experimental research of charge-transfer plasmons (CTP) implemented in different systems [1]. An original quantum-classical technique is presented that describes CTP in systems consisting of metal nanoparticles connected by narrow conducting linkers, consisting, for example, of conducting polymer molecules [2]. This technique makes it possible to describe CTP properties on 3-4 orders of magnitude faster compared to commercial electromagnetic solvers based on Finite Element Method (FEM) or Finite Difference Time Domain (FDTD) method, providing possibilities to predict the plasmonic properties of very large systems for different applications. It is presented also results of experimental synthesis of systems consisting of gold nanoparticles dimers adjacent by conducting molecules [3]. Based on this technique, it is developed also the technique for CTP properties calculating in systems of disordered or ordered metal nanoparticles located on the graphene surface [4]. The CTPs frequencies in these systems lie in the THz range, which has recently become more and more in demand in practice [5]. Based on the proposed quantum-classical approach and using FDTD/FEM calculations, CTP plasmons are studied in systems consisting of disordered or ordered metal nanoparticles located on the surface of a thin metal film. Using gold nanoparticles on a gold nanoplate as an example, it has been established that the frequencies and quality factors of these plasmons depend significantly on the size of the metal film. It is found that as the film size increases, the CTP frequencies shifts to the near-IR range along with a decrease in their amplitudes and quality factors.

Keywords: charge-transfer plasmons, graphene, THz range, Finite Difference Time Domain calculations

Acknowledgments: This study was supported by the Russian Science Foundation, Agreement No. 23-12-20007, and the Government of the Krasnoyarsk Territory and the Krasnoyarsk Territorial Foundation for Support of Scientific and R & D Activities, Agreement No. 256.

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Biography

Fedorov A.S. had graduated Krasnoyarsk State University, Physical Department and got degree of master of Physics in 1985. In 1994 he defended Ph.D. Thesis the Institute of Physics, Krasnoyarsk, Russia. He has degree of doctor of physics & mathematics till 2009. Now Fedorov A.S. is a Leading Researcher in Kirensky Institute of Physics, Krasnoyarsk. His research interests are mainly aimed at quantum chemical modelling of nanostructures, theoretical investigations of plasmonics, lithium-ion and hydrogen batteries, thermoelectrical materials. He is a co-author of more than 110 articles in leading journals. He is a co-author of 11 patents also in the fields of energy conversion, method of various substances separating, gas storage method, etc.

Title: Ferroelectric-defined Reconfigurable Photodetectors for In-memory Sensing and Computing

Guangjian Wu*, Xumeng Zhang, Qi Li, and Jianlu Wang
Researcher
Fudan University
China

Abstract

Recently, the increasing demand for data-centric applications is driving the elimination of image sensing, memory and computing unit interface, thus promising for latency- and energy-strict applications. Although dedicated electronic hardware has inspired the development of in-memory computing and in-sensor computing, folding the entire signal chain into one device remains challenging. Here an in-memory sensing and computing architecture is demonstrated using ferroelectric-defined reconfigurable two-dimensional photodiode arrays. High-level cognitive computing is realized based on the multiplications of light power and photoresponsivity through the photocurrent generation process and Kirchhoff’s law. The weight is stored and programmed locally by the ferroelectric domains, enabling 51 (>5 bit) distinguishable weight states with linear, symmetric and reversible manipulation characteristics. Image recognition can be performed without any external memory and computing units. The three-in-one paradigm, integrating high-level computing, weight memorization and high-performance sensing, paves the way for a computing architecture with low energy consumption, low latency and reduced hardware overhead.

Keywords: Ferroelectric, in-memory sensing and computing, photodetector

References:

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[2] Mennel L, Symonowicz J, Wachter S, et al. Nature, 2020, 579(7797): 62-66.

Biography

Guangjian Wu, a Researcher and Doctoral Supervisor at Fudan University. He obtained his bachelor's and doctoral degrees from Nanjing University from 2010 to 2020. In 2020, he joined Fudan University for postdoctoral research, and in 2023, he continued as a Researcher at Fudan University. His research interests include novel optoelectronic sensing devices and technologies, infrared detector devices and mechanisms, as well as in memory sensing and computing devices and systems. He has published more than 10 papers as first/corresponding author in journals such as Nat. Mater., Nat. Electron., Adv. Mater., Adv. Funct. Mater., and has led 8 projects including national and Shanghai talent and research projects.

SMSE Hybrid Session: Nanomaterials and Nanotechnology

Chaired by **Dr. Hung-Wing Li,** Associate Professor, Department of Chemistry, The Chinese University of Hong Kong, Hong Kong, China

Time: 15:30-16:50 (Afternoon), Nov. 5th, 2024 (Tuesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Highly Porous and High-Density Structures of Cellulose Nanofibrils and Their Applications

Thomas Geiger
Senior Scientist
Empa - Swiss Federal Laboratories for Materials Science and Technology
Laboratory for Cellulose and Wood Materials
Switzerland

Abstract

Nanofibrillated Cellulose, NFC, is a cellulose-based, biodegradable, renewable and intrinsically amphiphilic material composed of high aspect ratio fibrils obtained by disintegration of cellulose pulp. Highly porous NFC foams are attracting increasing attention for their potential in a wide range of applications where low density and high surface area are required, including filtration processes, gas adsorption and selective liquid absorption for the remediation of contaminated sites. A novel, simple freeze-thaw-drying method based on the use of urea as an additive to the aq. NFC suspension [1] is presented and discussed in detail. Such a method allows the preparation of mechanically stable, lightweight NFC structures, avoiding foam collapse, after simple freeze-thaw-drying steps. High-density structures have been prepared from commercially available NFC using a special dewatering process. These substrates exhibit exceptional mechanical properties with very high moduli and strengths (E_f= 14.0GPa, σ_f= 252MPa, E_T= 14.6GPa, σ_T= 152 MPa). Printed circuit boards (PCBs) are important components of many electronic devices. An electronic circuit was realized by conventional processing on a fibril substrate. To demonstrate the biodegradability of the PCBs, the assembled boards were composted. Finally, a holistic approach to the development of net-zero carbon electronics is presented (Horizon Europe HyPELignum project) [2].

Keywords: nanofibrillated cellulose, foams, high density structure, absorption material, PCB

References:

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[2] Geiger, T. et al. 20th European Conference on Composite Materials - Composites Meet Sustainability 2022. p. 1458; www.hypelignum.eu

Biography

Thomas Geiger works at Empa, Dübendorf, Switzerland, in the Cellulose & Wood Materials Laboratory. He received his diploma in 1995 and his Ph.D. in 1998 from the Johannes Gutenberg University, Mainz, Germany. In 1998 he joined Empa's Laboratory for Corrosion and Surface Protection. From 2003 to 2015 he was Group Leader at Empa's Laboratory for Functional Polymers. His research interests lie in the development, synthesis and characterization of functional materials based on cellulose as well as other biomasses. He is involved in several development projects for multifunctional sustainable bio-composites for industrial applications.

Title: Hybrid Membrane-coated Nanomotor for Immunotherapy and Chemotherapy of Breast Cancer

Man Lung Lee and Hung Wing Li*
Associate Professor
Department of Chemistry
The Chinese University of Hong Kong
Hong Kong, China

Abstract

Cancer cells adhesion and extracellular matrix penetration are important for drug delivery in cancer treatment. However, it is reported that coating nanoparticle surface with tumor-recognizing ligands can only achieve 0.7% delivery to solid tumors in preclinical animal models.[1] The major reason for low delivery efficiency is due to the blockade by extracellular matrix (ECM) in tumor microenvironment (TME). Here, we proposed a membrane coated NO driven mesoporous silica iron oxide drug carrier ([RBC-MDA]-GDL-MSN@Fe_3O_4) for drug delivery. Red blood cells (RBCs) membrane coating can prevent the immune clearance of nanoparticles by expressing “don’t eat me” signal, thus prolonging the blood circulation time.[2] Mesoporous silica iron oxide is loaded with Doxorubicin (DOX) and L-arginine(L-arg) for chemo/immunotherapy and starvation therapy. Through the conversion of L-arg to nitric oxide (NO) bubble in reactive oxygen species (ROS) overexpressed tumor microenvironment (TME), drug carrier can be propelled by the generation of nitric oxide gas to penetrate the extracellular matrix, thus enhancing the accumulation of nanoparticles in tumor site. Besides, the magnetic Fe_3O_4 core can be directed to tumor site by manipulating magnetic field, which further promotes the tumor adhesion of nanoparticles. The release of nitric oxide is also reported to exhibit a promising antitumor effect at high concentration and combine with ROS to generate more cytotoxic substance peroxynitrite (ONOO-). Synergizing with immunotherapy, [RBC-MDA]-GDL-MSN@Fe_3O_4 holds excellent potential to kill cancer without causing strong side effects.

Keywords: iron oxide nanoparticle, nanomotor, immunotherapy, chemotherapy and starvation therapy

Biography

Hung-Wing Li is currently the Associate Professor at the Department of Chemistry, The Chinese University of Hong Kong. She focuses on the development of new (nano)materials and tools that couple with highly sensitive laser-based detection techniques for advancing biomedical imaging, particularly in areas of i) imaging the biomarkers for early disease diagnosis, ii) single cell and single extracellular vesicles imaging, and iii) high-resolution imaging therapeutics for cancers and neurodegenerative related diseases.

Title: The Effect and Application of PEG Antibody in Nanomedicine

Zui Zhang*, Wenjing Tang, Cheng Li, Yuxiu Chu, Tianlei Ying, and Changyou Zhan
Associate Professor
Fudan University
China

Abstract

Polyethylene glycol (PEG), a low immunogenic and biocompatible polymer formed by repeating units of ethylene glycol, was more and more used in nanomedicine. Various levels of anti-polyethylene glycol (PEG) antibodies have been widely detected in human blood. The widespread vaccination of COVID-19 LNP-mRNA which contains PEG in formulation, was demonstrated to aggravate the existing of PEG antibodies in population. On one hand, our study focused on the influence of PEG antibodies on the safety and efficacy of LNP-mRNA, and found that PEG antibodies lead to reduced circulation, increased accumulation in liver and spleen and complement activation as LNP vaccine was injected, without affecting the production of anti-S protein antibodies. It suggested that when existence of PEG antibodies becomes norm in the population, LNP injection especially via i.v. is worth of paying attention to for safety consideration. On the other hand, we have developed an engineered single chain fragment variant (scFv) antibody for PEG, termed as PEG-scFv to prevent side effect of endogenous PEG antibody to nanomedicines. Based on PEG-scFv, we also have developed rapid method for separation of nanocarrier and its protein corona from biological media.

Keywords: PEG antibody, scFv, liposome, LNP, protein corona

References:

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[5] YX Chu#, WJ Tang#, Z Zhang*, C Li#, J Qian, XL Wei, TL Ying, WY Lu, CY Zhan*. Nano Letters, 21(5): 2124-2131(2021)

Biography

Dr. Zui Zhang was graduated from Nagoya University in Japan with a Ph.D. degree, and she is an Associate Professor at the School of Basic Medical Sciences, Fudan University. She mainly engaged in the research of novel targeted delivery strategies and mechanisms of brain diseases. She has published several papers in academic journals such as PNAS, Nature communication, Nano Letters, J Controlled release, etc. She won the 2019 Baxter Pharmaceutical Young Investigator Award, the first prize of the Excellent Paper of the China Pharmaceutical Preparation Conference, and the Outstanding Postdoctoral Fellow of Fudan University.

ICCST Hybrid Session: Plenary Forum of ICCST

Chaired by **Dr. Shunli Wang,** Professor, Inner Mongolia University of Technology, China

Time: 09:00-10:05 (Morning), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time
Place: Room Fuji, 4F, Hilton Nagoya

Title: The Neuroanatomical Crosstalk Network Topology Mapping of Brain Aging

Shuang Wu, Ang Dong1, Shen Zhang, Rongling Wu* and Shing-Tung Yau
Researcher
Beijing Institute of Mathematics and Applications,
China

Abstract

The human brain underlies structural changes during the aging process, but the biological underpinnings of the relationship between these changes and brain aging are poorly understood. We develop a generalized statistical mechanics model for linking the topological change of neuroanatomical communication networks with the process of brain aging. This model allows key brain aging-associated molecular pathways and crosstalk to be characterized by using computational GLMY theory. Our model provides new insight into the mechanistic mechanisms of how the human brain ages, through which an optimal strategy for personalized medicine can be created to prevent and inverse brain aging.

Biography

Professor Yau Shing-tung is one of the most influential contemporary mathematicians. He strived for research in mathematics for more than 50 years and has received numerous awards and honors. At his age of 33, he was granted the Fields Medal, which was regarded as the Nobel Prize in mathematics. He continued to be recognized via the Veblen Prize in Geometry (1981), the MacArthur Fellowship (1985), the Crafoord Prize (1994) and the US National Medal of Science (1997). Professor Yau received the Wolf Prize in 2010 and the Shaw Prize in 2023 in mathematics in recognition of his far-reaching contribution to geometric analysis, and his enormous impact on many areas of geometry and physics.

Title: Smart Energy Storage System Safety Monitoring and Mangement with Industrial Application

Shunli Wang
Professor
Executive Vice President of Smart Energy Storage Institute
Electric Power College at Inner Mongolia University of Technology
China

Abstract

As an important component of the smart grid energy storage system, high-precision state of health estimation of lithium-ion batteries is crucial for ensuring the power quality and supply capacity of the smart grid. To achieve this goal, improved integrated smart algorithms are proposed to estimate the SOH of Lithium-ion batteries. Kernel function parameters are used to simulate the update of particle position and speed, and genetic algorithm is introduced to select, cross and mutate particles. The improved particle swarm optimization is used to optimize the extreme value to improve prediction accuracy and model stability. The cycle data of different specifications are processed to construct the traditional high-dimensional health feature dataset and the low-dimensional fusion feature dataset, and each version of the constructed network is trained and tested separately. The results of the multi-indicator comparison show that the proposed algorithms can track the true value stably and accurately with satisfactory high accuracy and strong robustness, providing guarantees for the efficient and stable operation of the smart grid.

Biography

Prof. Shunli Wang is a Professor, Doctoral Supervisor, Executive Vice President of Smart Energy Storage Institute, Academic Dean of Electric Power College at Inner Mongolia University of Technology, Academician of Russian Academy of Natural Sciences, IET Fellow, Provincial Senior Overseas Talent, Tianfu Qingcheng Provincial Scientific and Technological Talent, Academic Leader of the National Electrical Safety and Quality Testing Center, Provincial Tianfu Talent, Academic and Technical Leader of China Science and Technology City, Top 2% Worldwide Scientist. His research interests include modeling, state estimation, and safety management for energy storage systems. 56 projects have been undertaken, supported by National Natural Science Foundation of China and the Provincial Science and Technology Department et al. 258 research papers have been published with RIS value of 11617 and h-index value of 34. 52 intellectual property rights have been approved. 9 monographs have been published by famous publishers of Elsevier and IET and so on. The total print number of New Energy Technology and Power Management reaches 6300 copies that are reprinted 4 times. He has guided students on 29 science and technology innovation projects with 6 excellent completion and 34 awards in science and technology competitions. He has won 13 scientific and technological awards, including the Gold Award at the 48th Geneva Invention Exhibition. The appraisal result has reached the internationally advanced level, as reported by People's Daily.

SMSE Hybrid Session: Materials Property, Characterization and Optimization

Chaired by **Dr. Pierre Jousset,** Professor at the OST, Eastern Switzerland University of Applied Sciences, Switzerland

Time: 10:20-11:40 (Morning), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Development of a New Method for the Design and Optimization of Laser-Welded Plastic Components

Pierre Jousset[1]*, Jan Vollenweider[1], Behdad Sadeghian[1], Ralph Gronowski[1], Alexander Franke[2], and Carsten Wenzlau[2]
1 OST, Eastern Switzerland University of Applied Sciences, Switzerland
2 Leister Technologies AG, Switzerland

Abstract

Laser transmission welding is the most commonly used process for joining plastics with a laser. The laser beam penetrates the first transparent component and is absorbed by the second component. The absorbed energy is converted into heat and melts the contact zone, which solidifies as it cools to form a weld. Laser transmission welding is used by industry to produce complex three-dimensional welds.

The quality of the weld for a given polymer pair depends on many parameters such as the power, the speed and angle of the laser beam to the weld surface. As a result, defining laser welding parameters for a complex 3D-weld is a very time-consuming trial and error process. To evaluate the weldability and critical points of a PC/PC-ABS weld, and to significantly reduce the time required to optimize weld quality, optical simulation has been used. For this purpose, lap-shear specimens welded at varied laser power and speed were first tested to investigate the process window for an optimal weld strength [1]. For a given laser power, the energy density depends on the speed of the laser beam and its area on the welded surface. Based on these experimental results, a Python script has then been written to control the Zemax OpticStudio software, which allows a continuous optical simulation of an entire weld seam based on CAD data. This script allows the optimization of the weld path by compensating for refraction effects in the component and the calibration of the laser speed profile to obtain a constant energy density corresponding to an optimum strength throughout the weld. As a result, this optimized speed profile can be implemented in the real welding process to obtain a perfect weld-design of any complex 3D contour. This new method drastically reduces the time to an optimized weld seam.

Keywords: Laser-welding, optical simulation, PC-ABS

Reference:

[1] P. Jousset, B. Sadeghian, J. Vollenweider, A. Franke, D. Csati, C. Wenzlau, KunststoffXtra, 6, 30 – 33, (2024).

Biography

Since 2015, Professor at the OST, Eastern Switzerland University of Applied Sciences, Lecturer in Mechanical Engineering and Innovation, Head of Joining Technologies at IWK, Institute of Materials Technology and Plastics Processing. From 2005 to 2015, Principal Scientist, Material Mechanics, Sika Technology AG in Zürich. From 2005 to 2015, Computational engineer, Altair Engineering, in Munich. In 2010 Ph.D. in Advanced Mechanics “Constitutive modelling of structural adhesives: experimental and numerical aspects” from the UTC Compiègne France, Award for the best Ph.D. from the UTC in 2010, Young Scientist Award at the ACE-X 2010.

Title: Light-Weight Lattice Structures: Manufacturability, Testing for Property, and Design for Protective Applications

Mohammad Reza Vaziri Sereshk* and Akib T. Lodhi
Assistant Professor
Department of Engineering
Central Connecticut State University
USA

Abstract

Application of lattices is growing for energy and impact absorption. Defects for additive manufacturing of this type of delicate structures are investigated to develop manufacturability thresholds for lattices made from polymer and metals [1]. Collapse mechanism for different topologies is discussed. This is used to improve plateau behavior and increase energy absorption capacity [2]. Application of lattices for protective devices requires appropriate threshold for impact. A diagram is presented to monitor both energy and impact during densification [3]. Then, this approach is used to design lattice sandwiches as crash-box. This consumable component is installed inside bumper to protect vehicle occupants in the event of a low-velocity crash. Design of blast absorber for military vehicle against landmine explosion is the second application which is discussed.

Keywords: Lattice, Additive Manufacturing, Manufacturability, Energy and Impact Absorption

References:

[1] M. R. Vaziri Sereshk, E. J. Faierson, Int. J. Adv. Manuf. Tech., 123, 3795−3806 (2022).
[2] M. R. Vaziri Sereshk, E. J. Faierson, Int. J. Adv. Manuf. Tech., 130, 1617-1633 (2024).
[3] M. R. Vaziri Sereshk, E. J. Faierson, Int. J. Adv. Manuf. Tech., 132, 4663−4676 (2024).

Biography

Dr. Vaziri Sereshk has worked extensively on different aspect of manufacturing including additive and subtractive manufacturing for different polymers, metals, and composites. Akib Lodhi is Research Assistant for NASA CT Space Grant (PTE Federal Award No.: 80NSSC20M0129).

Title: Electrochemical and Mechanical Characterization of Waste Biomass-Based Activated Carbon Coated Carbon Fiber Fabrics for Potential Applications in Structural Supercapacitors

Erdinc Gunaydın[c], Sevval Karademir[a], Merve Şehnaz Akbulut[c], Ozgur Demircan[b,c], and Isil Gurten Inal[a]*

a Department of Chemical Engineering, Faculty of Engineering, Ankara University, Turkey

b Department of Material and Metallurgical Engineering, Faculty of Engineering, Ondokuz Mayıs University, Turkey

c Department of Nanoscience and Nanotechnology, Ondokuz Mayis University, Turkey

Abstract

In this study, the conventional carbon fiber fabrics (CFF) were modified by coating them with a waste biomass-derived porous carbon material to enhance the poor energy storage performance of the CCFs as potential multifunctional structural supercapacitor electrode materials. The red pepper industrial wastes (RPW) were used for the starting material of activated carbon (AC). The highly porous AC was prepared by the chemical activation using K_2CO_3 followed by heat treatment at 800^{o} C under an inert atmosphere. The surface characterization of AC was conducted utilizing N_2 adsorption-desorption, XPS Raman, and SEM techniques. The electrochemical performance of AC was tested as symmetrical coin-cell type supercapacitor electrodes by cyclic voltammetry (CV), galvanostatic charge/discharge (GCD), and electrochemical impedance spectroscopy (EIS) analysis methods. To investigate the energy storage performance of the modified CFFs, the CFFs were coated with AC at different AC mass ratios of 2%, 5%, 10%. The cells were assembled using the coated CFF electrodes and tested under the same conditions as the previous AC based cells. As a result, the original CFFs, which exhibited poor energy storage performance, have shown a significant increase in energy storage capability. Furthermore, the modified CFFs-based composites plates were prepared using epoxy resin by conventional vacuum infusion method, and mechanical tests of the composites were conducted.

Keywords: Modified carbon fiber fabrics, activated carbon, biomass waste, structural supercapacitors, mechanical tests, energy storage

Biography

Isil received her B.Sc. degree in Chemical Engineering from the Faculty of Engineering at Ankara University in 2005. Since 2021, she has been working as an Assistant Professor in the same department, actively engaging in both research and teaching. Her research focuses on the development of carbon-based materials using environmentally friendly precursors and processes for various energy storage applications. Since her Ph.D. studies, she has concentrated on understanding the property-performance relationships of these materials through advanced characterization techniques to enhance and tailor them for specific requirements. She maintains a strong interest in innovative and sustainable energy storage systems, closely following the latest developments in the field. Isil has conducted research at the University of Manchester, UK, for one year (September 2014-September 2015) and, as of August 2024, has been working as a Visiting Researcher at Nagoya University, Japan.

SISED Hybrid Session: Intelligent Systems and Applications (Part 1)

Chaired by **Dr. Souad Bezzaoucha Rebai,** Associate Professor, EIGSI - La Rochelle, France

Time: 13:00-14:20 (Afternoon), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Advanced Control and Observer Design via LMIs

Souad BEZZAOUCHA REBAI
Associate Professor
EIGSI - La Rochelle
France

Abstract

The sector nonlinear approach ([1], [2]) is a useful method allowing for an exact polytopic representation of a system with a nonlinear behaviour. Once the model has been redefined in a polytopic form, one has to choose the right control structure. We will focus in this talk on the classical tool for control (state feedback, output feedback control, and observer-based control). It can be proven that for quadratic stabilization in the continuous case, it is necessary and sufficient to consider a PDC (Parallel Distributed Compensation) to stabilize the polytopic system. For that, it is convenient to use the classical/direct Lyapunov method to deal with stability. Once the Lyapunov Function has been selected, it is convenient to reformulate the stability/stabilization conditions as a set of LMIs. LMI formulation is the backbone of the polytopic approach as it provides an effective way to numerically solve the conditions (global convergence, feasibility check and optimization constraints).

Keywords: Nonlinear Systems, Control Design, Observer Design, Polytopic Representation, Lyapunov Theory, Linear Matrix Inequalities (LMIs).

References:

[1] K. Tanaka, H. Wang, Fuzzy Control Systems Design and Analysis: A Linear Matrix Inequality Approach. Ed Hardcover, John Wiley and Sons, Inc., New York, (2001).
[2] K. Tanaka, T. Ikeda, H. Wang, Fuzzy regulators and fuzzy observers: relaxed stability conditions and LMI based designs. IEEE Transactions on Fuzzy Systems,6(2), 250-265, (1998).

Biography

The author has an Engineering and Master of Science degrees in Automation Control, a Master degree in Computer Science Engineering and a PhD. Her research interests are in robust control theory, observers design, nonlinear Systems, robotics and cyber security.

Title: Development of Extended Reality-based Invasive Medical Procedure Training Platform

Kai-Sheng Hsieh[1], Yu-Lung Hsu[2]

1: Kai-Sheng Hsieh

Structural/congenital heart disease and Ultrasound Center, and Department of Medical Education and Research, China Medical University Children's Hospital, Taichung, Taiwan

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2: Yu-Lung Hsu

Department of Medical Education and Research, China Medical University Children's Hospital, Taichung, Taiwan

codan5230@gmail.com

Abstract

Conventionally, medical training relies on hands-on practice, especially for Many Invasive procedures. However, currently this practice is no more acceptable by the patients because patients aren't willing to be treated "experimentally"! The introduction of simulation manikins and related equipment is a solution for this situation. But repeated practice through multiple sessions of training will destroy the integrity of the manikins and related equipment. Thus, a novel approach is necessary to train the learners to practice various procedures. During the past few years, we have been developing novel medical training systems using virtual reality, extended reality so that the trainees will undergo training in an immersive environment.

Previously we developed an immersive simulation medical training system for ultrasound. Recently, we have been developing immersive simulation training systems for invasive procedures. Here in we will report on the immersive simulation training system for performing lumbar puncture. Lumbar puncture is a frequently used procedure for diagnosis and sometimes also for therapeutic purposes such as intrathecal administration of pharmacological agents. However, because it is an invasive procedure involving the central nervous system, much caution must be delivered to avoid complications. The system contains a wearable device on the head, a hand-held controller and interfaced to a conventional computer/notebook computer. The learner will see the immersive environment mimicking the site for lumbar puncture procedure. Through the controller, the learner can sequentially "call in "the model patient laterally lying on the on the bed with. Then the patient will be draped with a sterilized sheet while exposing the area of lumbar skin within the center of the sheet. Subsequently the whole sequence of virtual simulation of performing lumbar puncture step by step will be experienced by the learner!

Biography

Dr. Kai-Sheng Hsieh completed his Medicine study in National Defense Medical Center, Taipei, Taiwan in 1978. He then served as pediatric resident in Taipei Veterans Hospital between 1978-1982. Then he went to Boston, mass, USA in the Department of cardiology, Boston Children's Hospital as a clinical fellow and clinical lecturer in Harvard Medical School. After completion of his clinical fellowship, Dr. Hsieh returned to Taiwan as attending physician and then chief of section of pediatric cardiology, Department of Pediatrics, Taipei Veterans General Hospital in 1975. After 1976, Dr. Hsieh was appointed as chief of Department of Pediatrics, KaoHsiung Veterans General Hospital—a brand new hospital in southern part of Taiwan. Dr. has broad spectrum of interest, other than clinical medicine such as pediatric cardiology, structural/congenital heart diseases intervention. He also was very experienced in echocardiography/ultrasound, Kawasaki disease, clinical biomedical engineering and artificial intelligence. Dr. Hsieh currently is the professor of pediatrics, and Vice-superintendent of China Medical University Children's Hospital, Taichung, Taiwan. He also has been the president/board members in many local and international professional societies. Because he is enthusiastic in academic research, he has published near 300 peer-reviewed articles.

Title: Optimal Metaheuristic State-Dependent Parameter Proportional-Integral-Plus Control: Alternative to Gain-Scheduled Controller for Control of a Nonlinear Continuous Stirred Tank Reactor

Behrouz Kiani Talaei
Chemical Engineer
University of Sistan and Baluchestan,
Iran

Abstract

Continuous stirred-tank reactors exhibit complex dynamic behavior, particularly during exothermic reactions where the residual concentration decreases. Effective cooling is crucial during this transition to stabilize the reaction and prevent reactor overheating. This presentation introduces a data-driven metaheuristic state-dependent parameter proportional-integration-plus (M-SDP-PIP) control method as an alternative to gain-scheduled control for managing reactor coolant temperature. The proposed controller optimizes the parameters of the discrete transfer function in a nonlinear state space, leveraging metaheuristic techniques like genetic algorithms and particle swarm optimization to minimize energy consumption and error. Our results indicate that the proposed M-SDP-PIP controller offers superior servo-regulatory performance compared to traditional gain-scheduled methods, without the need for complex auxiliary equations or models, making it a simpler and more efficient solution.

Biography

Behrouz Kiani is a dedicated chemical engineer with a Ph.D. in Chemical Engineering from the University of Sistan and Baluchestan, where he graduated with first-class honors. His academic research focuses on data-driven modeling, optimization, and control in chemical processes, with several publications in prominent journals. Dr. Kiani has also contributed to the field through his involvement in optimizing natural gas processes, enhancing energy efficiency, and reducing greenhouse gas emissions. In addition to his research, Dr. Kiani has significant professional experience in leading projects related to energy optimization, process improvement, and safety in the oil, gas, and petrochemical sectors.

ICCST Hybrid Session: Chemical Mechanisms and Engineering

Chaired by **Dr. Akira Naito,** Emeritus Professor, Yokohama National University, Japan

Time: 14:35-16:45 (Afternoon), Nov. 6th, 2024 (Wednesday); Time Zone: GMT+9, Japan Time
Place: Room Fuji, 4F, Hilton Nagoya

Title: Thermal and Nonthermal Microwave Effects of Ethanol and Hexane-Mixed Solution as Revealed by In Situ Microwave Irradiation Nuclear Magnetic Resonance Spectroscopy

Akira Naito
Emeritus Professor
Graduate School of Engineering
Yokohama National University
Japan

Abstract

Microwave heating is widely used to heat a solution to accelerate the organic synthesis reaction. However, the role of the nonthermal microwave effect in the chemical reaction has not yet been well understood. To investigate the microwave heating effects, we developed microwave irradiation NMR appratus.[1] We first performed rapid temperature jump experiments in APAPA solution and succeeded to increase the temperature of 10 degree within 100 ms. Using the rapid microwave temperature jump experiment, we successfully obtained state-correlated two-dimensional ^{1}H NMR spectra of APAPA. Consequently, we could obtain the correlation between the isotropic phase and liquid crystalline phase ^{1}H NMR signals of APAPA. This experiment allows us to analyze anisotropic liquid crystalline APAPA ^{1}H NMR spectra in relation to high resolution spectra in the isotropic phase.[2]

Second, the microwave heating processes of an ethanol-hexane mixed solution were investigated using in situ microwave irradiation NMR spectroscopy and MD simulation.[3] The temperature of the solution under microwave irradiation was estimated from the temperature dependence of the ^{1}H chemical shift (chemical shift calibrated (CSC) temperature). The CSC temperature of OH proton was lower than that of CH_2 and CH_3 protons under microwave irradiation. The lower CSC-temperature of the OH protons than that of CH_2 and CH_3 protons can be attributed to a nonthermal microwave effect. MD simulation revealed that electron dipole moments of OH groups ordered along the oscillated electric field and form hydrogen bonds between OH groups as the nonthermal microwave effect, which explains the lower CSC-temperature of the OH protons.

Keywords: Microwave heating, NMR spectroscopy, Ethanol-hexane, Nonthermal microwave effect, Liquid crystal

References:

[1] Y. Tasei et al. J. Magn. Reson. 2015, 254, 27-34
[2] A. Naito et al. Ch. 5 Photoirradiation and Microwave Irradiation NMR Spectroscopy: Experimental Approaches of NMR Spectroscopy. Ed.; The NMR Society of Japan Springer 2018, 135-168
[3] Y. Tasei et al. J. Phys. Chem. B 2020, 124, 9615-9625

Biography

Akira Naito received his Ph D. in 1978 in Kyoto University, Japan and later worked as a Post-Doctoral research fellow in University of British Columbia, Canada. In 1984, he appointed as Assistant Professor, Kyoto University and in 1990, he became Associate Professor of Himeji Institute of Technology. Since 2001, he has been a professor and since 2015, he has been emeritus professor of Yokohama National University. His main research interests are development and application of solid-state NMR methods. He developed photo irradiation and microwave irradiation NMR spectroscopy. He determined the structures and dynamics of biological systems such as amyloid peptides, membrane associated peptides, silk materials and photoreceptor membrane proteins.

Title: Variation of Physical Properties Across the Mineralogical System: Data, Results, Takeaways

Milan Rieder
Professor
VSB-Technical University Ostrava
Czech Republic

Abstract

Four physical properties (density, reflectance, refractive index, and Vickers hardness VHN) for minerals and synthetic phases were plotted against two functions based on their chemical formulae alone [1]. The functions are InfEnt = $-\Sigma$ ixilnxi and Qual_4 = log Σ ixini , where xi and ni represent the i-th atomic fraction and i-th atomic number, respectively [2]. Plots of available data (all variables on logarithmic scale) contain between 462 and 3001 points. The plots and regression equations appear in slides and illustrate a pronounced dependence on the Qual_4 function and, a milder one, on the InfEnt. Regression planes in 3D space were fitted to all datasets, and the coefficients are on the highest level of statistical significance. There is one exception [3], to be discussed in the presentation.

Physical data have their strengths and peculiar weaknesses, but the regressions offer information that could be useful in the identification of unknown substances (new mineral phases, search for crystal-structure analogs). They also might be helpful in devising new synthetic compounds (e.g., man-made gemstones or superhard substances).

Keywords: Mineral density, reflectance, refractive index, Vickers hardness VHN, regression planes in 3D space

References:

[1] M. Rieder, Phys. Chem. Minerals 47, 19 (2020).
[2] C. E. Shannon, Bell System Tech. J. 27, 379-423,623-656 (1948).
[3] R. D. Shannon, R. X. Fischer, Am. Miner. 101, 2288-2300 (2016).

Biography

Milan Rieder studied geology/mineralogy at Charles University (Prague, Czechoslovakia), graduating in 1962. He defended his Ph.D, at Johns Hopkins University (Baltimore, MD, USA) in 1968, his Thesis dealt with experimental mineralogy (hydrothermal, 2 kbar). Later, he was employed at the Geological Survey of Czechoslovakia, in 1969 he moved on to Charles University, Faculty of Science (full professor from 1991), and in 2004 to VSB-Technical University Ostrava. Rieder's research interests included X-ray diffraction, crystal structures, and data treatment. His papers appeared in leading mineralogical/crystallographic periodicals like American Mineralogist, European Journal of Mineralogy, Zeitschrift fur Kristallographie, Science, Contributions to Mineralogy and Petrology, or Mineralogical Magazine. He chaired the Mica Nomenclature Subcommittee (International Mineralogical Association) and served 23 years as an Editor of Physics and Chemistry of Minerals (Springer).

Title: Possibility of Metallofoldamer as a Cross-Linked Reagent for Polymeric Material

Hiroto Achira*, Masashi Nakamura, Motohiro Shidzuma and Seiji Watase
Chief Researcher,
Hyogo Prefectural Institute of Technology
Japan

Abstract

Metallofoldamer[1] has attractive features such as host-guest interaction and luminescent switching derived from the folding structure. The solid states of metallofoldamer tend to form columnar packing structures, which causes concentration quenching due to the strong intermolecular interaction. In the previous study[2], we synthesized metallofoldamer composed of bis(tridentate Schiff base platinum (Ⅱ) complex) and 2-methylenepropane-1,3-diyl (isobutenylene) linker and improved the photophysical properties by hybridizing polymer and the precursor. In this presentation, we introduce the concept of polymerization of metallofoldamer as a monomer unit (Figure 1) and the solid state of the polymer material by spectroscopic methods and thermal analyses.

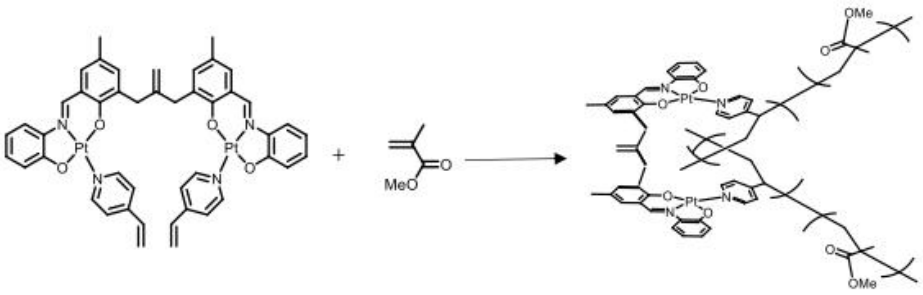

Figure 1 Copolymerization of metallofoldamer composed of bis(tridentate Schiff base platinum (II) complex) and isobutenylene linker

Keywords: Metallofoldamer, platinum (Ⅱ) complex, radical polymerization, phosphorescence.

References:

[1] S. Y.-L. Leung, V. W.-W. Yam, Chem. Sci. 4, 4228 (2013).
[2] H, Achira, M. Nakamura, M. Shidzuma, S. Watase, Eur. J. Inorg. Chem., e202200544 (2022)

Biography

After Hiroto Achira received Bachelor at Macromolecular Science and Technology, Kyoto Institute of Technology in 2011, he studied and received Master in 2014 and Ph. D. Engineering in 2017 at Department of Chemistry and Biotechnology, Graduate School of Engineering, the University of Tokyo. He started working at Hyogo prefectural institute of technology in 2017, who was in charge of supporting packaging industry. He moved to department of technical coordination, technical support office in 2021 and started using supercomputer for supporting small and medium-sized enterprises (SMEs). His interested fields are metal complex, polymer science, quantum chemistry and molecular dynamics simulation and some projects are being conducted for contributing research and development of SMEs, especially rubber and packaging industries.

Title: Measurements of Thermodynamic Properties and Activity Coefficients at Infinite Dilution of Selected Organic Solutes and Water in a Deep Eutectic Solvent (Choline Chloride + 1,3 Propanediol)

Banzi P. Mbatha, Peterson T. Ngema*, Suresh Ramsuroop, Kaniki Tumba and Nkululeko Nkosi
Durban University of Technology
Department of Chemical Engineering
Engineering Thermodynamics
South Africa

Abstract

Emissions of volatile organic compounds (VOCs) have received wide attention due to their impact on atmospheric quality and public health. Climate change pressures, resource depletion, and VOC emissions will all negatively impact the chemical industry over the next few decades. Even though the first two have been widely studied, little attention has been paid to industrial VOC emissions, even though they significantly impact millions of people's lives. To mitigate the dangerous effects of solvents, research into VOC replacement is essential to develop efficient and economical abatement techniques specific to solvent sources. In this context, as a replacement for VOCs, a deep eutectic solvent (DES) consisting of choline chloride (ChCl) and propanediol (PDiol) at a 1:2 molar ratio was evaluated experimentally for its extractive efficiency in this study. The DES' s physicochemical properties were measured at T = (293.15 - 353.15) K and 101.3 kPa. For developing green solvents, the density, viscosity, and refractive index of DESs are important physicochemical properties. Solvent intermolecular interaction strengths were assessed using experimental infinite dilution activity coefficients (IDAC) measured at T = (313.15 to 343.15) K and 101.3 kPa. The interactions between the solute and solvent molecules were further determined by partial molar excess properties ($\Delta H_i^{E,\infty}$, $\Delta G_i^{E\infty}$ and $T_{ref}\Delta S_i^{E,\infty}$)). The separation ability of the solvent was assessed using selectivity (S_{ij}^{∞}) and capacity (k_j^{∞}) as thermodynamic separationparameters. Desulphurisation is among the many industrial separation problems for which the investigated DES can perfectly substitute VOCs.

Keywords: Deep eutectic solvent; infinite dilution activity coefficient; Selectivity; Partial molar excess properties; intermolecular interactions, 1,3 Propanediol.

Biography

Currently, I am in the role of Acting Head of the Department for Chemical Engineering at Durban University of Technology (DUT). I have the following qualifications: PhD and MSc degrees in Chemical Engineering (UKZN); MTech and BTech degrees in Chemical Engineering (DUT); National Diploma in Chemical Engineering (DUT); Advance Diploma in Business Administration (DUT), Certificate in Leadership Development Programme (DUT); Certificate in Human-CentricDigitalization Transformation (DUT). Over 7 years of teaching and learning experience at DUT, 3 years as a researcher at the University of KwaZulu-Natal (UKZN) as well as 8 years' experience in heavy industry. I am registered as a Candidate Engineer at the Engineering Council of South Africa (ECSA). I am a member of the South African Institution of Chemical Engineers (SAIChE). I have graduated 6 x Master in Engineering (MEng). Currently, I am supervising 6 x MEng and 9 x DEng students.

Title: Chemical and Opto-Mechanical Kinetics of $CaCO_3$ at a Single-Particle Level

Andrei Ushkov
Senior Researcher
Moscow Center for Advanced Studies
Russia

The authors acknowledge the Russian Science Foundation grant (project No 24-79-00144) and the Azrieli Foundation's Postdoctoral Fellowship.

Abstract

Whereas the well-established colloidal techniques (i.e., micro-PIV or dissolution trends study via DLS) inherently rely on dynamic behavior of a great number of nano/micro-particles, in some applications (precious particles manipulations, targeted drug delivery in fine blood vessels) it can be undesirable or even impossible to employ the multi-particle approach. In such cases, an accurate registration of a single-particle response would be beneficial. In our work, we integrate the pulled glass micropipette and an optical fiber output into the optical tweezer setup for a high level of control over a single optically-trapped vaterite microparticle. As a result, we demonstrate an orientation-dependent optical response in rotation dynamics of the object, as well as a "switching" between dissolution regimes, which would have been hidden otherwise in multi-particle approaches.

Biography

Dr. Ushkov Andrei has studied Physics and received Bachelor and Master Degrees in Moscow Institute of Physics and Technology, Dolgoprudnyy, Russia. He went later to France to continue his research and study, and received his PhD in Photonics in University of Lyon-Jean Monnet. Currently, he is an Azrieli postdoc fellow in Tel Aviv University, Israel. His research focuses on optics of anisotropic materials, diffractive structures, with a special attention to optomechanics in optical tweezers.

SMSE Hybrid Session: Biomaterials and Biomedical Manufacturing

Chaired by **Dr. Yongmei Chen,** Professor, College of Bioresources Chemical and Materials Engineering, Shaanxi University of Science & Technology, China

Time: 09:00-10:20 (Morning), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: The Development of a Support Matrix as a New Option for the Tissue Regeneration of Mastectomized Women

R. A. Saucedo-Acuña[1]*, J.C. Cuevas-González[1], J. V. Ríos-Arana[1], M.I. Castellanos-García[2], E.A. Zaragoza-Contreras[3], and G.F. Tamayo- Pérez[4]

1 Professor at Institute of Biomedical Sciences, Universidad Autónoma de Ciudad Juárez, México

2 Professor at Institute of Engineering and Technology, Universidad Autónoma de Ciudad Juárez, México

3 Researcher at Centro de Investigación en Materiales Avanzados, México

4 Head of Research Department at Hospital Ángeles Ciudad Juárez, México

Abstract

This work describes the development of a hydrogel of Polyvinyl Alcohol and Hydroxy Ethyl Cellulose (PVA:HEC) for the regeneration of adipose tissue for women who suffered a radical mastectomy. In 2015 a PVA hydrogel was enriched with different amounts of HEC looking for hydrogel to use a support matrix of the adipose tissue. *In vivo* tests in female rabbits indicated that PVA hydrogel with 30 %w HEC may provide a viable approach for the regeneration of adipose tissue as first step as an alternative solution [1]. After this result, the PVA;HEC hydrogel was modified to obtain a conical material to promote the growing of adipose tissue in the thoracic region of female Balb-C mice. In this case, the reasons to modify the hydrogel are described.

Keywords: Support matrix; PVA; HEC; Hydrogel; adipose tissue regeneration

Reference:

[1] K. L. Tovar C., G. Tamayo, A. Donohue, T. Kobayashi, and R. A. Saucedo A. J Tissue Sci Eng 2015, 6:2, 1-5, (2015).

Biography

Founder of the Applied Chemistry Group at Universidad Autónoma de Ciudad Juárez. Member of the National Investigator System of Mexico. My research is focused on materials for environmental and biomedical applications. In 2021, I received recognition as an outstanding woman in Sciences by Chihuahua State Government.

Title: Polysaccharide-Based Injectable and Self-Healing Hydrogels with Multiple Functions

Yong Mei Chen[a]*, Jianhui Li[b], Haopeng Li[c], Hideyuki Miyatake[d], and Yoshihiro Ito[d]

a College of Bioresources Chemical and Materials Engineering, National Demonstration Center for Experimental Light Chemistry Engineering Education, Shaanxi University of Science & Technology, China

b Department of Surgical Oncology, Shaanxi Provincial People's Hospital, China

c Second Affiliated Hospital of Xi'an Jiaotong University, Xi'an Jiaotong University, China

d Nano Medical Engineering Laboratory, RIKEN Cluster for Pioneering Research, Emergent Bioengineering Materials Research Team, RIKEN Center for Emergent Matter Science, Japan

Abstract

Biocompatible dynamic self-healing hydrogels have emerged in biomedical applications because they can improve the performance of smart soft materials by spontaneously restoring functions and structures after damage. To meet the requirements of minimally invasive interventional therapy, hydrogels possessing both the capabilities of self-healing and injectability have been explored as smart multifunctional biomaterials utilized in tissue engineering, drug/cell delivery, and biosensors. The specific implementation steps of dynamic hydrogels can be manipulated as solids. Noteworthy, the concept of dynamic hydrogel reforms the traditional injectable hydrogel that is manipulated with fluid. The development of dynamic hydrogel avoids the main drawbacks of traditional injectable hydrogel, such as cargo (e.g., drugs, cells) being lost before gelation, hard to control gelation time, and the potential toxicity of chemical agents. Here the design of dynamic hydrogels based on biomacromolecules with the features of toughness, sequential protein delivery, storage and transportation of stem cells.

Keywords: Dynamic hydrogel, Mechanical reinforcement, Multiple reversible interactions

References:

[1] Wei, Z., Yang, J. H., Zhou, J., Xu, F., Zrínyi, M., Dussault, P. H., Chen, Y. M., Chemical Society Reviews, 43(23), 8114-8131. (2014).

[2] Gao, L. T., Chen, Y. M., Aziz, Y., Wei, W., Zhao, X. Y., He, Y., Ito, Y., Carbohydrate Polymers, 330, 121812.(2024).

[3] Wei, Z., Yang, J. H., Liu, Z. Q., Xu, F., Zhou, J. X., Zrínyi, M., Chen, Y. M., Advanced Functional Materials, 25(9), 1352-1359.(2015).

Biography

Yong Mei Chen is a Full Professor at Shaanxi University of Science & Technology, Leader of green flexible multifunctional material innovation team. She received her degree of Doctor of Philosophy in Biological Science from Hokkaido University. Her current research is focused on soft materials and functional gels for biomedical field and flexible electronics, including photoluminescent hydrogels, magnetic hydrogels, self-healing hydrogels and tough hydrogels. She published about 80 research papers in the journals of Chem. Soc. Rev., Nat. Commun., Adv. Funct. Mater., Chem. Eng. J., Biomaterials, Green Chem. and Small.

Title: Clinical Applications of Biopolymers in Neurosurgery: The in vivo Cranial Bone Reconstruction

Tomaz Velnar[1]*, Roman Bosnjak[1], and Lidija Gradisnik[2]

1 Department of Neurosurgery, University Medical Centre Ljubljana, Slovenia

2 Laboratory for Cell Cultures, Medical Faculty Maribor, Slovenia

Abstract

Background: Biomaterials and biotechnology are becoming increasingly important fields in modern medicine. For cranial bone defects of various aetiologies, artificial materials, such as poly-methyl-methacrylate, are often used. We report our clinical experience with poly-methyl-methacrylate for a novel in vivo bone defect closure and artificial bone flap development in various neurosurgical operations.

Methods: The experimental study included 12 patients at a single centre in 2018. They presented with cranial bone defects after various neurosurgical procedures, including tumour, traumatic brain injury and vascular pathologies. The patients underwent an in vivo bone reconstruction from poly-methyl-methacrylate, which was performed immediately after the tumour removal in the tumour group, whereas the trauma and vascular patients required a second surgery for cranial bone reconstruction due to the bone decompression. The artificial bone flap was modelled in vivo just before the skin closure. Clinical and surgical data was reviewed.

Results: All patients had significant bony destruction or unusable bone flap. The tumour group included five patients with meningiomas destruction, the trauma group comprised of four patients, all with severe traumatic brain injury. In the vascular group, there were three patients. The average modelling time for the artificial flap modelling was approximately 10 minutes. The convenient location of the bone defect enabled a relatively straightforward and fast reconstruction procedure. No deformations of flaps or other complications were encountered, except in one patient, who suffered a postoperative infection.

Conclusions: Poly-methyl-methacrylate can be used as a suitable material to deliver good cranioplasty cosmesis. It offers an optimal dural covering and brain protection and allows fast intraoperative reconstruction with excellent cosmetic effect during the one-stage procedure. The observations of our study support the use of poly-methyl-methacrylate for the ad hoc reconstruction of cranial bone defects.

Keywords: biopolymers, in vivo reconstruction, cranial bone, poly-methyl-methacrylate, bone flap

References:

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Biography

Tomaž Velnar works as a Doctor at the University Medical Centre Ljubljana and is also active in research. He regularly collaborates with other authors in clinical and preclinical research.

SISED Hybrid Session: Intelligent Systems and Applications (Part 2)

Chaired by **Dr. Yunxia Zhang,** Lecturer, Shaanxi University of Science & Technology, China

Time: 10:35-12:10 (Morning), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Tough, Rapid Self-Recovery and Responsive Organogel-Based Ionotronic for Intelligent Continuous Passive Motion System

Yongmei Chen* and Tang Jie
Professor
College of Bioresources Chemical and Materials Engineering
Shaanxi University of Science & Technology
China

Abstract

As an essential part of treatment plan, the objective of postoperative rehabilitation is to restore the injured joints to their natural biomechanical features[1-2]. Unfortunately, clinical practice by using CPM equipment with mechanical structure but no intelligent monitoring and sensing function for joints. Therefore, an intelligent CPM system that combines patient joint motion information with remote doctor guidance is crucial for efficient rehabilitation. However, the current materials cannot simultaneously meet the mechanical requirements of fast self-recovery, high toughness, and low elastic modulus under large deformation, as well as the sensing performance requirements of low hysteresis, high sensitivity and good cyclic stability proposed by the intelligent CPM system for sensing materials[3]. We report a novel intelligent telemedicine CPM system for personalized rehabilitation and telemedicine. The flexible ionotronic made of organogel which is designed to possess combined multifunction, including excellent mechanical properties, rapid self-recovery ability, water retention, anti-freezing, strong adhesion, and remarkable linear sensitivity. Especially, the corresponding ionotronic responds fast with a short response time (300 ms) and shows excellent cycling stability for strain sensing, ensuring the detection of actual joint bending angle with a high gauge factor and reliability. This work opens up a new horizon for developing digital intelligent medical that can remotely monitor the movement of hospitalized/at-home patients who use CPM for personalized postoperative rehabilitation.

Keywords: Organogels, Flexible Ionotronics, Intelligent Rehabilitation, Continuous Passive Motion

References:

[1] Zhang YX, , Chen Y, et al. Sensitive piezoresistive pressure sensor based on micropyramid patterned tough hydrogel. Applied Surface Science, 2023, 615: 156328.

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[3] Tang J, Chen Y, et al. Tough, rapid self-recovery and responsive organogel-based ionotronic for intelligent continuous passive motion system. npj Flexible Electronics, 2023, 7(1): 28.

Biography

Yong Mei Chen is a Full Professor at Shaanxi University of Science & Technology, Leader of green flexible multifunctional material innovation team. She received her degree of Doctor of Philosophy in Biological Science from Hokkaido University. Her current research is focused on soft materials and functional gels for biomedical field and flexible electronics, including photoluminescent hydrogels, magnetic hydrogels, self-healing hydrogels and tough hydrogels. She published about 80 research papers in the journals of Chem. Soc. Rev., Nat. Commun., Adv. Funct. Mater., Chem. Eng. J., Biomaterials, Green Chem. and Small.

Title: Intelligent Modulation Recognition for Communication Signals Based on Hybrid Artificial Features

Hui Chen

Associate Professor

School of Information and Communication Engineering

University of Electronic Science and Technology of China

China

Abstract

The existing modulation classification method using instantaneous features is poor for low SNRs, and the high-order cumulant features-based modulation recognition algorithm is only applicable to some types of communication modulation signals. To overcome these problems, we propose a hybrid features-based modulation recognition algorithm, which refines instantaneous features and high-order cumulant feature, and the back propagation (BP) neural network is adopted as a classifier to perform experiments. Besides, for some complex signals, such as composite (secondary) modulation signals, OFDM signals and so on, we also propose a joint decision-making recognition method based on mixed artificial features. The experimental results show that our proposed hybrid features-based modulation recognition method can improve the recognition rate for more kinds of signals.

Keywords: Modulation recognition; Artificial intelligence; Artificial features;Joint decision recognition

References:

[1] X. R. Jiang, H. Chen, Y. D. Zhao, W. Q. Wang, Automatic modulation recognition based on mixed-type features. INTERNATIONAL JOURNAL OF ELECTRONICS, 108(1): 105-114, (2021)

[2] R. Pan, H. Chen, H. Chen and W. -Q. Wang, Equalization-assisted domain adaptation for radio frequency fingerprint identification. IEEE Wireless Communications Letters, 13(7):1868-1872,(2024)

Biography

Hui Chen received the Ph.D. degree in the department of electronic engineering from the University of Electronic Science and Technology of China (UESTC), Chengdu, China, in 2013. Since January 2014, she has been with the School of Information and Communication Engineering, UESTC, where she is currently an Associate Professor. From November 2011 to May 2013, she was a visiting scholar at Columbia University, NY, USA. She has published more than 50 high-level international academic papers. Her research interests include array signal processing, wireless communication and artificial intelligence.

Title: Blind Image Super-Resolution Using Dual-Camera Capture and Deep Learning Registration

A. Pauwelyn*, M. Carré, D. Ginhac and F. Mériaudeau
Engineer
NT2I
France

Abstract

The present conference concerns the improvement of perceived image quality, in the visible spectrum, using AI (Deep Learning) approaches. More specifically, our work consists of developing Super Resolution (SR) algorithms with the aim of increasing the resolution of images in real time. In order to train these methods, pairs of Low-Resolution (LR) and High-Resolution (HR) images of the same scene are required. These images must be aligned with pixel precision, due to the cost functions we define for training. Classically, these image pairs are created by artificially degrading the HR image to create a synthetic LR image, historically by applying a simple resizing (division of the resolution by 2, 3 or 4) using bicubic interpolation followed by a blur kernel convolution. More recent works propose to apply various random degradations to HR images in order to create a space of LR images. The problem common to all these methods is the discrepancy that may exist between the LR images created and the LR images on which the model will be applied. This discrepancy makes reconstruction performance unsatisfactory in real-world scenes. To overcome this problem, we propose an innovative method of simultaneously capturing a pair of HR and LR images using two cameras of different quality and optics. This involves acquiring the same scene simultaneously using a specific optical set-up, then aligning them to pixel accuracy using image registration learning techniques. The solution we propose involves the following steps:

- Development of an optical device based on a semi-transparent splitter plate that enables simultaneous image acquisition.
- Capture of image pairs in a variety of contexts: city scenes, country scenes, indoors, outdoors, under different lighting conditions.
- Affine alignment of LR-HR images using the SIFT feature extractor and FLANN comparator.
- Pixel-accurate alignment of image pairs using a deep learning method, in the VoxelMorph framework. We have defined and optimized a network architecture as well as training and evaluation hyperparameters. The effectiveness of our approach will be illustrated by various examples.

Keywords: Image Processing, Visual Quality, Super-Resolution, Deep Learning, Deformable Image Registration, Super-resolution.

Biography

Arnaud Pauwelyn is currently a Machine Learning Development Engineer at NT2I in Saint-Étienne, France, where he focuses on developing innovative solutions for image acquisition, processing, and analysis in industrial vision, specializing in the design and implementation of deep learning networks. Since January 2023, he has been pursuing a Ph.D. at the Université Bourgogne Franche-Comté under the co-supervision of Dr. Fabrice Meriaudeau and Dr. Dominique Ginhac. His thesis, funded by a CIFRE agreement with NT2I, explores image super-resolution using deep learning. Mr. Pauwelyn holds a Master's degree in Optics, Image, and Vision from the Université Jean Monnet, Saint-Étienne, and a second Master's degree in Machine Learning Engineering from OpenClassrooms in partnership with CentraleSupélec. His academic background also includes a Bachelor's degree in Physics, Mechanics, and Engineering Sciences from the Université de Rouen. He possesses expertise in supervised and self-supervised learning, data analysis, data visualization, with proficiency in deploying models to the cloud and on embedded hardware.

Title: Nanocatalysts Induced Self-Triggering Leather Skin for Human-Machine Interaction

Yunxia Zhang*, Yoshihiro Ito, Hideyuki Miyatake and Yong Mei Chen
Lecturer
School of Physics & Information Sciences
Shaanxi University of Science & Technology
China

Abstract

Electronic skins mimicking the comprehensive functions of human skin are highly interesting for the development of human-machine interactions (HMI). Conventional conductive leathers face challenges of the nonuniform dispersion of conductive components and the complicated fabrication processes, hindering their applications for electronic skins. Herein, a novel ionically conductive leather skin is developed by in-situ self-triggering gelation of ionogel in the hierarchical structure of leather matrix. The core-shell structured liquid metal@catechin nanocatalysts enable rapid and uniform gelation within tens of seconds under ambient conditions. Resulting interpenetrating ionogel networks within leather matrix not only provide 3D continuous and highly conductive pathways for ionic transport, but also form multiple bonding for strong interfacial interactions. These advantageous properties endow leather skin with excellent mechanical robustness (tensile stress:17.8 MPa; toughness: 1590 kJ/m^3), high air transmission rate (720 mL/cm^2/h) and water vapor transmission rate (70 g/m^2/h), as well as broad environmental tolerance (-80 ~ 100 ℃). Impressively, the leather skin-based sensors exhibit stable and fast response with only 40 ms. The attractive performances of leather skin are further demonstrated by a bionic glove as a gesture-discernible wearable controller for HMI. This work opens up a new horizon for developing the ionically conductive leather skin, which will have profound implications for wearable electronic systems.

Keywords: Leather skin, Ionically conductive leather, Liquid metal@catechin nanocatalyst, Self-triggering ionogel, Bionic glove

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Biography

Yunxia Zhang is a lecturer at Shaanxi University of Science & Technology, belonging to green flexible multifunctional material innovation team. She received her degree of Doctor of Philosophy in Materials Science and Engineering from Xi'an Jiaotong University. Her current research is focused on design and synthesis of soft materials and its sensing properties and application in biological materials.

SMSE Hybrid Session: Materials for Architecture and Civil Engineering

Time: 13:30-14:25 (Afternoon), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: An Investigation of Rut Performance on Permeable Road Pavement

Chung-Lin Lin[1]*, Jhu-Han Siao[2], Tung-Chiung Chang[3], and Yu-Min Wang[4]

1,2 Ph.D. Candidate, Department of Civil Engineering, National Pingtung University of Science and Technology, Taiwan

3 Professor, Department of Civil Engineering and Geomatics, Cheng Shiu University, Taiwan

4 Professor, General Research Service Center, National Pingtung University of Science and Technology, Taiwan

Abstract

As the road usage duration increases, rutting significantly impacts driving safety, especially under conditions of high traffic volume and heavy vehicle weights. This study conducted rutting tests on permeable road pavements eight months after the road construction completion to evaluate its performance under repetitive traffic loads. The investigation started from the intersection of Nanfeng Road, extending westwards, covering 240 meters on each side of the roadway, totaling 480 meters. From March to December 2019, monthly elevation measurements were carried out using a digital level for the inner and outer wheel tracks of both the left and right lanes. The monthly elevation data was subtracted from the initial data (March 2019) to determine the changes in rut depth. Results showed that the left lane, between stake numbers A000 to A240, had the deepest rutting at an average of -2.66 mm in the inner wheel track, indicating the most significant deformation. In contrast, the outer wheel track of the right lane between B250 to B480 showed less deformation, with an average of -0.92 mm, reflecting significant differences in rutting across different road sections. Overall, the rutting condition in the study sections is classified as mild. This study demonstrates that after one and a half years of use, the mild deformation in the permeable pavement indicates sufficient resistance against rutting. The design conditions of this road section can serve as a reference for considering rutting under climate change environment.

Keywords: Permeable Road Pavement, Rutting Performance, Road Deformation, Digital Level, Sustainable Road Design, Climate Change

Biography

Mr. Lin Chung-Lin is currently a Ph.D. Candidate in the Department of Civil Engineering at National Pingtung University of Science and Technology, Taiwan and also serves as the General Manager at Yu Chen Construction Consultant Co., Ltd., Pingtung, Taiwan, specializing in the design and supervision of public construction projects in Taiwan. He has extensive experience in the field of public engineering and has been responsible for several major projects, including the Kaohsiung 10th Park and Underground Parking Lot project, the National Museum of Marine Biology and Aquarium project in Hengchun, the Kaohsiung University Section Expropriation project, and the Bay North Self-Run Land Readjustment project, as well as the construction of the Taiyi Bridge and Egret Bridge in Pingtung County. In addition, Mr. Lin Chung-Lin has been involved in various road engineering and improvement projects in Pingtung County, such as the improvement and maintenance of Route 132, Route 156, and Route 172, and has overseen key public construction projects, including park improvements and the enhancement of tourist roads in Hengchun.

Title: Electromigration of Nanosilica as a New Technology for Concrete Retrofitting, Results and Expectations

Fausto B. Mendonça[1]*, Girum S. Urgessa[2], Marcela G. Domingues[1], Bruno T. Rocco[3], Leopoldo R. Junior[3], and José A. F. F. Rocco[1]

1 Collaborating Professor in the Fundamental Science Division, Chemistry Department at Technological Institute of Aeronautics - ITA. Pça. Mal Eduardo Gomes, Brazil

2 Tenured Professor in the Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering (CEIE) at George Mason University, USA

3 Researcher in the Chemical Laboratory, Flowtest Engenharia e Pesquisa Ltda, Brazil

Abstract

Concrete durability is affected by weathering action, abrasion, and chemical attack and this may lead to reduction in desired material properties necessary to support structures. Electromigration transports material in a conductor under the influence of an applied electric field. It is important to consider the effects the electrical current resulting from the applied field may have on the conductor. The net force exerted on a single metal ion in a conductor has two opposing contributions: a direct force and wind force. Results of two small-scale tests using electromigration process as a means of transporting nanosilica to recover cement matrix integrity of aged 32 MPa concrete samples extracted from a 40-year-old structure are presented. A set up with two vessel was proposed, with 12 Vdc electrical font working for 48 h generating transportation of nanosilica (12 nm in diameter) into the aged concrete samples. Results showed that an electromigration of nanosilica into the cement matrix occurred reducing micro fissures. Additionally, deposition of silica on the sample surface was observed. Reduction of calcium in the matrix was verified with the development of hydrated calcium silicate, providing the recovery of cement matrix in increasing cement mechanical properties like strength and decreasing the porosity of the concrete matrix. Another important phenomenon is the rehabilitating of the chloride contaminated concrete structure to extend its service life; an electrochemical chloride extraction (ECE) treatment with simultaneous migration of silicate ion was performed. The next stage of this development is to replace the electric field with the diffusion phenomenon to take the nanosilica into the concrete. This may enable concrete retrofit treatment in the field.

Keywords: Electromigration, Nanosilica, Cement Matrix, Aged Cement Recovery

References:

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[3] T. T. Lima. Open. J. Civ. Eng., 13(1):1 – 24 (2023).

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Biography

Dr. Fausto Batista Mendonça holds a degree in Civil Engineering from the Rio de Janeiro State University (2001), a Master's in Applied Geosciences from the University of Brasília (2012), and a Ph.D. in Space Sciences and Technologies from the Aeronautics Institute of Technology - ITA (2017), with a Ph.D. internship at George Mason University (2016), in Washington, DC, USA. Currently, he is a Lieutenant Colonel from Brazilian Air Force conducting research on induced diffusion of nano-silica in Portland cement concrete. He is a Collaborating Professor at ITA in the Graduate Program in Space Sciences and Technologies. Having experience in structural dynamics, shockwaves on buildings, explosion shockwave effects, reinforced concrete and Nano-silica diffusion in concrete.

ICCST Hybrid Session: Cutting-edge Research of Catalysis

Time: 14:40-15:35 (Afternoon), Nov. 7th, 2024 (Thursday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Single Atom Co-Catalysts in Photocatalytic H_2 Generation: Maximizing SA Stability and Efficiency

Patrik Schmuki
Professor
FAU University of Erlangen
Germany

Abstract

In1972 Fujishima und Honda (1972) reported on the use of TiO_2 as a solar-illuminated semiconductor for the splitting of water into H_2 and O_2. Meanwhile, a large body of literature exists on photocatalytic H_2 generation using a wide variation of semiconductors, morphologies, and strategies to split water using the semiconductors suspended in an aqueous solution (with or without sacrificial agents). Many semiconductors have in common that for an efficient transfer of photogenerated charge carriers, a co-catalyst is required. For electron transfer and H_2 generation mostly Pt nanoparticles are used that are deposited onto the semiconductor surface by various techniques. Due to the precious nature of Pt, over the years, numerous efforts have been devoted to the shrinkage of the particle size and thus to enhance the utilization of the noble metal – shrinkage is, in the most extreme case, done down to an insulated single atom of Pt.

In the presentation we discuss the use of Pt dispersed and anchored as single atoms (SAs) on TiO_2 surfaces and the activation to a most efficient use for photocatalytic H_2 generation. We discuss various trapping and stabilization approaches of SAs on photocatalysts that prevent agglomeration (and according deactivation of SA Pt). Moreover, we show that only a small amount of Pt (loading density of SAs) is needed to achieve a maximum activity of a semiconductor surface.

References:

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[4]Wang Y., Qin S., Denisov N., Kim H., Bad'ura Z., Sarma B.B., Schmuki P., Advanced Materials 35 (2023) art. no. 2211814
[5]Qin S., Will J., Kim H., Denisov N., Carl S., Spiecker E., Schmuki P., ACS Energy Letters, 8 (2023) 1209 – 1214
[6]Qin S., Denisov N., Kim H., Schmuki P., Angewandte Chemie Int. (in press)

Biography

Patrik Schmuki's is a leading researcher the field of electrochemical materials science, photoelectrochemistry and photocatalysis. In particular, he has carried out pioneering work on the electrochemical growth of self-organized nanotubular transition metal oxide layers, their synthesis, properties, modification, and functional applications. The focus of his research activities in the last decade has been on photocatalytic systems – based on titania, or other functional oxide nanostructures. Most recent research is exploring single atom noble metal co-catalysts for photocatalytic generation of hydrogen.

Patrik Schmuki's track record includes >750 publications in peer-reviewed journals, with more than 55000citations and an h-index of 114. He was Thomson Reuters Highly Cited Researcher from 2013-2021.

Patrik Schmuki studied Physical Chemistry at the University of Basel (CH) and obtained his PhD from ETH Zurich in 1992. After research stays at Brookhaven National Laboratory, NY (USA), and National Research Council of Canada, he was appointed Associate Professor for Microstructuring of Materials at EPFL Lausanne. In 2000, he joined the Department of Materials Science and Engineering at University of Erlangen-Nuremberg as Full Professor and head of the Institute for Surface Science.

Patrik Schmuki is a Fellow of the Electrochemical Society, the International Society of Electrochemistry and the Royal Society of Chemistry and the recipient of numerous awards such as the ETH Medal, the Swiss National Science Foundation

fellowships for Advanced Researchers and the PROFIL grant, the NACE H.H. Uhlig Award, the Volta Award of the Electrochemical Society and the ECS H.H. Uhlig Award as well as the Rudolf Zahradnik Award (CZ), Giulio Natta Award (Milano) and most recently the Heinz Gerischer award of the Electrochemical Society.

Patrik Schmuki received the prestigious Reinhart Koselleck Funding from the German Research Foundation and was awarded an ERC Advanced Investigator Grant. He has been active as guest PI and/or visiting professor at the University of Burgundy, Dijon (F), King Abdulaziz University, Saudi-Arabia, and Palacky University Oloumuc, Czech Republic.

Title: Function-oriented Bifunctional Mg & MoP Modified Polymeric Carbon Nitride for Selective Photoreduction of CO_2 to CH_4

Junying Tang
Assistant Professor
School of Energy and Power Engineering
University of Shanghai for Science and Technology
China

Abstract

Semiconductor photocatalysts is promising for alleviating global climate warming and world energy crisis but limited for the practical application due to the rapid recombination of electrons and holes, limited photo-absorption and inadequate adsorption of CO_2. The evolution of valuable derivatives CH_4 involves eight proton-coupled electrons transfer, where its kinetics are of great significance for the production efficiency and selectivity. Constructing photocatalysts with dual-function active sites can coordinate the photogenerated electrons transfer and the adsorption energy of key intermediates, thereby converting CO_2 into valuable methane with high efficiency. However, the role that the interfacial position of functional catalysts played in determining the activity and selectivity of CO_2 photoreduction remains unclear. Herein, the importance and mechanism of interfacial position of bi-functional catalysts in regulating CO_2 photoreduction activity and product selectivity were systematically introduced in this report.

Keywords: iron oxide nanoparticle, nanomotor, immunotherapy, chemotherapy and starvation therapy.

Biography

Junying Tang, is an Assistant Professor and Postgraduate Supervisor of School of Energy and Power Engineering, University of Shanghai for Science and Technology. She is engaged in the research of CO_2 capture and in-situ conversion, green hydrogen production and application. She has presided over 1 project of National Natural Science Foundation and 1 project of Shanghai Education Foundation, and published more than 20 papers in international SCI journals such as Joule, ACB, CEJ, etc.

ICCST Hybrid Session: Energy Conversion, Electrocatalysis and Sustainable Chemistry

Chaired by **Dr. Kanta Ogawa,** Postdoctoral Research Fellow, Tokyo Institute of Technology, Japan

Time: 09:00-10:20 (Morning), Nov. 8th, 2024 (Friday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Multi-hierarchy Design Strategy of Electrocatalysts for DMFCs

Chenjia Liang* and Weiping Ding
Key Laboratory of Mesoscopic Chemistry
School of Chemistry and Chemical Engineering
Nanjing University
China

Abstract

Electrocatalysts are pivotal for direct methanol fuel cells (DMFCs). While adjusting catalytic center morphology or doping with heteroatoms can speed up reactions, it doesn't prevent metal site dissolution in harsh environments, leading to a loss of active area and increased internal resistance due to metal-proton membrane interactions. Single regulation of metal centers is insufficient, suggesting a strategy of ordered, multi-hierarchy mesoscale structure catalysts for methanol oxidation and oxygen reduction reaction. Our innovative approach includes: **(1) High-energy supports**: The design of innovative corrosion-resistant anode and cathode catalyst supports, including NiSi2 and SiC-Ni, emphasizes the regulation of active centers through electronic effects. The corrosion potential, proven to significantly exceed the actual operating potential of DMFC using DEMS, is a key feature. **(2) Micro-environment structure**: The construction of a graphitized nest-type structure and organically modified high-activity alloy aims to balance activity and stability. After ADT, the mass activity meets DOE standards. In summary, rational, ordered mesoscale catalyst design is essential for reducing precious metal usage and improving electrocatalytic efficiency in fuel cells.

Keywords: Multi-hierarchy catalyst; Methanol oxidation reaction; Oxygen reduction reaction; DMFC

References:

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Biography

Weiping Ding received his bachelor's and doctor's degrees from the Department of Chemistry, Nanjing University. He has engaged in postdoctoral research in the National Laboratory of Solid Microstructure, Department of Physics, Nanjing University, as well as researched in the Department of Chemical Engineering, University of California at Berkeley, and the Department of Chemistry and Biology, Harvard University, successively. He is currently a professor in the School of Chemistry and Chemical Engineering, Nanjing University and director of the Key Lab of Mesoscopic Chemistry. In recent years, his advocacy, about "Meso Catalysis" research, has achieved fruitful innovative results in hydrogenation, oxidation, acid catalysis, fuel cell catalysts, and electrocatalysis, which are being transferred to industrial applications.

Chenjia Liang is, currently, pursuing for a doctor's degree at Nanjing University under the guidance by Professor Weiping Ding. His research interests focus on the novel design of electrocatalyst under mesoscale for oxygen reduction reaction and methanol oxidation reaction in DMFC.

Title: Band Gap Narrowing by Suppressed Lone-pair Activity of Bi^{3+}

Kanta Ogawa
Postdoctoral Research Fellow
Tokyo Institute of Technology
Japan

Abstract

Post-transition metal cations such as Sn, Sb, Pb, and Bi are important components for solar-to-energy conversion systems.1 Their unique structural and electronic features are derived from the lone pair (ns^2np^0) configuration. Often, the stereochemical activity of the lone pair results in a distorted local atomic environment of these cations in crystals.

Our question is "what happens if the cationic lone pair is confined to an un-distorted site in a crystal". Based on the underlying orbital interactions (Fig. 1), we predict that such a confined lone pair significantly narrows the band gap. Validation is performed for Bi^{3+} using a cation substitution approach. To realize a high-symmetry Bi^{3+}, we focus on isovalent substitutions with Y^{3+} because of its similar ionic radius and absence of a lone pair. Through the survey of the coordination environments, Bi2YO4X with un-distorted Y^{3+} is singled out as a candidate for Bi substitution. DFT calculation supported that introducing Bi^{3+} to the Y^{3+} in Bi2YO4X results in a narrowed band gap. The band gap narrowing was also demonstrated experimentally through the Bi3+ doping to Y^{3+} by using solid-state reaction synthesis. The present lone pair engineering offers a strategy for controlling the optoelectronic structure of the post-transition metal compounds for the intended application beyond the limits of known materials.[2]

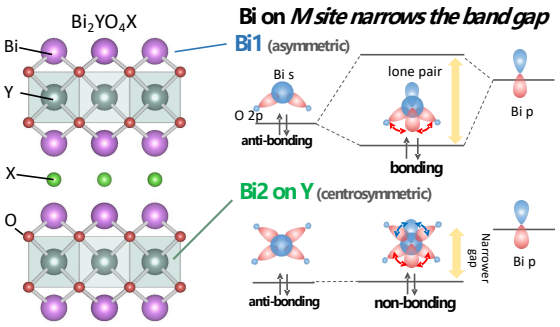

Fig. 1. In Bi_2YO_4X (X =Cl, Br, I), Bi site is asymmetric while Y site is centrosymmetric. At the asymmetric site (Bi1), the anti-bonding combination forming the upper valence band is stabilized by Bi p coupling. When Bi is located at the centrosymmetric Y site (Bi2), this orbital interaction is suppressed due to destructive interference.

Keywords: Semiconductor, Post-transition cations, Lone-pair, Photocatalyst

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[2] K. Ogawa, R. Abe and A. Walsh, J. Am. Chem. Soc., 2024, 146, 5806−5810.

Biography

Kanta Ogawa is a JSPS (Japan Society for the Promotion of Science) postdoctoral research fellow at the Tokyo Institute of Technology. He received his B.A. (2017), M.A. (2019), and Ph.D. (2022) degrees in Engineering from Kyoto University (The supervisor was Prof. Ryu Abe). From 2022-2024, he joined Prof. Aron Walsh's group in London as a JSPS overseas postdoctoral research fellow. From April 2024, he is based on the Tokyo Institute of Technology (Prof. Fumiyasu Oba's lab). Dr. Kanta Ogawa's research focuses mainly on understanding and controlling electronic structures of semiconductor materials, especially for solar-to-energy conversion systems such as water-splitting photocatalysts.

Title: Eco-Friendly Green Synthesis of Co^{2+} and Mn^{2+} ion Doped ZnO Nanoparticles for Silicon Solar cell Applications

Shelan M. Mustafa*, Azeez A. Barzinjy and Abubaker H. Hamad
Lecturer
Department of Automation Industrial Technology
Erbil Polytechnic University
Iraq

Abstract

Global warming is a threat for human health in context of the growing organic or inorganic pollutants, which are produced by diverse products output. Therefore, the green synthesis method successfully eradicates the harmful and/or toxic effects usually associated with wet chemical methods. Different concentrations (0, 1, 5 and 10 at%) of Co^{2+} and Mn^{2+} ion-doped ZnO nanoparticles (NPs) were synthesized by eco-friendly green synthesis method by exploiting dandelion leaf extract as a solvent at lower temperature 70 ℃ and annealed the NP at 600 ℃ for 3 h to grow the crystallinity of the NPs. The phase purity, crystal structure and crystallinity of the as-synthesized product was verified by XRD, showing hexagonal-Wurtzite phase structure. SEM and TEM images of the NPs demonstrated sub-100nm spherical shaped particles. Fourier transform infrared (FTIR) displays the band at 523 cm^{-1} is assigned to asymmetric stretching of the Zn – O tetrahedron. Both UV-Visible and photoluminescence studies confirm the near band edge emission of ZnO and successive incorporation of Co^{2+} and Mn^{2+} ion-doped ZnO host. In order to increase the efficiency of the solar cell power conversion on Polycrystalline silicon solar cells, different layers of Co^{2+} and Mn^{2+} ion-doped ZnO NPs coated on bare polycrystalline silicon are considered to be a promising strategy. Furthermore, solar cell efficiency decreases with further coating of NP layers and/or thickness. Optimum solar cell power efficiency was observed for 5%Mn ion doped ZnO NP with three layers. In addition, Radish and Cress plants grown using NP supernatant showed high environmental biocompatibility using Dandelion Leaf extract.

Keywords: ZnO NP, nanoparticles, Green Synthesis, Dandelion Leaf extract

Biography

Dr. Shelan M. Mustafa, hailing from Erbil, Iraq, is a renowned academic deeply versed in physics and nanotechnology. She earned her Bachelor of Science degree in General Physics and her Master of Science degree in Nanotechnology from Salahaddin University, Erbil, in 2001 and 2010, respectively. Continuing her academic journey, she obtained her Ph.D. from the Scientific Research Centre at Soran University.

In October 2011, Dr. Mustafa began her academic career at Erbil Technology College at Erbil Polytechnic University. She quickly advanced and was appointed Vice Head of the Road Department in 2012. Her leadership abilities and expertise were further recognized when she assumed the role of Head of the Electricity Department, a position she held from 2014 to 2020. During her tenure, she played a pivotal role in transforming the department into the Automation Industrial Technology Engineering department, which offers both diploma and Bachelor's degrees. On July 25, 2024, she was appointed Director of Scientific and Higher Education at the Erbil Polytechnic University Presidency, a position she continues to hold.

Dr. Mustafa's research interests are extensive and influential, encompassing pioneering fields such as nanotechnology, renewable energy, and solar cell technology. She has devoted considerable effort to studying green synthesis methods, nanomaterials, and semiconductor nanostructure devices. Her research also delves into the physical properties of materials at the nanoscale, with a particular focus on surface structure analysis and X-ray diffraction techniques. Dr. Mustafa's contributions in these areas have significantly enhanced the academic and practical understanding of nanotechnology and renewable energy solutions.

ICCST Hybrid Session: Medicinal Chemistry

Chaired by **Dr. Dae Dong Sung,** Professor, Korea University, Samse Medical Center, Republic of Korea

Time: 10:35-11:55 (Morning), Nov. 8th, 2024 (Friday); Time Zone: GMT+9, Japan Time

Place: Room Fuji, 4F, Hilton Nagoya

Title: Application of Nucleophilic Substitution Reaction Mechanism of Aniline Derivatives to Biomedicine Developments

Dae Dong Sung
Professor
Korea University
Samse Medical Center
Republic of Korea

Abstract

Recently, the field of chemical reaction mechanism tools has made a significant contribution to the field of biomedicine. Among the areas of biomedicine, reaction mechanism tools are making a groundbreaking contribution to treating the anti-aging field, which aims to realize the dream of gene scissor therapy and life extension. Understanding of reaction mechanism is an important role in identifying and resolving the results of measurements of analysis of cellular heterogeneity in gene expression. Although the latest physiological measurements are used to identify the diseases and to provide a lot of measurement data, there are many difficulties in accurately determining the cause of the disease, diagnosing and finally treating it. Recently, new technologies have been used as variant of flow cytometry based on fluorescence, light scattering and separation techniques to sort cells and to confirm the results of measurements. These tools are based on molecular spectroscopy. Laser capture microdissection based on mass spectrometry is helpful to identification that is coupled to a microscope and focused on a tissue. Molecular mass spectrometry is contributed to RNA sequencing tool based on headspace solid-phase microextraction/gas chromatography-mass spectrometry. Inflammation is one of the major causes of cellular senescence. Inflammatory aging is characterized by increased levels in the proinflammatory factors in the cells. The cell changes lead to the aging of the cells. Senescent fibroblasts and keratinocytes secrete a large number of senescent associated secretory phenotypes including the pro-inflammatory cytokines induce cell senescence by promoting the production of ROS and activating the ATM /p53/p21-signaling pathway. Fibroblasts positive for SA-beta-gal activity and p16 expression are available to reveal immunofluorescent imaging to be identified the senescent fibroblasts. Utilizing the separation techniques based on mass spectrometry in the field of biomedicine can help in understanding and applying treatments for a multitude of different disease or diverse types of cancer, and even expand upon efficient and reliable diagnosis in clinical settings. However, despite the use of these technologies, interpretation of the measured results is very difficult. Chemical reaction mechanism, especially, nucleophilic substitution reaction mechanism tools are needed to accurately interpret these measurement results to determine the cause of chronic diseases and develop treatments. Aniline and its derivatives serve as important molecules in biomedicine. Understanding the reaction mechanism of aniline helps to accurately understand the base reactions of DNA in our body cells. How the length of telomeres at the ends of DNA in our body's cells increases or decreases can be understood by applying the reaction mechanism of aniline and its derivatives. Using the nucleophilic reaction mechanism tools of aniline and their derivatives in the field of biomedicine are available to understand and to apply also treatments for multitude of different disease as Alzheimer's disease and divers types of cancer, and to expand on efficient and reliable diagnosis in clinical treatments.

Keywords: Aniline, Reaction mechanism, Biomedicine, Inflammatory aging, Telomere, Gene expression

References:

[1] Dae Dong Sung, The Role of Chemistry in Contribution to Biomedicine Recently, J. Clin. Biomed. Adv. Vol.3. 1-12(2024)

[2] Dae Dong Sung et. al. Theoretical studies of the nucleophilic substitution of halides and amine at a sulfonyl center, J. Phys. Chem A. 7073-7079 (2009).

Biography

Professor Dae Dong Sung studied chemistry at Dong-A University as BS and MS in 1969 to 1975, and Princeton University as Ph.D. 1982. He joined the research group of Professor Donald Bethel at Liverpool University as the Royal Society Fellow of Chemistry UK. He joined the research group of Professor Hideo Tomioka at Mie University Japan as visiting Professor. He studied very fast intermediate molecules, reaction mechanisms of various nucleophilic substitution reaction especially amines and anilines, theoretical calculation of reaction mechanisms of nucleophilic substitution in the field of physical organic chemistry. He worked as a professor after completing his degree, he worked at Dong-A University and Korea University in the field of physical organic chemistry. Now he has been contributing to the development of new drugs and anti-aging drugs that can be applied to the treatment of chronic diseases in the biomedicine area at Samse Medical Center. He has published more than 240 research articles in SCI journals and has given more than 60 invited oral presentations at international academic conferences around world.

Title: Development of Efficient Glycosides Synthesis Strategies and Application for Drug Discovery

Jiang Wang
Researcher
Lingang Laboratory
China

Abstract

C-glycosides, which are abundant in both natural products and drug molecules, exhibit high biological activity and enhanced in vivo metabolic stability. However, there are currently few reports on the synthesis methods of C-alkyl glycosides, usually involving active reagents such as organometallic reagents or Michel receptors. Therefore, developing efficient strategies for constructing C-alkyl glycosides using inexpensive and readily available reagents remains a challenge. We have long been committed to the efficient synthesis methodology of glycoside compounds and the research of innovative carbohydrate drugs, achieving a series of achievements. We have utilized C-H activation methods to construct amino acid C-alkyl glycosides and indole-2-deoxycarbosides, and employed cross-coupling methods to efficiently and stereospecifically construct β-deoxy-C-glycosides and α-C-alkyl glycosides catalyzed by transition metals. Currently, we have constructed a library of over 10 scaffolds comprising approximately 500 structurally diverse glycoside compounds. Among these, we have discovered a novel C,O-spiroaryl glycoside SGLT2 inhibitor, LH-1801, which is currently undergoing Phase III clinical trials. LH-1801 is a structurally novel SGLT2 inhibitor used for treating diabetes. It exhibits excellent SGLT2 inhibitory activity and selectivity, demonstrating significant oral hypoglycemic effects in six diabetes animal models and having advantages such as low effective dose and significant hypoglycemic effects. The 5 mg oral dose of LH-1801 showed great effects in promoting urinary glucose excretion in healthy volunteers after single administration.

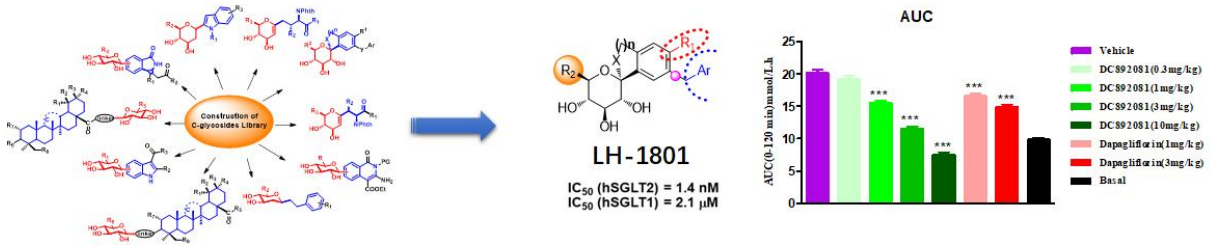


Figure 1. Construction of the C-glycosides library and discovery novel diabetes drug candidate

Keywords: Carbohydrates, Highly Efficient Synthetic Methodology, SGLT2 Inhibitor, Drug Candidate of Diabetes

References (representative):

[1] Liu, Y.; Wang, Y. et al. Palladium-Catalysed C(sp3)-H Glycosylation for Synthesis of C-Alkyl Glycoamino Acids. Angew. Chem. Int. Ed., 2020, 59, 3491.

[2] Yu, C.; Liu, Y. et al. Ir(I)-Catalyzed C-H Glycosylation for Synthesis of 2-Indolyl-C-deoxyglycosides. Adv. Synth. Catal. 2021, 363, 4926 – 4931.

[3] Zeng, M.; Yu, C. et al. Cobalt(II)-Catalyzed C(sp3) – C(sp3) Coupling for the Direct Stereoselective Synthesis of 2-Deoxy-C-Glycosides from Glycals. Angew. Chem. Int. Ed., 2023, 62, e202300424.

[4] Yu, C.; Xu, Y. et al. Direct Construction of C-Alkyl Glycosides from Non-activated Olefins via Nickel-Catalyzed C(sp3)-C(sp3) Coupling Reaction. Adv. Sci., 2024, 2307226.

Biography

Prof. Jiang Wang mainly focuses on the medicinal chemistry, chemical biology, and drug design. She mainly focuses on discovery and development novel drug candidates against metabolic diseases, a number of lead compounds with highly biological activities and druggability were discovered. Among them, 3 drug candidates have been entered in clinical trials,

2 drug candidates have entered Phase II/III clinical trials. In addition, 4 drug candidates were successfully licensed to Pharmaceutical Co., Ltd. Prof. Wang has published a total of 122 academic articles, with 64 of them being published as corresponding author in peer-review journals, such as Chemical Reviews, Cell Metabolism, Nature Communications, Angewandte Chemie International Edition, Advanced Science, Journal of Medicinal Chemistry and European Journal of Medicinal Chemistry., etc., and these articles have been cited more than 8000 times by others. Prof. Wang received the Most Cited Chinese Researchers from Elsevier reports from 2020 to 2023. And she has published 4 books as chapter author as well and been issued 42 patents.

Title: Stereoselective Synthesis of the Novel Anti-Influenza Medicine: Baloxavir Marboxil using Photocatalyst

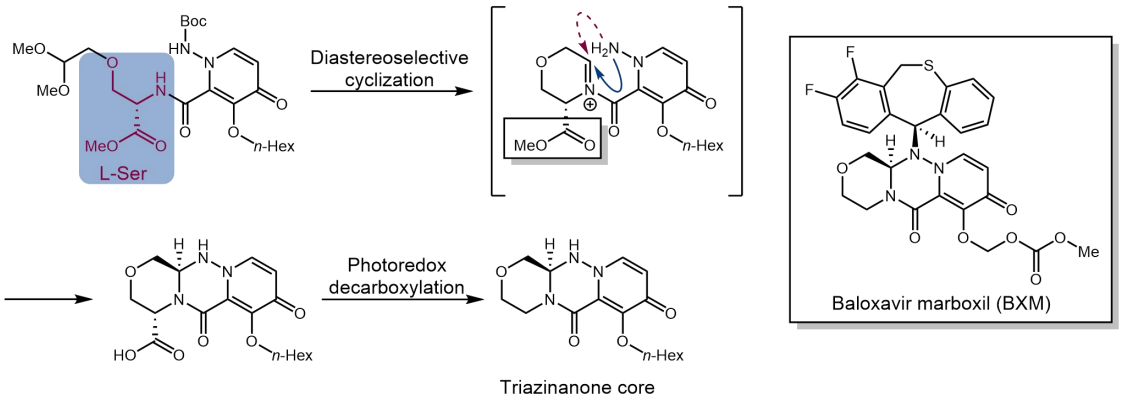
Kazuya Okamoto*, Shohei Majima, Toshikazu Hakogi

Research Division, Shionogi Pharma & Co., Ltd., 1-3, Kuise Terajima 2-Chome, Amagasaki, Hyogo 660-0813 Japan

Abstract

Baloxavir marboxil (BXM) is a potent drug used for treating influenza infections. The current synthetic route to BXM is based on optical resolution,[1-3] which results in the loss of nearly 50% of the material. To supply the medicine more efficiently, especially in emergency circumstances, more productive method is required. Therefore, we explored a stereoselective synthetic route. As a result, the stereoselective synthesis was achieved using a common, widespread feedstock, L-serine, as a chiral building block following photoredox decarboxylation. Compared to the chiral resolution route, the current way uses 2 fewer steps, and the overall yield is improved from 12% to 48%.[4]

Keywords: Baloxavir marboxil, stereoselective cyclization, photoredox decarboxylation



References

[1] K. Anan, M. Miyagawa, A. Okano, H. Sugimoto, N. Miyake, N. Fukui, A. Kijima, E. Tanimoto, M. Kawai, *Org. Process Res. Dev.*, **28**, 2117–2127, (2024).

[2] N. Fukui, T. Maki, K. Ban, A. Kijima, S. Shibahara, K. Okamoto, S. Kamiya, T. Yasukata, T. Tsuritani, *Org. Process Res. Dev.*, **28**, 2128–2138, (2024).

[3] N. Fukui, S. Shibahara, T. Maki, T. Ueno, S. Yanagisawa, K. Okamoto, E. Tanimoto, T. Ohara, T. Yasukata, T. Tsuritani, *Org. Process Res. Dev.*, **28**, 2139–2149, (2024).

[4] K. Okamoto, T. Ueno, Y. Hato, Y. Kawaguchi, T. Hakogi, S. Majima, T. Ohara, M. Hagihara, N. Tanimoto, T. Tsuritani, *J. Org. Chem.*, **89**, 9937–9948, (2024).

Biography

Dr. Kazuya Okamoto has studied chemistry and received his B.S. in Kyoto Pharmaceutical University, Japan in 1999, and then his M.S. in Kyoto University, Japan in 2001. Then he started his career at SHIONOGI & CO., LTD. in the field of medicinal chemistry and process chemistry. During that time, he received Ph.D. in pharmaceutical science in Hokkaido University, Hokkaido in 2013, then experienced a year postdoctoral stay at David W.C. MacMillan's laboratory in Princeton University, U.S in 2015. Currently, he is a manager at Shionogi Pharma. His research focus lies on the continuous manufacturing, especially on flow chemistry.

Posters of SMSE

Title: Renal Regeneration Effect of Human Fat Derived Collagen in Partial Nephrectomy Animal Model

Bo Hyun Yoon[a]*, Eun Hye Lee[b], Minji Jeon[b], Jae-Wook Chung[c], Jun Nyung Lee[c], Yun-Sok Ha[c], Tae Gyun Kwon[c], and Bum Soo Kim[c]

a BioMedical Research Institute, Kyungpook National University Hospital, Republic of Korea

b Joint Institute for Regenerative Medicine, Kyungpook National University, Republic of Korea

c Department of Urology, School of Medicine, Kyungpook National University, Republic of Korea

Abstract

Chronic kidney disease (CKD) is a major public health problem in worldwide. Based on past studies, maladaptive repair leads to cell death, endothelial dysfunction, tubular epithelial cell senescence, inflammatory responses and fibrosis. To regenerate tissues, differentiation of mesenchymal stromal cells and angiogenesis are highly required. Extracellular matrix (ECM) helps these repair processes and is mostly composed with collagen. We extracted collagen from human perirenal adipose tissue by passing delipidation, decellularization, lyophilization, and sterilization. Collagen sheet was cut into 1x1x5mm^3 and implanted into 3/4 nephrectomized tissue. In serum analysis, we observed elevated BUN, creatinine, and cystatin C in nephrectomy group and collagen implantation significantly decreased BUN and cystatin C. In tissue examination, nephrectomy induced up- regulated pro-inflammatory genes (IL-6, TNF-α, IL-8), anti-inflammatory genes (IL-4, IL-10, IL-1Ra), kidney regeneration markers (Wt1, PAX2), and lymphocytes markers (CD4, CD8) and these genes were suppressed from collagen sheet. We counted number of glomeruli around injury site in kidney, and we observed increased number of glomeruli in collagen implanted group compared to nephrectomy group. We need further study for effect of human adipose derived collagen sheet in kidney injury. In the study, we could conclude that human adipose derived collagen sheet effectively regenerated injured kidney in animal model.

Keywords: Kidney, Regeneration, Human fat derived collagen, nephrectomy

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[2] Wang PF, Chiu AW, Lin YM, Lin CY, Shih HJ. Effect of fibrin sealant aided with Dexon mesh for renal repair in a rat model of partial nephrectomy. Int J Surg 2014;12:304-9.

Biography

She earned a Bachelor's degree in medical laboratory science from Daegu Health College.

Title: Stretchable Pressure Sensor with Wide Sensing Range for Gait Analysis

Chanho Jeong*, Hyunjong Lee, InSung Choi, Eunki Baek, SoHee Kim, SangjunPark, Junyoung Hwang, Dongyook Kim, Jaehoon Park, and Youngjun Yun

School of Semiconductor • Display Technology

Hallym University

Republic of Korea

Abstract

There is growing interest in human motion detection with the rapid development of wearable sensors. In this study, we introduce a stretchable piezoresistive pressure sensor for gait analysis. The sensor was fabricated using a micro-cracked gold (Au) layer on a stretchable styrene ethylene butylene styrene (SEBS) substrate. Thermally evaporated Au atoms, which can penetrate into the SEBS polymer network and form current conduction pathway, work as piezoresistive sensor with high stretchability of 50%. The sensor showed a gauge factor of 14.14 with high deposition rate (5 Å/s) and a gauge factor of 9.36 with low deposition rate (0.5 Å/s) over a wide pressure range of 0-150 KPa, respectively (Fig1.a). Furthermore, the stretchable sensor demonstrated stable durability after 1000 cycles of testing with strain of 30% (Fig1.b). We conducted analysis of foot pressure distribution and motion detection using 6x3 pressure sensor array (Fig1.c). These piezoresistive sensor array shows the potential for human motion detection by gait analysis.

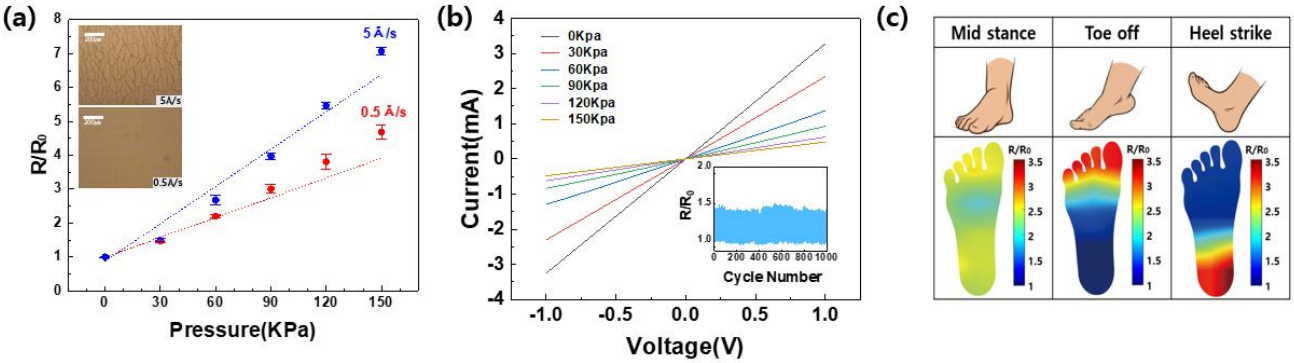


Figure1 (a) Relative resistance of the pressure sensor deposited at different pressures. The inset is optical microscopy images of the pressure sensor with 0 KPa at different deposited rates (0.5, 5 Å/s), scale bars: 200 ㎛. (b) The current – voltage curve of the sensor at different pressures (0-150 KPa). The inset is durability test with strain of 30%. (c) Pressure sensor gait distribution for the three different motion detection (mid stance, toe off, heel strike).

Keywords: stretchable, pressure sensor, microcrack

Reference:

[1] Yeongjun Lee, Science advances, Vol. 7, No. 23 (2021).

Biography

Chan-Ho Jeong is currently a M.S. Student in school of Semiconductor • Display Technology from Hallym University. He focuses on wearable sensors, organic field effect transistors and organic photodiodes.

Title: The Role of Pyruvate Dehydrogenase Kinase 4 in Prostate Cancer

Eun Hye Lee[a]*, Bo Hyun Yoon[b], Minji Jeon[a], Jun Nyung Lee[c], Tae Gyun Kwon[c], Bum Soo Kim[c,d], Jae-Wook Chung[c], and Yun-Sok Ha[c]

a Joint Institute for Regenerative Medicine, Kyungpook National University, Republic of Korea

b BioMedical Research Institute, Kyungpook National University Hospital, Republic of Korea

c Department of Urology, School of Medicine, Kyungpook National University, Republic of Korea

d Department of Urology, School of Medicine, Kyungpook National University Hospital, Republic of Korea

Abstract

Prostate cancer ranks as the second most common cancer in men globally and represents a significant cause of cancer-related mortality. Metastasis, the spread of cancer cells from the primary site to distant organs, remains a major challenge in managing prostate cancer progression. Pyruvate dehydrogenase kinase 4 (PDK4) is implicated in regulating aerobic glycolysis and has emerged as a potential player in various cancer types, yet its role in prostate cancer remains poorly understood. In this study, we aimed to investigate the involvement of PDK4 in prostate cancer progression using cell lines and human tissue specimens. We found elevated expression of PDK4 in prostate cancer cell lines compared to normal prostate cells, with particularly high levels observed in DU145 and LnCap cell lines. Knockdown of PDK4 in these cell lines resulted in suppressed invasion ability, indicating a potential role for PDK4 in prostate cancer metastasis. Furthermore, our results revealed alterations in epithelial-mesenchymal transition (EMT) markers and downstream signalling molecules following PDK4 suppression, suggesting its involvement in modulating invasion-related pathways. Analysis of patient tissue samples confirmed elevated PDK4 expression in prostate cancer tissues compared to normal prostate tissues. Overall, our findings suggest that PDK4 may contribute to prostate cancer progression and metastasis, highlighting its potential as a therapeutic target for combating this disease.

Keywords: Pyruvate dehydrogenase kinase 4, Prostate cancer, Metastasis

Reference:

[1] Rawla, P., Epidemiology of Prostate Cancer. World J Oncol, 2019. 10(2): p. 63-89.

[2] Gandaglia, G., et al., Impact of the Site of Metastases on Survival in Patients with Metastatic Prostate Cancer. Eur Urol, 2015. 68(2): p. 325-34.

Biography

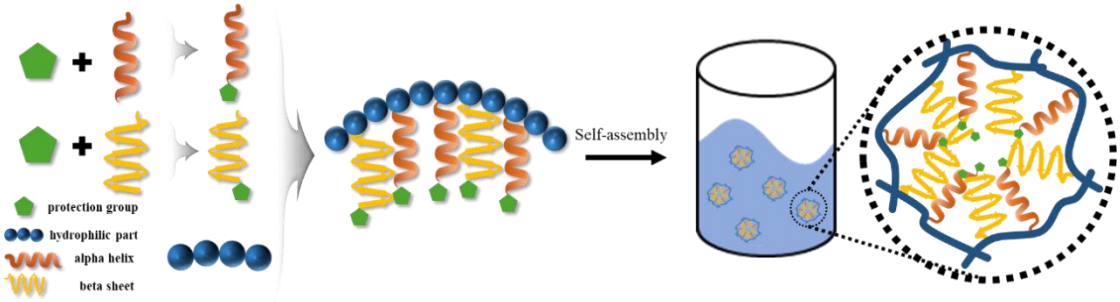
She earned Ph.D. major in pathology from Kyungpook National University.

Title: Bio-inspired Self-assembly of Poly(aspartic acid)s Grafted with Oligo(L-leucine) and Oligo(L-valine)

Heeseon Yoo*, Chaewon Woo, Jimin Jeong, Sara Han, and Jae Hyun Jeong
Dept. of Chemical Engineering
Soongsil University
Republic of Korea

Abstract

Amphiphilic polymers with self-assembly capabilities hold significant potential for drug delivery, owing to their unique ability to form water-soluble surfaces that encapsulate hydrophobic cores in aqueous environments. In this study, we present a novel approach to engineer self-assembling poly(aspartic acid) derivatives grafted with oligo(L-leucine) and oligo(L-valine), which incorporate both α-helical and β-sheet structures within a single polymer chain. This dual-structure design allows for precise control over the degree of substitution (DS) of α-helices and β-sheets within the self-assemblies. By fine-tuning the DS and the degree of polymerization (DP) of these amino acid grafts, our method enables the creation of self-assembled structures that closely mimic the composition and functionality of native proteins. This innovative approach opens new avenues for the design of biomimetic materials with potential applications in drug delivery and beyond.



Keywords: Amphiphilic polymers, Self-assembly, Poly(aspartic acid)s, Alpha helices, Beta sheets

Biography

Heeseon Yoo is currently a M.S. course in the Soongsil University from South Korea. Her research focuses specifically on the theragnostic drug delivery system.

Title: Properties of Concretes with the Addition of Carbon Fibers Recovered from Advanced Products of the Automotive Industry and the Renewable Energy Sector

Julita Krassowska[1]* and Małgorzata Grądzka-Dalhe[2]

1 Faculty of Civil and Environmental Engineering, Bialystok University of Technology, Poland

2 Faculty of Mechanical Engineering, Bialystok University of Technology, Poland

Abstract

This article presents the results of studies on the properties of concrete with the addition of carbon fibers recovered from the recycling of advanced products in the automotive industry and the renewable energy sector[1,2]. The mechanical properties of concrete, such as compressive strength, tensile strength, flexural strength, and Young's modulus, were analyzed. The results showed a significant improvement in the flexural strength of the concrete, which increased by up to 50% compared to concrete without the addition of carbon fibers. Additionally, the positive impact of carbon fibers on other mechanical properties was observed, suggesting that recycled carbon fibers can be an effective and environmentally friendly solution for enhancing the properties of concrete. In addition, microscopic observations were made of the microstructure of the tested materials using a CT scanner and of the fracture surfaces after strength testing using a SEM. The results of the observations indicate a very favourable distribution of carbon fibers in the concrete - bundles of long fibers promote the strength of the material, while randomly distributed individual fibers counteract the crack propagation of the concrete. The study's findings highlight the potential application of recycled carbon fibers in practical construction uses, contributing to sustainable development in the construction sector.

Keywords: concrete, Recycled carbon fiber (RCF), Flexural strength, Compressive strength, Microstructure

The work was carried out at the Bialystok University of Technology. Project supported by the Ministry of Science in the frame of “Regional Initiative of Excellence”.

References:

[1] A. Patchen, S. Young, D. Penumadu, An Investigation of Mechanical Properties of Recycled Carbon Fiber Reinforced Ultra-High-Performance Concrete, Materials 16 (2023) 314. https://doi.org/10.3390/ma16010314.

[2] F. Sayed Ahmad, G. Foret, R. Le Roy, Bond between carbon fibre-reinforced polymer (CFRP) bars and ultra high performance fibre reinforced concrete (UHPFRC): Experimental study, Construction and Building Materials 25 (2011) 479 – 485. https://doi.org/10.1016/j.conbuildmat.2010.02.006.

Biography

Main interests include innovative building materials, particularly concrete with basalt fibers, applications of cement composites in infrastructure constructions, and technologies for the production of prefabricated concrete elements.

Title: The Use of Low-emission Cements for Concrete with Basalt Fibers and Minibars

Julita Krassowska[1]*, Grzegorz Świderski[1], and Andrzej Kazberuk[2]

1 Faculty of Civil and Environmental Engineering, Bialystok University of Technology, Poland

2 Faculty of Mechanical Engineering, Bialystok University of Technology, Poland

Abstract

The study examines the impact of basalt minibars and fibers on low-emission cement concrete, focusing on controlling cracking and increasing fracture toughness.

Basalt fibres (BFs) are obtained from basalt rocks through melting and drawing process. According to Sim et al. [1] the BFs have better tensile strength than the E-glass fibres, greater failure strain than the carbon fibers as well as good resistance to chemical attack, impact load and fire. Kabay [2] reported that the addition of short basalt fibers resulted in decrease in compressive strength and at the same time the enhancement of fracture energy and reduction of abrasive wear of concrete. Patnaik et al. [3] research the influence on strength using both basalt fibres (BF) and minibras (MB) in concrete. The compressive strength is not typically significant, the primary advantage of using both basalt fibres (BF) and (MB) in concrete compression lies in achieving a transition from a brittle to a more ductile failure mode.

These cements are formulated to emit fewer greenhouse gases and other pollutants compared to traditional variants. The research analyzes alterations in fracture mechanics attributes based on variations in microfiber content (0, 2, 4, 8 kg/m^3), cement type, and water-to-cement ratio (*w/c*). Results indicate that incorporating basalt microfibers enhances the concrete's resistance to crack initiation and propagation. Specifically, there is a notable increase in the stress intensity factor for CEMI 42.5R concrete at *w/c* =0.5 by 27% and at *w/c* =0.4 by 62%. Similarly, for CEM II 42.5R/A-V concrete, enhancements are observed at *w/c* =0.5 by 29% and at *w/c* =0.4 by 30%. These findings underscore the significant improvement in mechanical properties achieved by introducing microfibers into low-emission cement-based concrete.

Keywords: concrete, basalt minibars, basalt fibers, fracture parameters

The work was carried out at the Białystok University of Technology financed by the Ministry of Science and Higher Education of the Republic of Poland; project number WZ/WB-IIL/6/2023.

Project supported by the Ministry of Science in the frame of “Regional Initiative of Excellence”.

References:

[1] J. Sim, C. Park, D.Y. Moon, Characteristics of basalt fibre as a strengthening material for concrete structures, Composite Structures Part B (2005) 504 – 512.

[2] N. Kabay, Abrasion resistance and fracture energy of concretes with basalt fiber, Construction and Building Materials 50 (2014) 95 – 101. https://doi.org/10.1016/j.conbuildmat.2013.09.040.

[3] A. Patnaik, L. Miller, S. Adhikari, C. Standal Per, Basalt FRP minibar reinforced concrete, (2013).

Biography

Main interests include innovative building materials, particularly concrete with basalt fibers, applications of cement composites in infrastructure constructions, and technologies for the production of prefabricated concrete elements.

Title: Recycling of Chemical Mechanical Polishing Sludge and Waste Diatomaceous Earth to Prepare Eco-porous Water-retaining Bricks by Co-Sintering

Kae-Long Lin[1]*, Ya-Wen Lin[2], Min-Chang Gu[1], Chen-Yun Yang[1], and Jyun-Ting Syu[1]

1. Professor, Department of Environmental Engineering, National Ilan University, Taiwan

2. Assistant Professor, Bachelor Program for Fire and Safety Science, Da-Yeh University, Taiwan

Abstract

This study utilized the forming and sintering technology to produce eco-porous water-retaining bricks by substituting chemical mechanical polishing (CMP) sludge for waste diatomaceous in different proportions (0 – 40%). The powder was pressed at a forming pressure of 5 MPa, and then sintered at temperatures ranging from 1000 to 1280°C to prepare the bricks. The brick samples then underwent a series of tests including XRD, FTIR, and SEM were employed to investigate changes in crystalline phases, bonding, and microstructures of the eco-porous water-retaining bricks. The results indicated that increasing the substitution rate of CMP sludge effectively enhanced the compressive strength of the eco-porous water-retaining bricks. FTIR analysis revealed that the main bonding in these bricks was Si – O – Si vibration bonding, confirming that SiO_2 was the primary component. The principal crystalline phase of the eco-porous water-retaining bricks was quartz, and its characteristic peak intensity decreased noticeably with increasing sintering temperature. The results demonstrated that at a sintering temperature of 1280°C, the eco-porous water-retaining bricks with a 40% substitution rate of CMP sludge exhibited a compressive strength of 9.31 MPa, which was met the three types of bricks in CNS 382 standards.

Keywords: Waste diatomaceous earth, chemical mechanical polishing sludge, water-retentive, sintering; eco-porous water-retaining bricks

Biography

Kae-Long Lin is a Professor in Department of Environmental Engineering National Ilan University, Taiwan, 26047, Republic of China. To pursue a research career in Pozzolanic reaction/ Eco-cement/ Waste Treatment/Management/ recycle/ E-waste recycle. Department of Environmental Engineering, National Ilan University, 1, Sec. 1, Shen-Lung Road, Yi-Lan 260007, Taiwan, ROC.

Title: Integration of Metabolomics with Endodontics; The Way toward the Future

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2 Assistant Professor, Senior Research Scientist and University Lecturer, ICER, Research Institute for Dental Sciences Shahid Beheshti University of Medical Sciences, Iran

Abstract

Metabolomics is the scientific study of small molecules, commonly known as metabolites as well as the methodical investigation on small molecule substrates, intermediates, and products of metabolism within cells, biofluids, tissues or organisms (1). In addition, the root canal system presents a highly complex microenvironment with dynamically metabolic processes, and thus, metabolomics could offer a means to recognize and quantify the diverse array(s) of metabolites involved in pulpoperiapical diseases.

Furthermore, metabolomics may pave the path for academics, researchers and clinicians to enable them in gaining valuable insights into the molecular signatures associated with various endodontic conditions. Moreover, metabolomics has shown to have the capability of clarifying the complicated interaction of metabolites, pathways, and biological processes underlying pulpitis, periapical diseases, and other endodontic pathosis (2). Besides, metabolomics prepares proper grounds for the discovery of biomarkers; serving as indicators of disease progression, treatment response, and prognosis. It has been shown that metabolomics of root canals could provide valuable information on treatment planning (3); aiding in the specific identification of metabolic signatures associated with treatment success or failure (4). In addition, the identification of metabolic biomarkers holds a promise for the prediction of individual patient response to endodontic interventions; making the personalized treatment strategies easier and more achievable.

In conclusion, embracing metabolomics in endodontic research and practice may represent a paradigm shift toward a more data-driven approach to oral health care. The potential impact of metabolomics on endodontics can offer present-day opportunities for enhanced diagnosis, targeted therapeutics, and improved patient outcomes. The current presentation aims to explore the potential of metabolomics in significantly changing concepts in endodontics; providing a deeper understanding of the root canal system, corresponding disease mechanisms and possible new approaches to more personalized ministration.

Keywords: Metabolomics, Endodontics, root canal system

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4. Hussein H, Kishen A. Application of Proteomics in Apical Periodontitis. Frontiers in Dental Medicine. 2022;3.

Biography

Mahta Bahri is a Dental Student, at Shahid Beheshti School of Medical Sciences, Iran. She has been participating in different Iranian and international dental congresses; Searching and giving presentations in various fields and specialties of dentistry, she has a special interest in orthodontics and oral and maxillofacial surgery(OMFS).

Title: Effect of Titanium Addition on Tribological Properties of Al0.7CoCrFeNi High-Entropy Alloy

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2 Faculty of Mechanical Engineering and Aeronautics, Rzeszow University of Technology, Poland

3 Mechanical Faculty, Lublin University of Technology, Poland

Abstract

High-entropy alloys have been generating a lot of interest among researchers in recent years because of the unique properties that can be obtained by selecting the chemical composition of these materials [1-3]. One potential application of HEAs is friction nodes with high wear resistance [4]. In the work presented here, the tribological properties of a popular alloy from the AlxCoCrFeNi group additionally modified with titanium were analysed. Materials were made by induction melting of pure metals, yielding Al0.7CoCrFeNiTix alloys (where x=0; 0.05, 0.2; 0.5). Ball-on-disc friction tests were performed without lubrication using an Al2O3 alumina ball as a countersample. Wear was measured using a confocal microscope. In addition, friction tracks were analysed by SEM. The results show that as the titanium content in the alloy increases, the wear resistance increases significantly. Analysis of the friction tracks indicates a change in the wear mechanism for alloys with titanium. The presence of titanium-mediated intermetallic phase precipitates in the alloy microstructure results in a strengthening of the surface layer of the materials, reducing adhesive wear involving wear products.

Keywords: high entropy alloy, tribological properties, wear resistance, mechanism of wear

The work was carried out at the Bialystok University of Technology. Subsidised by a special purpose grant from the Ministry of Education and Science in the framework of the task titled "President of the Republic of Poland Lech Kaczyński Polytechnic Network VIA CARPATIA".

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Biography

Research interests include modern metallic materials for engineering applications, mainly high-entropy alloys, analysis of functional properties, influence of the materials structure on properties, possibilities to improve strength, wear resistance, corrosion resistance through the use of additives and modification of the surface layer.

Title: Renal Protective Effect of Tadalafil in Ischemic-Reperfusion Injury for Partial Nephrectomy in Animal Model

Minji Jeon[a]*, Eun Hye Lee[a], Bo Hyun Yoon[b], Jun Nyung Lee[c], Tae Gyun Kwon[c], Bum Soo Kim[c,d], Yun-Sok Ha[c], and Jae-Wook Chung[c]

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b BioMedical Research Institute, Kyungpook National University Hospital, Republic of Korea

c Department of Urology, School of Medicine, Kyungpook National University, Republic of Korea

d Department of Urology, School of Medicine, Kyungpook National University Hospital, Republic of Korea

Abstract

The safe time for partial nephrectomy is reported as 25 min for warm ischemic time and 35 min for cold ischemic time. However, even in the case of arterial ligation within 30 min, acute renal injury occurs, which causes serious problems in patients with renal disease. Various drugs are being studied, but the effectiveness and safety are insufficient. This study aims to prove that Tadalafil has a protective effect on renal function by administering it before surgery when performing partial nephrectomy. We orally treated tadalafil for 14 d prior to ischemic-reperfusion injury (IRI) with partial nephrectomy. 24 h after IRI, blood and kidney samples were collected for biochemical and molecular analysis. We observed that there was no effect on blood urea nitrogen (BUN) or creatine levels, but it improved damaged kidney tissue. In addition, it was confirmed that inflammatory factors decreased and CD4, CD8, and oxidative stress factor expression (iNOS, eNOS) decreased. In conclusion, it was demonstrated that tadalafil inhibits oxidative stress and inflammation and increases renal tissue recovery ability in ischemic-reperfusion damage after partial nephrectomy.

Keywords: Ischemic reperfusion injury, Tadalafil, PDE5 inhibitor, partial nephrectomy

References:

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Biography

She earned a Bachelor's degree in pharmaceutical engineering from Daegu Haany University.

Title: A Study on the Characterization of the Polymer Solidification for Disposal of Powdered Radioactive Wastes

Sang-Hyun Lim[a]*, Sang-Heon Lee[b], Do-Won Hyun[b], Jong-Soon Song[b], and Doo-Hee Lee[a]
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b Chosun University, Republic of Korea

Abstract

Roll compaction technology is very effective in reducing the physical volume of powdered radioactive waste. This allows the powdered radioactive waste to be compressed into pellets of a specific shape and size. In addition, the polymer solidification process can be applied to produce a polymer-solidified body incorporated with high strength/high density pellets. Consequential, the characterization of the polymer-solidified body incorporated with pellets was performed to confirm that they met the Waste Acceptance Criteria of the radioactive waste repository, Republic of Korea.

Keywords: Powdered waste, Pelletization, Roll compaction, Volume reduction, Disposal

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Biography

Sanghyun Lim studied nuclear engineering at the Chosun University, Republic of Korea and graduated as B.S. in 2018. He then joined the research group of Prof. Song at the Dept. of Nuclear Engineering, Chosun University. He received his Ph.D. degree (Dept. of Nuclear Engineering Radiology) in 2023 at the same institution. At present, Dr. Lim is Senior Manager of LC Gen Company Limited (Nuclear Engineering Specialty Company). He research interest is solidification/stabilization of radioactive waste for disposal, and published more than 4 research articles in SCI(E) journals. In addition interested in powdered waste, pelletization, roll compaction, volume reduction.

Title: Thermal Diffusivity Analysis for Anisotropic and Inhomogeneous Material by Laser Spot Periodic Heating Radiation Thermometry Method

Seiichiro Sando[12]* and Hiromichi Ohta[2]

1 BETHEL Co., Ltd., Japan

2 Ibaraki University, Japan

Abstract

Laser spot periodic heating radiation thermometry method is thermal diffusivity analysis by laser spot periodic heating and infrared radiation thermometer. Measuring both of total and local thermal diffusivity of anisotropic and inhomogeneous material such as composite material is available by this method. Furthermore, distribution of density, orientation and dispersed filler are available through thermal diffusivity measurement. The material this analysis can apply ranges from plastic to metal and graphite sheet.

Keywords: Laser spot periodic heating radiation thermometry method, Thermal diffusivity, Composite material, Graphite sheet

References:

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[2] BETHEL Co., Ltd. Hudson Laboratory Thermowave Analyzer Introduction web page application sheet, https://hrd-thermal.jp/en/apparatus/ta.html

Biography

Seiichiro Sando is Ph.D. Student at Ibaraki University and working as an Engineer at company BETHEL Co., Ltd. that manufactures equipment for thermal property measurement based on the analysis by spot periodic heating and infrared radiation thermometer method. His research in the university focuses on measurement technics for thermal properties of anisotropic and inhomogeneous material such as composite material. His main works in the company are designing the equipment and consignment measurement service.

Title: Enhanced 3D Alignment of C2C12 Myotubes Induced by Magnetic Field

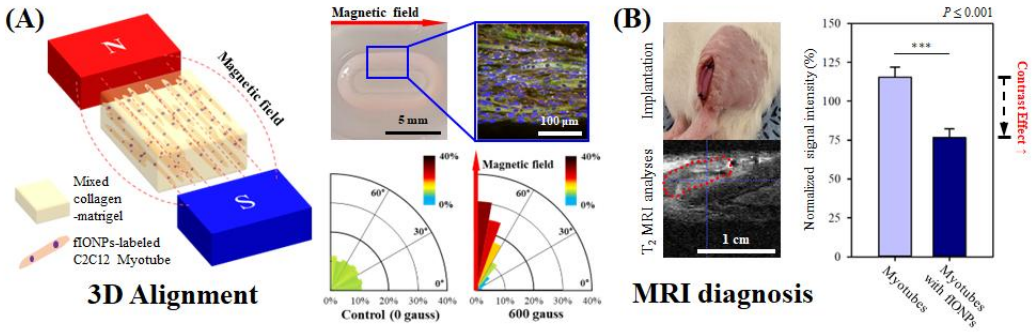
Daniel Jung[2], Suk Hyeon Hong[1]*, NamHyun Kim[1], Sung Gyu Shin[1], and Jae Hyun Jeong[1]

1 Dept. of Chemical Engineering, Soongsil University, Republic of Korea

2 Korean International School, Republic of Korea

Abstract

In the fields of biomedical and tissue engineering, the integration of contractile skeletal muscle cells with biomaterials is being actively pursued for applications such as soft actuators, bio-robots, and organ-on-a-chip systems. A critical aspect of optimizing these systems is the precise alignment of myotubes, which directly impacts their contractile efficiency and force generation. In this study, we introduce an innovative method to enhance the 3D structural alignment of skeletal myotubes by utilizing functionalized iron oxide nanoparticles(fIONPs). By applying a magnetic field, we successfully directed the alignment of myotubes in a controlled manner. Additionally, these fIONP-treated myotubes demonstrated MRI contrast effects, allowing for enhanced visualization of myotube movement within grafted tissues. This novel approach to aligning myotubes using magnetic fields has significant potential for advancing tissue engineering, clinical diagnostics, and tissue regeneration.



Keywords: 3D alignment of myotube, Iron oxide nanoparticles, Magnetic field, MRI diagnostics

Biography

Daniel Jung is currently a Senior at Korea International School. Suk Hyeon Hong is currently a Ph.D. Student in the Soongsil University from South Korea. His research focuses specifically on the nano/bio-actuator, engineered organoid study.

Title: A Novel Red Fluorescent and Dynamic Nanocomposite Hydrogel

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b Department of Surgical Oncology, Shaanxi Provincial People's Hospital, China

c Emergent Bioengineering Materials Research Team, RIKEN Center for Emergent Matter Science, Japan

Abstract

It is still a challenge to achieve a biomacromolecules based dynamic hydrogels simultaneously combining with excellent red fluorescence, good mechanical properties, and biocompatibility. Here we first explore hydrophilic inclusion complex of (R-CDs@α-CD) derived from hydrophobic red fluorescent carbon dots (R-CDs) and α-cyclodextrin (α-CD), and then achieved a red fluorescent and dynamic polysaccharide R-CDs@α-CD/CEC-l-OSA hydrogel. The nanocomposite hydrogel can be fabricated through controlled doping of red fluorescent R-CDs@α-CD into dynamic polymer networks, taking reversibly crosslinked N-carboxyethyl chitosan (CEC) and oxidized sodium alginate (OSA) as an example. The versatile red fluorescent hydrogel simultaneously combines the features of injection, biocompatibility, and augmented mechanical properties and self-healing behavior, especially in rapid self-recovery even after integration. The novel red fluorescent and dynamic hydrogel based on polysaccharides is promising for using as biomaterials in biomedical field.

Keywords: Red fluorescent dynamic hydrogel, Biocompatible nanocomposite hydrogel, Self-healing and self-recovery, Red emissive inclusion complex, Injection and self-healing

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Biography

Yong Mei Chen is a Full Professor at Shaanxi University of Science & Technology, Leader of green flexible multifunctional material innovation team. She received her degree of Doctor of Philosophy in Biological Science from Hokkaido University. Her current research is focused on soft materials and functional gels for biomedical field and flexible electronics, including photoluminescent hydrogels, magnetic hydrogels, self-healing hydrogels and tough hydrogels. She published about 80 research papers in the journals of Chem. Soc. Rev., Nat. Commun., Adv. Funct. Mater., Chem. Eng. J., Biomaterials, Green Chem. and Small.

Title: Customizable Hydrospongel Based on Chitosan Microfibers

Yunxia Zhang[a]*, Zhen Xiu Liu[b], Hui Jie Zhang[b], Yong Mei Chen[b], Hideyuki Miyatake[c], and Yoshihiro Ito[c]

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b College of Bioresources Chemical and Materials Engineering, National Demonstration Center for Experimental Light Chemistry Engineering Education, Shaanxi University of Science & Technology, China

c Nano Medical Engineering Laboratory, RIKEN Cluster for Pioneering Research, Emergent Bioengineering Materials Research Team, RIKEN Center Formergent Matter Science, Japan

Abstract

Hydrogel is a kind of hydrophilic biomaterial with three-dimensional polymer network structure. In this paper, we report a hydrogel derived from chitosan microcrystalline fibers. The chitosan microcrystal fibers which formed at high shear force during the crystallization of chitosan, and can be crosslinked through covalent bonds and hydrogen bonds to form the hydrogel. The relatively high rigidi of the chitosan microcrystal fibers provide the hydrogel with bulk elasticity at small defamation, and the synergistic effect of covalent bond and non-covalent bond endow the excellent self-recovery property to the hydrogel after a large compression deformation. These advantages make it have great application potential in the field of biological tissue engineering.

Keywords: Hydrogel, Chitosan, Microcrystalline fibers, Self-recovery property

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Biography

Yunxia Zhang is a Lecturer at Shaanxi University of Science & Technology, belonging to green flexible multifunctional material innovation team. She received her degree of Doctor of Philosophy in Materials Science and Engineering from Xi'an Jiaotong University. Her current research is focused on design and synthesis of soft materials and its sensing properties and application in biological materials.

Posters of ICCST

Title: Multi-hierarchy Design Strategy of Electrocatalysts for DMFCs

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Key Laboratory of Mesoscopic Chemistry
School of Chemistry and Chemical Engineering
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China

Abstract

Electrocatalysts are pivotal for direct methanol fuel cells (DMFCs). While adjusting catalytic center morphology or doping with heteroatoms can speed up reactions, it doesn't prevent metal site dissolution in harsh environments, leading to a loss of active area and increased internal resistance due to metal-proton membrane interactions. Single regulation of metal centers is insufficient, suggesting a strategy of ordered, multi-hierarchy mesoscale structure catalysts for methanol oxidation and oxygen reduction reaction. Our innovative approach includes: **(1) High-energy supports**: The design of innovative corrosion-resistant anode and cathode catalyst supports, including NiSi2 and SiC-Ni, emphasizes the regulation of active centers through electronic effects. The corrosion potential, proven to significantly exceed the actual operating potential of DMFC using DEMS, is a key feature. **(2) Micro-environment structure**: The construction of a graphitized nest-type structure and organically modified high-activity alloy aims to balance activity and stability. After ADT, the mass activity meets DOE standards. In summary, rational, ordered mesoscale catalyst design is essential for reducing precious metal usage and improving electrocatalytic efficiency in fuel cells.

Keywords: Multi-hierarchy catalyst; Methanol oxidation reaction; Oxygen reduction reaction; DMFC

References:

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Biography

Weiping Ding received his bachelor's and doctor's degrees from the Department of Chemistry, Nanjing University. He has engaged in postdoctoral research in the National Laboratory of Solid Microstructure, Department of Physics, Nanjing University, as well as researched in the Department of Chemical Engineering, University of California at Berkeley, and the Department of Chemistry and Biology, Harvard University, successively. He is currently a professor in the School of Chemistry and Chemical Engineering, Nanjing University and director of the Key Lab of Mesoscopic Chemistry. In recent years, his advocacy, about "Meso Catalysis" research, has achieved fruitful innovative results in hydrogenation, oxidation, acid catalysis, fuel cell catalysts, and electrocatalysis, which are being transferred to industrial applications.

Chenjia Liang is, currently, pursuing for a doctor's degree at Nanjing University under the guidance by Professor Weiping Ding. His research interests focus on the novel design of electrocatalyst under mesoscale for oxygen reduction reaction and methanol oxidation reaction in DMFC.

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