EITC
Emerging Information & Technology Conference

The 2017 EITA Conference on New Materials, Nanotechnology and New Energy

(EITA-New Materials 2017)

"Recent Research Advances in New Materials, Nanotechnology and New Energy: Challenges, Opportunities and Future Directions"

Conference Proceedings

Taubman A Alfred Biomedical Science Research Building
The University of Michigan
Ann Arbor, Michigan, U.S.A.

Saturday, July 1, 2017

<Draft as of 6/20/17>

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Welcome Message

Conference Themes

"Recent Research Advances in New Materials, Nanotechnology and New Energy: Challenges, Opportunities and Future Directions"

The EITA-New Materials 2017 conference consists of three parallel workshops:

- **Workshop 1 (W1):** Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems
- **Workshop 2 (W2):** Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials
- **Workshop 3 (W3):** Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Planning Committee

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Pei-Cheng Ku	(古培正)	The University of Michigan, Ann Arbor

Project Manager

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Workshop 1 (W1): Emerging Technologies and Applications in Materials for Health & Medicine: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems:

Hsueh-Fen Juan	(阮雪芬)	National Taiwan University
Aichi Chien	(簡艾琪)	University of California at Los Angeles

Workshop 2 (W2): Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials:

I-Chun Cheng	(陳奕君)	National Taiwan University
Jung-Tsung Shen	(沈榮聰)	Washington University in St. Louis

Workshop 3 (W3): Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies:

Yu-Bin Chen	(陳玉彬)	National Tsing Hua University
Pei-Cheng Ku	(古培正)	The University of Michigan, Ann Arbor

Publication

Conference Program:

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Co-organizing Associations and Co-sponsors

- Taipei Economic & Cultural Office in Chicago
- Science and Technology Division, Taipei Economic and Cultural Representative Office in the U.S.

Conference Program

Day 1 (Saturday, July 1, 2017)

7/1 (Sat) 9:00 am - 5:30 pm: Registration

Room: **Seminar Room A, BSRB**

7/1 (Sat) 9:30 am - 9:50 am: Opening Session

Chair: **Dr. Pei-Cheng Ku** (古培正), Associate Professor, Department of Electrical Engineering & Computer Science, The University of Michigan, Ann Arbor
Room: **Seminar Room A, BSRB**

Welcome Remarks:

Mr. Calvin Chen-huan Ho
Director General
Taipei Economic and Cultural Office in Chicago
(駐芝加哥台北經濟文化辦事處何震寰處長)

Plenary Sessions:

7/1 (Sat) 9:50 am - 10:40 am: Plenary Session (I):

Chair: **Dr. Pei-Cheng Ku** (古培正), Associate Professor, Department of Electrical Engineering & Computer Science, The University of Michigan, Ann Arbor
Room: **Seminar Room A, BSRB**

Plenary Speaker:

"Noninvasive Dermatological Micro-Imaging of Melanin for Histopathological Diagnosis and Treatment Assessment"

Dr. Chi-Kuang Sun (孫啟光)
Life Distinguished Professor, Graduate Institute of Photonics and Optoelectronics and
Chief Director, Molecular Imaging Center
National Taiwan University

7/1 (Sat) 10:40 am - 10:50 am: Break

7/1 (Sat) 10:50 am – 11:40 am: Plenary Session (II):

Chair: **Dr. Chun-Chi (Richard) Liang** (梁駿騏), Research Assistant Professor, Department of Neurology, The University of Michigan, Ann Arbor
Room: **Seminar Room A, BSRB**

Plenary Speaker:

"Connected and Automated Vehicles"

Dr. Huei Peng (彭暉)
Professor, Mechanical Engineering
US Director, US-China Clean Energy Research Center-Clean Vehicle Consortium
Roger L. McCarthy Professor
The University of Michigan, Ann Arbor

7/1 (Sat) 11:40 pm - 1:00 pm: Lunch

Parallel Sessions:

7/1 (Sat) 1:00 pm – 2:20 pm: Technical Session D1-W1-T1: Emerging Technologies and Applications in Materials for Health & Medicine: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Chair: **Dr. Aichi Chien** (簡艾琪), Associate Professor, Division of Interventional Neuroradiology, Department of Radiological Sciences, Biomedical Physics IDP, David Geffen School of Medicine at UCLA, Ronald Reagan UCLA Medical Center
Room: **Seminar Room A, BSRB**

Dr. Liqun (Andrew) Gu
Associate Professor, Department of of Bioengineering and
Dalton Cardiovascular Research Center
University of Missouri

"Electroactive Polypyrrole Actuators for Implantable Devices"
Dr. Liang Guo
Assistant Professor, Department of Electrical and Computer Engineering, Department of Neuroscience
The Ohio State University

"Nanowire Nano-Bioelectronics Devices and Systems"
Dr. Wei Zhou
Assistant Professor, Department of Electrical & Computer Engineering
Virginia Tech

"Bio-Inspired Design of Multiscale Structures via Assembly of Nanoscale Building Blocks"
Dr. Po-Yen Chen (陳柏彥)
Assistant Professor, Department of Chemical and Biomolecular Engineering
National University of Singapore (NUS)

7/1 (Sat) 1:00 pm – 2:20 pm: Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Chair: **Dr. Fang-Chung Chen** (陳方中), Professor, Department of Photonics, National Chiao-Tung University
Room: **Seminar Room B, BSRB**

"Engineering light at the nanoscale: structural colors and broadband perfect absorbers"
Dr. L. Jay Guo
Professor, Department of Electrical Engineering and Computer Science
Mechanical Engineering, Macromolecular Science & Engineering, and Applied Physics
The University of Michigan, Ann Arbor

"Phosphor-Free InGaN/AlGaN Core-Shell Nanowire Light-Emitting Diode Arrays on Si and Flexible Substrates"

Dr. Hieu P. T. Nguyen
Assistant Professor, Department of Electrical and Computer Engineering
New Jersey Institute of Technology

"From Nanolaser to Photonic Integrated Circuits"
Dr. Qing Gu
Assistant Professor, Department of Electrical and Computer Engineering
The University of Texas at Dallas

Dr. Dong Meng
Assistant Professor, Swalm School of Chemical Engineering
Mississippi State University

7/1 (Sat) 1:00 pm – 2:20 pm: Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Chair: **Dr. Pei-Cheng Ku** (古培正), Associate Professor, Department of Electrical Engineering & Computer Science, The University of Michigan, Ann Arbor
Room: **Seminar Room C, BSRB**

"Thermo-electrochemical conversion of low-grade heat into electricity"
Dr. Shien-Ping Feng (馮憲平)
Assistant Professor, Department of Mechanical Engineering
The University of Hong Kong

"Advanced Organic Redox Flow Batteries for Grid Energy Storage"
Dr. Xiaoliang Wei (魏晓亮)
Staff Scientist, Energy Processes and Materials Division
Pacific Northwest National Laboratory

"Revealing Li-Ion Battery Processes Using Neutrons"
Dr. Anne Co
Assistant Professor, Department Of Chemistry and Biochemistry
The Ohio State University

Dr. Vincent (C.) Tung (童俊智)
Assistant Professor, Department of Materials Science and Engineering
University of California, Merced

7/1 (Sat) 2:20 pm – 2:35 pm: Break

Parallel Sessions:

7/1 (Sat) 2:35 pm – 3:55 pm: Technical Session D1-W1-T2: Emerging Technologies and Applications in Materials for Health & Medicine: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Chair: **Dr. Allen Po-Chih Liu,** Assistant Professor, Department of Mechanical Engineering
Department of Biomedical Engineering, University of Michigan, Ann Arbor
Room: **Seminar Room A, BSRB**

"Implantable, MEMS-based, Multimodal Neural Interfaces for Brain Research"
Dr. Wen Li
Associate Professor, Department of Electrical & Computer Engineering
Michigan State University

"Nanoengineering of Transparent Graphene for Wireless Biosensing"
Dr. Mark Ming-Cheng Cheng
Associate Professor, Electrical and Computer Engineering, Biomedical Engineering, and Nanoengineering
Wayne State University

"Fabricating patterned neuroectoderm tissue from human pluripotent stem cells"
Dr. Yubing Sun
Assistant Professor, Department of Mechanical and Industrial Engineering
Adjunct Assistant Professor, Department of Chemical Engineering
University of Massachusetts, Amherst

Dr. Chun-Chi (Richard) Liang (梁駿騏)
Research Assistant Professor, Department of Neurology
The University of Michigan, Ann Arbor

"3D biomimetic environment for functional angiogenic assays"
Dr. Yi Zheng
NSERC Postdoctoral Fellow, Department of Mechanical Engineering
The University of Michigan, Ann Arbor

7/1 (Sat) 2:35 pm – 3:55 pm: Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Chair: **Dr. L. Jay Guo**, Professor, Department of Electrical Engineering and Computer Science Mechanical Engineering, Macromolecular Science & Engineering, and Applied Physics, The University of Michigan, Ann Arbor
Room: **Seminar Room B, BSRB**

"Emerging Photovoltaic Devices for low-power indoor applications"
Dr. Fang-Chung Chen (陳方中)
Professor, Department of Photonics
National Chiao-Tung University

"Dynamic kirigami structures for solar energy conversion"
Dr. Max Shtein
Associate Professor, Department of Materials Science and Engineering
The University of Michigan, Ann Arbor

"Organic-Inorganic Hybrid Bulk Quantum Materials: Bridging Molecules to Crystals"
Dr. Biwu Ma
Associate Professor, Department of Chemical & Biomedical Engineering
Materials Science Program
Florida State University

"Self-assembled 2D Materials"

Dr. Zhengdong Cheng
Associate Professor, The Artie McFerrin Department of Chemical Engineering
Texas A&M University

7/1 (Sat) 2:35 pm – 3:55 pm: Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Chair: **Dr. Meng-Ju Renee Sher** (佘孟儒), Assistant Professor of Physics, Wesleyan University
Room: **Seminar Room C, BSRB**

"Optimizing Discharge Capacity of Li-O2 Batteries by Design of Air-electrode Porous Structure: Multifidelity Modeling and Optimization"
Dr. Wenxiao Pan
Assistant Professor, Department of Mechanical Engineering
University of Wisconsin-Madison

Dr. Zhiting Tian
Assistant Professor, Department of Mechanical Engineering
Virginia Tech

"Nanostructured Inorganic Materials for Thermal Storage and Thermoelectricity Made Via Solution-Phase Synthesis"
Dr. Robert Wang
Assistant Professor, Department of Mechanical Engineering
Arizona State University

"Algae-Based Sustainable Urban-Wastewater Reclamation Ecosystem (aSURE): An Integrated Approach to Sustaining Food-Energy-Water Supply"
Dr. Yongli Zhang
Assistant Professor, Department of Civil and Environmental Engineering
Wayne State University

7/1 (Sat) 3:55 pm – 4:10 pm: Break

Parallel Sessions:

7/1 (Sat) 4:10 pm – 5:30 pm: Technical Session D1-W1-T3: Emerging Technologies and Applications in Materials for Health & Medicine: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Chair: **Dr. Chi-Kuang Sun (**孫啟光), Life Distinguished Professor, Graduate Institute of Photonics and Optoelectronics and Chief Director, Molecular Imaging Center, National Taiwan University
Room: **Seminar Room A, BSRB**

"Drug-delivery Nanoparticles"
Dr. Ying Liu
Associate Professor, Department of Chemical Engineering and
Department of Biopharmaceutical Sciences
University of Illinois at Chicago

"Smartphone-Based Imaging and Sensing Devices for Cost-Effective Molecular Diagnostics"
Dr. Qingshan Wei
Assistant Professor, Department of Chemical and Biomolecular Engineering
North Carolina State University

"Synthetic biology approach for building artificial cell"
Dr. Allen Po-Chih Liu
Assistant Professor, Department of Mechanical Engineering
Department of Biomedical Engineering
The University of Michigan, Ann Arbor

"Self-clearing implantable sensors and actuators for neurological applications"
Dr. Hyowon (Hugh) Lee
Assistant Professor, Weldon School of Biomedical Engineering
Purdue University

Dr. Aichi Chien (簡艾琪)
Associate Professor, Division of Interventional Neuroradiology, Department of Radiological Sciences, Biomedical Physics IDP
David Geffen School of Medicine at UCLA, Ronald Reagan UCLA Medical Center

7/1 (Sat) 4:10 pm – 5:30 pm: Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Chair: **Dr. Max Shtein,** Associate Professor, Department of Materials Science and Engineering
The University of Michigan, Ann Arbor
Room: **Seminar Room B, BSRB**

"Ultrafast and Nanoscale Interfacial Charge Transport"
Dr. Peng Zhang
Assistant Professor, Department of Electrical and Computer Engineering
Michigan State University

"III-V Compound Semiconductor Devices for Future Electronics"
Dr. Yuping Zeng
Assistant Professor, Department of Electrical and Computer Engineering
University of Delaware

"Graphene: A Versatile Material for Mid-infrared and Terahertz Photonic and Optoelectronic Applications"
Dr. Peter Qiang Liu
Assistant Professor, Department of Electrical Engineering
University at Buffalo, the State University of New York

"Local Strain Engineering and its Applications in GaN Optoelectronics"
Dr. Pei-Cheng Ku (古培正)
Associate Professor, Department of Electrical Engineering & Computer Science
The University of Michigan, Ann Arbor

7/1 (Sat) 4:10 pm – 5:30 pm: Technical Session D1-W3-T3: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle

Technologies

Chair: **Dr. Shien-Ping Feng** (馮憲平) , Assistant Professor, Department of Mechanical Engineering, The University of Hong Kong
Room: **Seminar Room C, BSRB**

"Distribution Management and Emerging Automation Technologies"
Dr. Chee-Wooi Ten
Associate Professor, Department of Electrical and Computer Engineering
Michigan Technological University

"Terahertz spectroscopy: tracking charge carrier motions in organic solar cells"
Dr. Meng-Ju Renee Sher (佘孟儒)
Assistant Professor of Physics
Wesleyan University

Dr. Wencong Su
Assistant Professor, Department of Electrical and Computer Engineering
The University of Michigan, Dearborn

Abstracts and Biographies

Day 1 (July 1, 2017)

Opening Session

Conference Chair

Pei-Cheng Ku (古培正)

Associate Professor, Department of Electrical Engineering & Computer Science
The University of Michigan, Ann Arbor
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(M) +1.734.709.3304

BIOGRAPHY

P.C. Ku received all his degrees in electrical engineering including a BS from the National Taiwan University and a PhD from the University of California at Berkeley. He was awarded the Ross Tucker Memorial Award in 2004 as a result of his PhD research. He was with Intel from 2004 to 2005 before joining the University of Michigan in 2006 where he is currently an associate professor of electrical engineering and computer science. In 2010, he cofounded Arborlight that is dedicated to solid-state lighting system design and application. He received the DARPA Young Faculty Award in 2010.

Opening Session

Welcome Remarks

Calvin Chen-huan Ho

Director General
Taipei Economic and Cultural Office in Chicago
(駐芝加哥台北經濟文化辦事處何震寰處長)

BIOGRAPHY

Current Position:

Director General, Taipei Economic and Cultural Office in Chicago, U.S.A. (2014-present)

Education:

M.I.P.P., The George Washington University, Washington, D.C., USA (2004)
B.A., Political Science, National Taiwan University, Taipei, Taiwan, Republic of China (1984)

Career:

- Deputy Director General, Public Diplomacy Coordination Council, Ministry of Foreign Affairs (MOFA), Taipei, Taiwan, Republic of China (2012-2014)
- Deputy Director General, Department of Information and Cultural Affairs, MOFA, Taipei (2012)
- Senior Secretary, Office of Deputy Minister, MOFA, Taipei (2011-2012)
- Counselor, Permanent Mission of the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu to the World Trade Organization, Geneva, Switzerland (2005-2010)
- Secretary, Department of International Organizations, MOFA, Taipei (2003-2005)
- Section Chief for Asia-Pacific Economic Cooperation (APEC) Affairs, Department of International Organizations, MOFA, Taipei (2000-2003)
- Senior Assistant to Director General, Taipei Economic and Cultural Office in Seattle, U.S.A. (1998-2000)
- Senior Assistant to Director General, TECO in Vancouver, Canada (1996-1998)

- Assistant to Director General, TECO in Vancouver, Canada (1993-1996)
- Senior Officer, Department of International Organizations, MOFA, Taipei (1991-1993)
- Senior Administrative Officer, Taipei Representative Office in the United Kingdom, London, U.K. (1990)
- Senior Officer, Department of North American Affairs, MOFA, Taipei (1989-1990)

Family:

Married, two daughters

Plenary Session (I)

Session Chair

Pei-Cheng Ku (古培正)

Associate Professor, Department of Electrical Engineering & Computer Science
The University of Michigan, Ann Arbor
(O) +1.734.764.7134
(M) +1.734.709.3304

BIOGRAPHY

P.C. Ku received all his degrees in electrical engineering including a BS from the National Taiwan University and a PhD from the University of California at Berkeley. He was awarded the Ross Tucker Memorial Award in 2004 as a result of his PhD research. He was with Intel from 2004 to 2005 before joining the University of Michigan in 2006 where he is currently an associate professor of electrical engineering and computer science. In 2010, he cofounded Arborlight that is dedicated to solid-state lighting system design and application. He received the DARPA Young Faculty Award in 2010.

Plenary Session (I)

Plenary Speaker

Noninvasive Dermatological Micro-Imaging of Melanin for Histopathological Diagnosis and Treatment

Chi-Kuang Sun (孫啟光)

Life Distinguished Professor, Graduate Institute of Photonics and Optoelectronics
Chief Director, Molecular Imaging Center
National Taiwan University
1, Section 4, Roosevelt Road, Taipei, Taiwan
Tel: +886-2-3366-5085, Fax: +886-2-3366-1552
Email: sun@ntu.edu.tw

ABSTRACT

We have previously developed a virtual biopsy imaging system based on the non-invasive multi-harmonic generation microscopy (HGM) with a femtosecond Cr:frosterite laser. The system aims to histo-pathologically detect subclinical life-threatening disease and to assist diagnostic decision making for clinically evident diseases. In this presentation, I will first introduce the principle of the HGM system, with a focus on its capability for absolute quantitative imaging of melanin. This system enables 3D subsurface imaging in vivo without the need for surgical approach. High penetration, sub-micron resolution, noninvasiveness, and high sensitivity to melanin make HGM a unique tool for pre-surgical differential diagnosis and treatment assessment of pigmented skin lesions. I will then review the results of several clinical trials on skin aging and pigmented skin lesion diagnosis, which all indicate the superior performance of the development system.

BIOGRAPHY

Chi-Kuang Sun was born in Tainan, Taiwan in 1965. He received his S.B. in EE from National Taiwan University (NTU) in 1987, and S.M. and Ph.D. in applied physics from Harvard University in 1990 and 1995 respectively.

He was a visiting scientist at the Research Laboratory of Electronics, MIT, between 1992-1994, 2015-2016, and was an assistant researcher in the NSF Center for Quantized Electronics Structures (QUEST) at UCSB between 1995 and 1996. He joined the NTU faculty in 1996 and is currently life distinguished professor of electrical engineering and photonics and AmTRAN chair professor of NTU. He is also an adjunct research fellow of physics and applied sciences at Academia Sinica, Taiwan. He is the founder and a chief investigator of the Molecular Imaging Center, one of the 7 university-level excellence centers at NTU. He was Deputy Dean of the College of Electrical Engineering and Computer Science, NTU. Chi-Kuang Sun's research involves optical molecular imaging, nonlinear microscopy, ultrafast phenomena, nano-ultrasonics, THz health care, advanced femtosecond laser technologies, and applications in virtual biopsy diagnosis, treatment and therapy assessment, surgical guidance, wearable monitoring device, neural science, virus epidemic control, paleontology, interfacial water imaging, and boson peak studies.

Chi-Kuang Sun a fellow of OSA, IEEE, SPIE, and Royal Microscopical Society. He serves in the Board of Directors of Taiwan Photonics Society and Microscopy Society of Taiwan. He received the Outstanding Research Award from National Science Council (Taiwan) for 3 times, MERIT Award from National Health Research Institute (Taiwan) for 2 times, Leica Microsystems Innovation Award, C.N. Yang Outstanding Young Researcher Award, the 2010 Engineering Medal from the Taiwan Photonic Society,and Y. Z. Hsu Science Chair Professorship. He co-authored 234 journal articles, 498 international conference papers, 343 domestic conference papers, 13 book chapter, and was awarded with 17 patients.

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Plenary Session (II)

Session Chair

Chun-Chi (Richard) Liang (梁駿騏)
Research Assistant Professor, Department of Neurology
The University of Michigan, Ann Arbor

BIOGRAPHY

Dr. Liang received his bachelor degree in Agricultural Chemistry at National Taiwan University in 1997 and PhD degree in cancer research and neuroscience at Cornell University in 2009. As an expert in engineering in-vitro and in-vivo systems for developing human therapeutics, he built several assays and animal models featuring the essential qualities: innovative, simple, reliable, and reproducible for other multidisciplinary and cross-functional teams. Since 2007, Dr. Liang has been mainly focusing on the pathogenesis driving pediatric neurological diseases. Currently, he is a research assistant professor in the Department of Neurology at the University of Michigan.

Plenary Session (II)

Plenary Speaker

Connected and Automated Vehicles

Huei Peng (彭暉)

Professor, Department of Mechanical Engineering
US Director, US-China Clean Energy Research Center-Clean Vehicle Consortium
Roger L. McCarthy Professor
The University of Michigan, Ann Arbor

ABSTRACT

Despite of continued progress, the number of fatalities and injuries caused by ground vehicles remain high. In the US, about 32,000 people were killed in 2010 and in China the number is about twice of that. Normalized by the vehicle population, in China the traffic fatality rate is about an order of magnitude higher than the world average. The field of “intelligent vehicles” has experienced resurgence in recent years. Recently due to the push for the dedicated short range communication technology (DSRC), the relevant development is divided into two complementary areas of “automated vehicles” and “connected vehicles”, and both now seem to have more clear definitions of functions and enabling technologies. SAE and the industrial coalition CAMP have defined the concept of automation into 6 levels, from no automation (level 0) to being fully driverless under all conditions (level 5). The communication through DSRC is also defined in a few SAE and IEEE standards in the US. There are several large scale development effort and field tests in Europe and in the US. In this talk the recent development will be summarized, which will be followed by the fundamental challenges that remain to be addressed.

BIOGRAPHY

Huei Peng, Roger L. McCarthy Professor of Mechanical Engineering

Huei Peng received his Ph.D. in Mechanical Engineering from the University of California, Berkeley in 1992. He is now a Professor at the Department of Mechanical Engineering at the University of Michigan. His research interests include adaptive control and optimal control, with emphasis on their applications to vehicular and transportation systems. His current research focuses include design and control of electrified vehicles, and connected/automated vehicles.

In the last 10 years, he was involved in the design of several military and civilian concept vehicles, including FTTS, FMTV, Eaton/Fedex, and Super-HUMMWV—for both electric and hydraulic hybrid concepts. He served as the US Director of the DOE sponsored Clean Energy Research Center—Clean Vehicle Consortium, which supports more than 30 research projects related to the development of clean vehicles in US and China.

He currently serves as the **Director** of the **University of Michigan Mcity**, which studies connected and autonomous vehicle technologies and promotes their deployment. He has served as the PI or co-PI of more than 50 research projects, with a total funding of more than 45 million dollars. He has more than 250 technical publications, including 110 in referred journals and transactions and four books. His h-index is 63 according to the **Google scholar analysis**. The total number of citations to his work is more than 15,000. He believes in setting high expectation and helping students to exceed it by selecting forward-looking and high-impact research topics. One of his proudest achievements is that more than half of his Ph.D. students have each published at least one paper cited more than 100 times.

Huei Peng has been an active member of the Society of Automotive Engineers (SAE) and the American Society of Mechanical Engineers (ASME). He is both an **SAE fellow** and an **ASME Fellow**. He is a ChangJiang Scholar at the Tsinghua University of China.

Technical Session D1-W1-T1: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Session Chair

Aichi Chien (簡艾琪)

Associate Professor, Division of Interventional Neuroradiology, Department of Radiological Sciences, Biomedical Physics IDP
David Geffen School of Medicine at UCLA, Ronald Reagan UCLA Medical Center

BIOGRAPHY

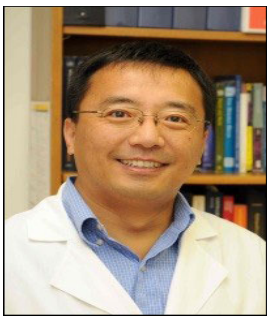
Technical Session D1-W1-T1: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Liqun (Andrew) Gu

Associate Professor, Department of of Bioengineering and
Dalton Cardiovascular Research Center
University of Missouri

ABSTRACT

BIOGRAPHY



Technical Session D1-W1-T1: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Electroactive Polypyrrole Actuators for Implantable Devices

Liang Guo

Assistant Professor, Department of Electrical and Computer Engineering, Department of Neuroscience
The Ohio State University
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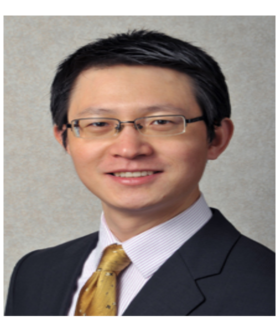
ABSTRACT

Electroactive polymers have attracted great interests as artificial muscles capable of generating significant strain and stress via ion exchanges with surrounding electrolyte. Polypyrrole (PPy) actuators featuring great chemical stability and biocompatibility have been extensively studied and developed for biomedical devices. Depending on the specific application, such polymeric actuators might assume various shapes and structures (e.g., monolithic, bi- or tri-layered). Tri-layered actuators usually involve an electrolyte-enriched gel sandwiched between two PPy layers for operation in air, while bi-layered and monolithic PPy actuators often operate in phosphate buffered saline (PBS) solution or other supporting electrolytes.

Recently, we developed a PPy-driven insulin pump for controllable microinjection. The pump operated at a relatively low voltage (1~2 V) and could generate a volumetric output of ~15 μL at a resolution down to 0.5 μL. Its low-power demand (3~5 mW) motivated us to further pursue a wirelessly driven implantable insulin pump for the treatment of Type 1 Diabetes. This battery-free design could dramatically reduce the pump's weight and size and eliminate the necessity for periodic battery replacement.

We will present our latest progresses on this project, focusing on material and device designs. We will report a unilaterally passivated PPy actuator doped with macromolecular counterions, which features enhanced performances on output strain and durability. We will detail our efforts on the optimization of this monolithic PPy actuator's electroactivity and electrochemical stability. We will also overview its fabrication and characterization to show that this enduring and power-efficient PPy actuator is particularly suitable for implantable devices.

BIOGRAPHY



Liang Guo, Ph.D., Assistant Professor of Electrical & Computer Engineering and Neuroscience at The Ohio State University received his B.E. degree in biomedical engineering from Tsinghua University, Beijing in 2004 and his Ph.D. degree in bioengineering from Georgia Institute of Technology, Atlanta, GA in 2011. His Ph.D. research with Professor Stephen P. DeWeerth focused on the development of high-density stretchable microelectrode arrays for neural and muscular surface interfacing. He worked with Professors Robert S. Langer and Daniel G. Anderson at Massachusetts Institute of Technology, Cambridge, MA as a postdoctoral scholar in neural tissue engineering and regenerative medicine from 2011 to 2013. He started his current position at The Ohio State University in September 2013. His primary research interests are in neural interfacing technology and biological circuits engineering as applied to neuroscience and neural prosthetics. His research expertise covers biomedical micro/nano materials and devices, biomedical instrumentation, biomedical signal processing, electrophysiology, and tissue engineering.

Technical Session D1-W1-T1: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Nanowire Nano-Bioelectronics Devices and Systems

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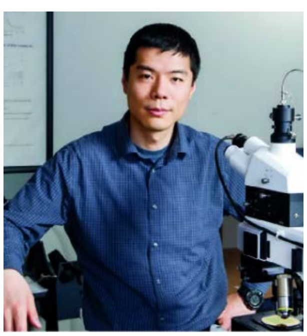
ABSTRACT

In this talk, Dr. Zhou will discuss innovative concepts and approaches to design, fabricate, and exploit novel nanoelectronic devices/systems for applications in healthcare. Nanowire nanoelectronic field-effect-transistors in 3D arrays can be integrated into 3D macroporous polymeric scaffolds to create synthetic cyborg tissues, in which 3D real-time electric mapping of heart activities with drug responses was demonstrated. He will discuss a new strategy to overcome Debye screen effects for field effect detection of biomolecules in physiological environments using biomimetic nanoporous polymer coatings. Moreover, a bio-inert coating technique can be developed to achieve long-term stability of semiconductor nanoelectronic bio-sensors for chronic physiological studies. The innovations discussed in this talk could be inspiring for the development toward integrated nanosystems for applications including handheld point-of-care diagnostics platforms, lab-on-a-chip biomedical architectures, and implantable bio-integrated nanosystems.

BIOGRAPHY



Wei Zhou received his B.Sc. degree (2004) and M.Sc. degree (2007) from Shanghai Jiao Tong University, and Ph.D. degree (2012) from Northwestern University under the supervision of Prof. Teri Odom, and later he worked as a Postdoctoral Fellow in Prof. Charles Lieber's lab at Harvard University. He is an Assistant Professor of Electrical and Computer Engineering at Virginia Tech since 2015. He conducts interdisciplinary research on the design, manufacturing, and investigation of nano-enabled photonic and electronic materials, devices, and systems targeting applications in the areas of information technology, healthcare, and energy. He was honored Chinese Government Award for Outstanding Self-Financed Students Abroad in 2012, and he has also won other highly selective awards/Fellowships including International Institute for Nanotechnology (IIN) Outstanding Research Award (2011), Ryan Fellowship (2009-2011), MRSEC Fellowship (2009-2012), etc. Zhou is a member of the Institute of Electrical and Electronics Engineers (IEEE), the Materials Research Society (MRS), and the International Society for Optics and Photonics (SPIE).

Technical Session D1-W1-T1: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Bio-Inspired Design of Multiscale Structures via Assembly of Nanoscale Building Blocks

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ABSTRACT

The structural hierarchies in nature possess various intriguing properties, providing new insights and design rules for artificial, nature-inspired multiscale structures with multiple functions. Bottom-up technique provides a scalable approach to assembling multiple nano-building blocks into biomimetic structures. In this talk, I will present the projects that we learned from elephant's wrinkled skin, and fabricated biomimetic architectures using versatile nanomaterials. I will demonstrate a technique to mimic the wrinkled structures on elephant's skin and pattern a planar graphene film into multi-generational wrinkled/crumpled structure via mechanical deformation. These multiscale architectures display excellent functionality as superhydrophobic surfaces, electrochemical electrodes, ion intercalation templates, and stretchable toxicant barriers.

BIOGRAPHY

Po-Yen Chen earned his Ph.D. degree in Chemical Engineering from Massachusetts Institute of Technology (MIT) under Professors Angela M. Belcher and Paula T. Hammond. After his Ph.D., he received Hibbitt Engineering Fellowship and conducted independent research in the groups of Professors Ian Y. Wong and Robert H. Hurt at Brown University. He is now an assistant professor in Department of Chemical and Biomolecular Engineering at National University of Singapore (NUS). His research interests include the self-assembly of nanomaterial building blocks, higher dimensional patterning of 2D materials, and the templated synthesis of nanocomposites for energy conversion and storage devices.

Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Session Chair

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BIOGRAPHY

Prof. Fang-Chung Chen was born on 4th June, 1974 in Taichung, Taiwan. He received the B.S. and master degree in Chemistry from National Taiwan University, Taiwan, in 1996 and 1998, respectively, and the Ph.D. degree in Materials Science and Engineering from University of California, Los Angeles (UCLA), USA, in 2003.

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include flexible solar cells, organic electronics and materials, and low-dimensional nanomaterials.

Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 100 Journals papers, 4 book chapters, 90 conference papers and owned 14 patents. He is the section editor (Organic Materials) of Encyclopedia of Modern Optics, edition II, Elsevier. He is also currently on the Editorial Boards of Active and Passive Electronic Components and Current Smart Materials. He frequently serves as a referee for many high-quality Journals, such as *JACS, Adv. Mat., Adv. Funct. Mat., ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..*

Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Engineering light at the nanoscale: structural colors and broadband perfect absorbers

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ABSTRACT

Controlling light transmission, absorption and reflection are essential for a wide range of engineering applications. Controlling these properties in narrow bands lead to the new type of spectral filters that can be used for display, imaging, and color printing applications. On the other hand, broadband absorption can benefit solar harvesting, while broadband transmission is important for transparent conductor application. Integrating these properties with optoelectronic devices will enable dual functional systems. Proper design of photonic structures can also modify the thermal emission properties of heated objects, e.g. more energy efficient incandescent lights can be envisioned. We will introduce the guiding principles for achieving some of these optical responses by exploring nanoscale structures and multi-layer films. In particular, structural colors based on optical resonances in thin-film structures, guided-mode resonances in slab waveguide gratings, and surface plasmon resonances in plasmonic nanoresonators will be described. Broadband perfect absorbers, including schemes that exploi highly absorbing media, multi-cavity resonances, and broadband impedance matching, will be introduced

BIOGRAPHY

The author was born in Tianjin, China, and completed all his schooling there. He graduated with a B.S. degree in physics from Nankai University, with a major in Biophysics. He then studied at the University of Minnesota, and completed M.S. and Ph.D. in Electrical Engineering in 1995, and 1997 respectively.

Upon graduation, he moved with his former research group to Princeton University. After a short period of Postdoctoral appointment in Electrical Engineering at Princeton, he started his academic career at the University of Michigan in 1999 as a tenure track faculty. He has been a full Professor of Electrical Engineering and Computer Science since 2011, with affiliation in Applied Physics, Mechanical Engineering, Macomolecular Science and Engineering.

His group's researches include polymer-based photonic devices and sensor applications, organic and hybrid photovoltaics, plasmonic nanophotonics, nanoimprint-based and roll to roll nanomanufacturing technologies. He has > 200 refereed journal publications with over 25,000 citations, and close to 20 US patents. Many published work from his lab have been featured by numerous media. Dr. Guo received the Research Excellence Award from the College of Engineering, and Outstanding Achievement Award in EECS from the University of Michigan. He served on a number of international conference program committees related to nanotechnologies and photonics. He is also associate editor of IEEE Journal of Photovoltaics.

Representative publications:

C. Zhang, N. Kinsey, L. Chen, C.-G. Ji, M. Xu, M. Ferrera, X.Q. Pan, V. M. Shalaev, A. Boltasseva and L. J. Guo, “High-performance Doped Silver Films: Overcoming Fundamental Material Limits for Nanophotonic Applications,” *Adv. Mater.* 29(19), 1605177, 2017

S. L. Chen, Y.-C. Chang, C. Zhang, J. G. Ok, T. Ling, M. T. Mihnev, T. B. Norris, L. J. Guo, “Efficient real-time detection of terahertz pulse radiation based on photoacoustic conversion by carbon nanotube nanocomposite,” *Nat. Photon.* 8(7), 537-542, 2014

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Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Phosphor-Free InGaN/AlGaN Core-Shell Nanowire Light-Emitting Diode Arrays on Si and Flexible Substrates

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ABSTRACT

Group III-nitride nanowire heterostructures have been intensively studied as an emerging platform for future solid-state lighting, full-color display and visible light communication. Compared to the conventional GaN based planar light-emitting diodes (LEDs), due to the effective lateral stress relaxation, III-nitride nanowires offer several distinct advantages including greatly reduced dislocation densities, polarization fields, and quantum-confined Stark effect. Moreover, the use of nanowire structure provides an effective approach to scale down the dimensions of future devices and systems. In this talk, I will present the molecular beam epitaxial growth, fabrication, and characterization of phosphor-free III-nitride core-shell nanowire LEDs on Si and flexible platforms. Moreover, multiple color emission across nearly the entire visible wavelength range can be realized by varying the In composition in the InGaN active region. Multiple AlGaN shell layers are spontaneously formed during the growth of InGaN/AlGaN dot active region, leading to the drastically reduced nonradiative surface recombination, and enhanced carrier injection efficiency. Such core-shell nanowire structures exhibit significantly increased carrier lifetime and massively enhanced photoluminescence intensity compared to conventional InGaN/GaN nanowire LEDs. A high color rendering index of >95 was recorded for white-light emitted from such phosphor-free core-shell nanowire LEDs. Future prospects of these nanowire devices will also be discussed.

BIOGRAPHY

Hieu P. T. Nguyen received his PhD degree in Electrical Engineering from McGill University, Canada in 2012. In September 2014, he joined the Department of Electrical and Computer Engineering, New Jersey Institute of Technology as an Assistant Professor. His current research interests include molecular beam epitaxial growth, fabrication, and characterization of nanowire heterostructures for high performance nano-optoelectronic devices including light-emitting diodes, lasers, photodetectors, solar fuels, and solar cells.

Prof. Nguyen is a member of the IEEE Photonics Society, the international society for optics and photonics, and the American Chemical Society. He is the author/coauthor of more than 50 journal articles and ~ 75 conference presentations including several invited talks. He was a recipient of the SPIE scholarship in optics (2012), the outstanding paper award at the 28th North American Molecular Beam Epitaxy conference (2011), and the best student paper award (2nd place) at the IEEE photonics conference (2011).

Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

From Nanolaser to Photonic Integrated Circuits

Qing Gu

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ABSTRACT

Semiconductor nanolasers have recently become excellent candidates for light sources in densely-packed chip-scale photonic circuits, due to their small footprint and enhanced light-matter interactions. In this talk, I will discuss the design, fabrication, and characterization of semiconductor nanolasers, focusing on the metal-clad type. I will also outline an integrated treatment of multiple design aspects beyond pure electromagnetic consideration. To better understand light-matter interactions in nanoscale devices, I will describe a formal treatment of the Purcell effect – the modification of the spontaneous emission rate by a sub-wavelength cavity. Lastly, I will discuss other nanoscale laser configurations and emerging light emitting materials on the silicon platform, as well as perspective for integrated photonic circuits.

BIOGRAPHY

Dr. Qing Gu is an Assistant Professor of Electrical and Computer Engineering at UT Dallas since 2016, directing research in the Nanophotonics Lab (www.utdallas.edu/nanophoton/). She received the Bachelor degree from the University of British Columbia, Canada in 2008, and the Ph.D. degree from the University of California, San Diego in 2014, both in Electrical Engineering. Her research interests include the design, fabrication and characterization of nano- and micro- scale photonic devices (such as lasers, waveguides and sensors), novel light-emitting materials and optical cavity configuration, quantum behavior analysis in nanostructures, and integrated photonic circuits. She is the author of book “Semiconductor Nanolasers” by Cambridge University Press, published in 2017.

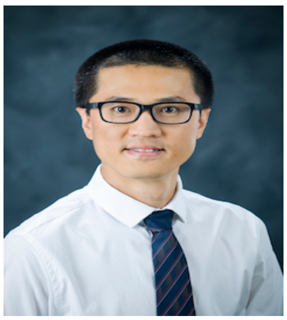
Technical Session D1-W2-T1: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Dong Meng

Assistant Professor, Swalm School of Chemical Engineering
Mississippi State University

ABSTRACT

BIOGRAPHY



Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Session Chair

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BIOGRAPHY

P.C. Ku received all his degrees in electrical engineering including a BS from the National Taiwan University and a PhD from the University of California at Berkeley. He was awarded the Ross Tucker Memorial Award in 2004 as a result of his PhD research. He was with Intel from 2004 to 2005 before joining the University of Michigan in 2006 where he is currently an associate professor of electrical engineering and computer science. In 2010, he cofounded Arborlight that is dedicated to solid-state lighting system design and application. He received the DARPA Young Faculty Award in 2010.

Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Thermo-electrochemical conversion of low-grade heat into electricity

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ABSTRACT

In this work, we demonstrated a novel "thermal charging" phenomenon in Electrical Double Layer Capacitors (EDLC), which may open up a new and cost-effective route to harness low-grade heat by converting it into electricity and directly storing the electrical charges. The underlying mechanism is related to a thermo-electrochemical process which enhances the kinetics of Faradaic process at electrode surface (e.g. surface redox reaction of functional group, or chemical adsorption/desorption of electrolyte ions) at higher temperature. The charge generated at high temperature can be stored in the device after its returning to the room temperature, thus allowing the lighting up of LEDs by connecting the "thermally charged" supercapacitors in a series. Thermally charging effect at low temperatures suggests potential of using electrochemical systems for converting heat into electricity. As low grade heat is abundantly available in industrial processes, environment, biological entities, solar-thermal, and geothermal energy, we believe that further optimization and searching for new materials with high temperature coefficient, fast kinetics, and low heat capacity will lead to new development and possibly practical deployment of electrochemical "thermal-charging" device that combines low-grade heat conversion and charge storage, which can be a game-changing technology.

BIOGRAPHY

Shien-Ping Feng is an Assistant Professor in the department of Mechanical Engineering at Hong Kong University. He received his Ph.D. in chemical engineering from National Tsing-Hua University (2003-2008), and was a postdoctoral associate at MIT (2009-2011) prior to his appointment at The University of Hong Kong. He was a principal engineer, section manager and technical manager at Taiwan Semiconductor Manufacturing Company (2001-2008), and a deputy director at Tripod Research Center (2008-2009). His current research is focused on the electrochemical fabrication of nanostructured materials and their applications in solar, thermal and electrochemical energy conversion and storage.

Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Advanced Organic Redox Flow Batteries for Grid Energy Storage

Xiaoliang Wei (魏晓亮)

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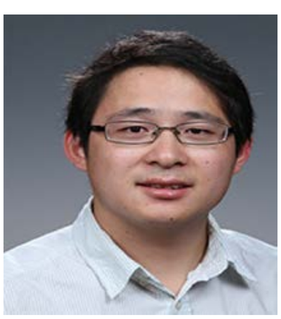
ABSTRACT

The deployment of clean, renewable energy technologies such as solar and wind is rapidly increasing, but their intermittent nature has brought critical grid challenges in terms of reliability and efficiency. An effective way to address these challenges is to incorporate scalable, cost-effective energy storage into the power grid. In this regard, redox flow battery (RFB) has gained significant momentum. Unlike traditional lithium-ion batteries, the energy-bearing electroactive materials in RFBs are dissolved in liquid electrolytes and stored in external reservoirs. This structural feature enables excellent scalability and design flexibility to satisfy large-scale grid storage applications. The electroactive material is the central to RFBs for achieving high energy density and good cyclability. The most successful system is the all-vanadium RFB (VRB), which is based on the four oxidation states of the same element leading to minimal cross-contamination of electrolytes and long-term cyclability. Traditional VRBs are based on sulfuric acid electrolytes, but suffer serious limitations such as low solubility, side reactions, and narrow temperature window. In addition, the vanadium materials and Nafion membranes are expensive, leading to high capital cost. These factors have greatly hampered the broad market penetration of VRBs.

Here we report our efforts in developing new-generation VRBs based on mixed sulfuric acid and hydrochloric acid electrolytes. This new formulation has greatly improved the performance parameters of VRBs in terms of energy density, stability, and temperature tolerability. Scientific understandings of the mechanism were gained through combined spectroscopic studies to guide design of the new VRB electrolytes. Moreover, we have developed cost-effective membranes with comparable performance merits that lead to greatly reduced capital and maintenance costs. Finally, our achievements in developments of alternative organic RFBs will be briefly introduced.

BIOGRAPHY



Dr. Xiaoliang Wei (魏晓亮) was born in 1980 in Henan Province, China. In 2003, he completed his undergraduate study in materials science and engineering at University of Science and Technology of China in Hefei, Anhui Province of China. He continued to earn his PhD degree in chemistry at Brown University located in Providence, RI, USA in the year of 2009.

In 2010, Xiaoliang became a Research Associate in polymer science and engineering at Case Western Reserve University in Cleveland, OH. Then he joined Pacific Northwest National Laboratory (PNNL) in Richland, WA in the year of 2011 as a Post Doctorate Research Associate and was then hired on as a Scientist in 2013. Xiaoliang has authored and co-authored more than 40 peer-reviewed journal publications, 8 patent applications, and 1 book chapter. His research experiences include electrochemical energy storage and self-assembled monolayers. The current focus of his work is to develop novel materials for redox flow batteries and metal ion batteries.

Dr. Wei is a member of the Electrochemical Society (ECS). He has lead-organized technical symposia at Materials Research Society (MRS), guest-edited Special Issues in scientific journals, and served as an editorial board member for Scientific Reports and Cogent Engineering. He has earned a Ronald L. Brodzinski Early Career Exceptional Achievement Award and an Exceptional Contribution Award at PNNL. The following lists his selected journal publications:

1. J. Zhang, Z. Yang, I. A. Shkrob, R. S. Assary, S. Tung, B. Silcox, W. Duan, J. Zhang, C. Su, B. Hu, B. Pan, C. Liao, Z. Zhang, W. Wang, L. A. Curtiss, L. Thompson, X. Wei,* L. Zhang,* Annulated dialkoxybenzenes as catholyte materials for nonaqueous redox flow batteries: achieving high chemical stability through bicyclic substitution. **Advanced Energy Materials**, 2017, accepted.
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6. X. Wei,* W. Xu, J. Huang, L. Zhang, E. Walter, C. Lawrence, M. Vijayakumar, W. A. Henderson, T. Liu, L. Cosimbescu, B. Li, V. Sprenkle, W. Wang, Radical compatibility with nonaqueous electrolytes and its impact on an all-organic redox flow battery. **Angewandte Chemie International Edition** 2015, *54*, 8684. (IF=11.709)
7. X. Wei**,** B. Li, W. Wang, **Porous polymeric composite separators for redox flow batteries. Polymer Reviews 2015, *55*,** 247. (IF=6.216)
8. X. Wei, W. Xu, M. Vijayakumar, L. Cosimbescu, T. Liu, V. Sprenkle, W. Wang, TEMPO-based catholyte for high energy density nonaqueous redox flow batteries. **Advanced Materials** 2014, *26*, 7649. (IF=18.960)
9. X. Wei, Z. Nie, Q. Luo, B. Li, B. Chen, K. Simmons, V. Sprenkle, W. Wang, Nanoporous polytetrafluoroethylene/silica composite separator as a high-Performance all-vanadium redox flow battery membrane. **Advanced Energy Materials** 2013, 3, 1215. (IF=15.23)

Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Revealing Li-Ion Battery Processes Using Neutrons

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ABSTRACT

Rechargeable Li-ion batteries (LIBs) have been the predominant energy storage for a wide range of portable devices like cell phones, laptops and digital electronics. LIBs are now being considered for larger scale systems such as electric vehicles (hybrid, plug-in, pure) that require even more stringent specifications in terms of size, weight and most importantly lifetime or cyclability. We have recently developed a nondestructive method to visualize and quantify Li atom position in real-time using neutrons by a method referred to as neutron depth profiling (NDP). In situ NDP is an ideal technique for probing Li complex formation, accumulation and transport within the battery material during charge/discharge. Currently, our work is focused on understanding the effect of an electrochemical event to the materials' storage properties. Specifically we report our recent work on the preferential Li nucleation, Li trapping and Li transport in intermetallic materials like LixSny, LixSiy and LixAly and intercalating materials like LiNiMnCoO3.

BIOGRAPHY

Anne Co is an Associate Professor of Chemistry and Biochemistry and an Associate Fellow of the Center for Automotive Research at the Ohio State University. She received her Ph.D. in Chemistry with a specialization in Electrochemistry from the University of Calgary, Canada under the guidance of Professor Viola Birss. She then joined the National Research Council Canada's Institute for Chemical Process and Environmental Technology (NRC-ICPET) as a NSERC Visiting Fellow and later promoted to Research Associate. She was awarded a Mary Fieser Fellowship Award in 2008 to continue her postodoctoral studies with Professor Cynthia Friend at Harvard University. Professor Co's research interest is in understanding electrode processes, mechanistic pathways of electrocatalytic reactions for applications related to energy conversion and storage. Professor Co received an NSF-CAREER award in 2014. She currently serves on the editorial advisory board of the Journal of Applied Electrochemistry, the Education Committee of The Electrochemical Society (ECS), the Board of Directors of the Society for Electroanalytical Chemistry, and a member-at-large of the Physical and Analytical Electrochemistry Division of the ECS.

Technical Session D1-W3-T1: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

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University of California, Merced

ABSTRACT

BIOGRAPHY

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Session Chair

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BIOGRAPHY

Prof. Liu was born in Taiwan and moved to Canada with his family when he was a teenager. He obtained his bachelor's degree in Honours Biochemistry from The University of British Columbia in 2001. From 2002-2007, Prof. Liu performed his doctoral research in Biophysics at University of California-Berkeley where developed interests in membrane biophysics and cell motility. Upon graduation, Prof. Liu began his post-doctoral research in the Department of Cell Biology at The Scripps Research Institute where he studied the dynamics of endocytosis in living cells. In 2012, Prof. Liu started his research group at University of Michigan-Ann Arbor where holds a position in the Department of Mechanical Engineering, the Department of Biomedical Engineering, the Cellular and Molecular Biology Program, and the Biophysics Program.

He has developed strong interests in systems biology and synthetic biology during his previous research experience and is working at the interface of biology and engineering. His previous works were published in Nature Physics, Lab on a Chip, Integrative Biology, Journal of Cell Biology, and Biophysical Journal.

Prof. Liu is a member of the Biophysical Society, American Society of Cell Biology, and Biomedical Engineering Society. Prof. Liu is a recipient of Innovator Award from National Institutes of Health, Young Innovator in Cellular and Molecular Bioengineering, Rising Star Award from BMES-Cellular and Molecular Bioengineering, and Burroughs-Wellcome Future of Biophysics Symposium Speaker.

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Implantable, MEMS-based, Multimodal Neural Interfaces for Brain Research

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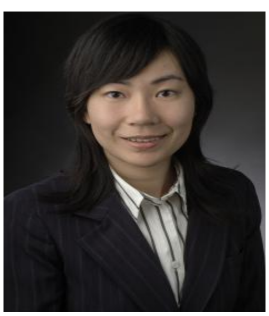
ABSTRACT

Understanding the role of brain function in health and disease is one of the greatest scientific challenges of our time. Although tremendous efforts have been made to explain how local brain regions operate, no general theory of brain function is universally accepted due to our insufficient knowledge of the whole brain circuitry. Therefore, there is a urgent need for advanced engineering tools that enable modulation and mapping of large-scale brain activity with high spatiotemporal resolution. To meet this need, Dr. Li's group at Michigan State University has been focusing on development of MEMS-based neural prosthetic tools for minimally-invasive and multimodal communication with brain networks. This talk will describe examples of multimodal neural interface devices that we have developed over the post years. In one example, an Opto-μECoG array consists of epidural LEDs and transparent microelectrodes for stimulating and recording neural activity from superficial layers of the cortex. In another example, a 3-D optical neurostimulator combines LEDs with out-of-plane optrodes for optogenetic neuromodulation and electrophysiological recording in deep cortical layers. In a third example, boron-doped polycrystalline diamond electrodes are transferred onto flexible polymer substrates for neurotransmitter sensing. The efficacy of the above devices has been demonstrated in vitro or in vivo in the rat models.

BIOGRAPHY



Dr. Wen Li received the B.S. degree in material science and engineering from Tsinghua University, Beijing, and the M.S. and Ph.D. degrees both in electrical engineering from California Institute of Technology, Pasadena, California in 2004 and 2008, respectively. She joined Michigan State University, East Lansing, Michigan in 2009 and is currently an Associate Professor in the Departments of Electrical and Computer Engineering and Biomedical Engineering.

Dr. Li is the recipient of the NSF CAREER Award (2011), the Best Application Paper Award at 3M-NANO (2011), and the Best Paper Award at International Neurotechnology Consortium (2013). She has published 6 book chapters and over 80 journal and conference papers. She served as a member of the technical program committee or a session chair for a number of professional conferences, including IEEE EMBS Wearable Biomedical Sensors and Systems Technical Committee, IEEE MEMS, 3M-NANO, IEEE NANO, IEEE NEMS, IEEE BioCAS, and IEEE SENSORS. She is currently an expert reviewer for over 20 premiere journals and 10 refereed conferences in the fields of MEMS and

Microfluidics, Biomedical Engineering, Neural Engineering, and Nanotechnology. She is a senior member of the IEEE, and a member of the American Chemical Society (ACS), the IEEE Engineering in Medicine and Biology Society (IEEE-BMES), the IEEE Eta Kappa Nu Honor Society (IEEE-HKN), and American Neurological Association (ANA).

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Nanoengineering of Transparent Graphene for Wireless Biosensing

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ABSTRACT

In this talk, I will go over the recent development of wireless harmonic biosensing with graphene electronics, which is atomically smooth, optically transparent, and mechanically flexible. Thanks to its exotic properties, the binding of molecules on graphene can be wirelessly monitored by launching a single-tone RF signal (f0) and detecting the strength of the reflected second-harmonic signal (2f0), as its frequency multiplication gain is altered by the bio/chemical binding. We propose here the design and concept of self-powered wireless sensor based on the graphene radio-frequency (RF) components, which are transparent, flexible, and monolithically integrated on biocompatible soft substrate. This all-graphene wireless sensor consists of an optically transparent graphene antenna, which receives the fundamental tone and retransmits the sensed signal at its second harmonic, thus allowing low-noise sensing in a severe interference/clutter background.

BIOGRAPHY

Dr. Mark Ming-Cheng Cheng is Associate Professor in the Departments of Electrical and Computer Engineering/Biomedical Engineering at Wayne State University (WSU). Dr. Cheng received his bachelor and PhD degrees in Electrical Engineering from National Tsing-Hua University, Hsinchu, Taiwan in 1995 and 2003, respectively. From 2003 to 2006, he was an NIH postdoctoral fellow at the Comprehensive Cancer Center, the Ohio State University (OSU). Prior to joining WSU in 2008, he was Research Assistant Professor in the Department of Nanomedicine and Biomedical Engineering at the University of Texas Health Science Center at Houston, TX, where he focused on multi-stage silicon nanoparticles for tumor targeting and imaging.

Dr. Cheng's research interests include biomedical devices, graphene, MEMS and energy storage technologies. At WSU, his research has been involved in design, fabrication and characterization of micro/nanodevices for biological samples analysis and neural prosthesis. Dr. Cheng received National Science Foundation (NSF) CAREER award in 2011 and 2013 ONR Faculty Summer Fellowship. He served as symposium chair of 2011 Annual Spring Symposium of American Vacuum Society (AVS) -Michigan Chapter on the theme of graphene nanomaterial and neural interfaces. He is a member of IEEE, AVS and Sigma Xi. He has served in TPC committees for IEEE IFCS, IEEE Sensors and Electrowetting.

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Fabricating patterned neuroectoderm tissue from human pluripotent stem cells

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ABSTRACT

Embryonic cells act in a coordinated fashion to shape the body plan of multicellular animals. Understanding and harnessing such tissue morphogenesis and patterning principles are critical for the bio-fabrication of functional tissues. It remains undetermined how these tissue-scale morphogenetic changes work in concert with diffusive biochemical signals for proper spatial regulations of genetic and cell fate patterning during neural induction.

We reported a micropatterned human pluripotent stem cells (hPSCs) system to model neural induction, and depicted a putative biomechanical-biochemical signaling network that regulates the neural induction. The neuroectoderm tissue we generated comprised of Pax6+ neural plate cells and Pax3+ neural plate border cells at the colony center and periphery, respectively. We found neuroectoderm patterning was correlated with patterns of traction force and cell area. We further showed that mechanical cues directly regulated BMP-Smad signaling through p-Smad 1/5 localization assay and RT-PCR analysis of BMP target genes. To confirm that mechanic cues could directly regulate cell fate decision during neuroectoderm patterning, we locally stretched cells at the colony center; this local stretching of colony center effectively rescue the BMP-Smad activity and inhibit neural plate cell differentiation at the colony center. We further showed that neuroectoderm patterning could be abolished under either hyperactive or hypoactive BMP-Smad activity modulated using pharmacological drugs.

We have demonstrated an in vitro platform to generate patterned neuroectoderm tissue from hPSCs for the first time, which can be used to model human neural development and expands our understanding of functional roles of mechanical cues in cell patterning.

BIOGRAPHY

Prof. Sun was born in Hefei, China. He obtained his bachelor's degree in Materials Chemistry from the University of Science and Technology of China in 2010. He then worked with Prof. Jianping Fu at the University of Michigan, Ann Arbor from 2010-2015 for his doctoral research. Since 2016, Prof. Sun is an Assistant Professor of Mechanical Engineering and Chemical Engineering at the University of Massachusetts, Amherst.

His main research interests include mechanobiology, lab-on-chip, microfabrication, biomaterials, stem cell biology, and tissue engineering. His work in those fields were published in Nature Materials, Integrative Biology, Biophysical Journal, Lab on a Chip, ACS Nano, etc.

Prof. Sun is a member of Biomedical Engineering Society, American Heart Association, and American Society of Mechanical Engineers. Prof. Sun is a recipient of Chinese Government Award for Outstanding Self-Financed Students Abroad, and Robert M. Caddell Memorial Award for Research from the University of Michigan.

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Chun-Chi (Richard) Liang (梁駿騏)
Research Assistant Professor, Department of Neurology
The University of Michigan, Ann Arbor

ABSTRACT

BIOGRAPHY

Dr. Liang received his bachelor degree in Agricultural Chemistry at National Taiwan University in 1997 and PhD degree in cancer research and neuroscience at Cornell University in 2009. As an expert in engineering in-vitro and in-vivo systems for developing human therapeutics, he built several assays and animal models featuring the essential qualities: innovative, simple, reliable, and reproducible for other multidisciplinary and cross-functional teams. Since 2007, Dr. Liang has been mainly focusing on the pathogenesis driving pediatric neurological diseases. Currently, he is a research assistant professor in the Department of Neurology at the University of Michigan.

Technical Session D1-W1-T2: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

3D biomimetic environment for functional angiogenic assays

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ABSTRACT

Angiogenesis is the development of neo-blood vessels from pre-existing vascular networks, which plays a prominent role in both normal physiological processes (e.g., embryonic development and wound healing) and cancer metastasis. Angiogenesis is a highly orchestrated process, in which endothelial cells (ECs) migrate collectively, make new connections, and remodel nascent vascular structures to form functional blood vessels. In this talk, I will first demonstrate the usage of a microengineered 3D biomimetic model to study leukemic-cell-induced bone marrow angiogenesis. Rational design of the 3D angiogenesis chip incorporating endothelial cells (ECs), leukemic cells, and bone marrow stromal fibroblasts provide an efficient biomimetic means to promote and visualize early angiogenic processes. I then will present the application of the microengineered biomimetic system to quantitatively investigate the role of Notch signaling in regulating early angiogenic sprouting and vasculature formation of ECs in a 3D extracellular matrix. Moreover, leveraging a novel nanobiosensor system, mRNA expression of Dll4, a Notch ligand, was monitored in invading tip cells using live cell imaging during the dynamic angiogenic process. Our data showed that inhibition of Notch signaling resulted in hyper-sprouting endothelial structures, while activation of Notch signaling led to opposite effects. Our results also supported the role of Notch signaling in regulating EC proliferation and dynamic invasion of tip cells during angiogenesis.

BIOGRAPHY

Dr. Yi Zheng was born in Liaoning, China. He obtained his B.S. and M.S. degrees in Mechanical Engineering from Zhejiang University in 2007 and 2010, respectively. From 2010 - 2014, he performed his doctoral study in the Department of Mechanical and Industrial Engineering at the University of Toronto. Dr. Yi Zheng is currently a postdoctoral fellow in the Department of Mechanical Engineering at the University of Michigan, Ann Arbor. His research interests lie at the interface of microengineering, biophysics and cell biology, aiming to address current technical hurdles in disease modeling, diagnostics and personalized medicine. He has authored 22 peer-reviewed journal articles and 13 conference articles. He is a recipient of the Natural Sciences and Engineering Research Council of Canada (NSERC) Postdoctoral Fellowship (2015-2017), Chinese Government Award for Outstanding Students Abroad (2014), and UToronto NSERC CREATE Scholarships (2010-2013).

Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Session Chair

L. Jay Guo

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BIOGRAPHY

The author was born in Tianjin, China, and completed all his schooling there. He graduated with a B.S. degree in physics from Nankai University, with a major in Biophysics. He then studied at the University of Minnesota, and completed M.S. and Ph.D. in Electrical Engineering in 1995, and 1997 respectively.

Upon graduation, he moved with his former research group to Princeton University. After a short period of Postdoctoral appointment in Electrical Engineering at Princeton, he started his academic career at the University of Michigan in 1999 as a tenure track faculty. He has been a full Professor of Electrical Engineering and Computer Science since 2011, with affiliation in Applied Physics, Mechanical Engineering, Macomolecular Science and Engineering.

His group's researches include polymer-based photonic devices and sensor applications, organic and hybrid photovoltaics, plasmonic nanophotonics, nanoimprint-based and roll to roll nanomanufacturing technologies. He has > 200 refereed journal publications with over 25,000 citations, and close to 20 US patents. Many published work from his lab have been featured by numerous media. Dr. Guo received the Research Excellence Award from the College of Engineering, and Outstanding Achievement Award in EECS from the University of Michigan. He served on a number of international conference program committees related to nanotechnologies and photonics. He is also associate editor of IEEE Journal of Photovoltaics.

Representative publications:

C. Zhang, N. Kinsey, L. Chen, C.-G. Ji, M. Xu, M. Ferrera, X.Q. Pan, V. M. Shalaev, A. Boltasseva and L. J. Guo, "High-performance Doped Silver Films: Overcoming Fundamental Material Limits for Nanophotonic Applications," *Adv. Mater.* 29(19), 1605177, 2017

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Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Emerging Photovoltaic Devices for low-power indoor applications

Fang-Chung Chen (陳方中)

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ABSTRACT

Conventional photovoltaic devices, such as crystalline Si cells, exhibit poor efficiency under indoor or low level outdoor lighting. Many applications, however, require efficient, low cost light harvesting under dim-light conditions, e.g. wireless sensor nodes in home security and automation. Therefore, while Si solar cells dominate the solar panel market, there remains a need for developing of low-cost photovoltaic technology which can efficiently harvest photon energy under indoor or low-level lighting conditions. Herein, we will present our recent progress on the development of emerging photovoltaic devices, including organic and perovskite solar cells and flexible waveguiding photovoltaics, especially for indoor applications. In particular, we have found that organic photlvotaic devices and perovskite solar cells exhibited extremely high performance under the indoor illumination conditions, thereby making them suitable for low-power indoor applications. A PCE higher than 20% is achievable under illumination of low-power light sources. The details of the device characterization will be described.

BIOGRAPHY

Prof. Fang-Chung Chen was born on 4th June, 1974 in Taichung, Taiwan. He received the B.S. and master degree in Chemistry from National Taiwan University, Taiwan, in 1996 and 1998, respectively, and the Ph.D. degree in Materials Science and Engineering from University of California, Los Angeles (UCLA), USA, in 2003.

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include flexible solar cells, organic electronics and materials, and low-dimensional nanomaterials.

Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 100 Journals papers, 4 book chapters, 90 conference papers and owned 14 patents. He is the section editor (Organic Materials) of Encyclopedia of Modern Optics, edition II, Elsevier. He is also currently on the Editorial Boards of Active and Passive Electronic Components and Current Smart Materials. He frequently serves as a referee for many high-quality Journals, such as *JACS, Adv. Mat., Adv. Funct. Mat.,* *ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..*

Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Dynamic *kirigami* structures for solar energy conversion

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ABSTRACT

Conventional electronic devices are usually flat and rigid, in large part because they are made from crystalline semiconductors using well-established, wafer-based processing methods. Many new applications and materials, however, compel us to think about non-planar device structures and new processes for realizing them. In this talk we will consider kirigami [1] based solar cells capable of increasing solar energy conversion efficiency over their conventional, flat analogs. We will discuss how dynamic solar tracking is accomplished by a 2D-to-3D transformation, involving engineered stress-strain behavior of a mechanical metamaterial. The dynamic loading of the metamaterial results in controlled, uniform buckling and can be used to increase energy output throughout the day. The trade-offs between economy of semiconductor material and module area will be discussed, as well as other advanced configurations that can drive down the cost of semiconductor used in a PV module by a factor of 10 or more.

Reference:

1. "Dynamic kirigami structures for integrated solar tracking." Lamoureux, *et al.*, *Nature Comm.* **6**, 8092 (2015)

BIOGRAPHY

Prof. Shtein earned his B.S. in Chemical Engineering at UC Berkeley (1998) and Ph.D. in Chemical Engineering, while working in an Electrical Engineering lab of Stephen Forrest at Princeton University (Summer 2004), where he developed Organic Vapor Phase Deposition and Organic Vapor Jet Printing techniques. He joined the Materials Science and Engineering department at the University of Michigan in Fall 2004, where he now serves as Professor of MSE, with courtesy appointments in Chemical Engineering, Applied Physics, Macromolecular Science and Engineering, and Art & Design. He also serves as faculty co-director for the Undergraduate Program in Entrepreneurship. His work has been recognized through several awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE) from the Air Force Office of Scientific Research, the MSE Department Achievement Award, College of Engineering-wide Vulcans Prize for Excellence in Education, the Holt Award for Excellence in Teaching, the Newport Award for Excellence and Leadership in Photonics and Optoelectronics, and the Materials Research Society (MRS) graduate student Gold Medal Award. He recently co-founded Arborlight, LLC (www.arborlight.com – a lighting technology company), and co-authored the book "Scalable Innovation: A Guide for Inventors, Entrepreneurs, and IP Professionals." (Taylor & Francis, ISBN-10: 1466590971)

Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Organic-Inorganic Hybrid Bulk Quantum Materials: Bridging Molecules to Crystals

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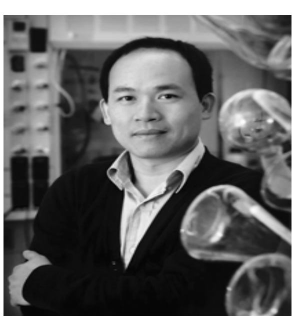
ABSTRACT

A crystalline solid is a material whose constituents, such as atoms, molecules or ions, are arranged in an ordered structure, forming a periodic lattice that extends in all directions. The interactions between the lattice points could lead to the formation of band structure. As a result, the properties of inorganic crystals show strong dependence on their size, especially in nanoscale, or so called quantum size effect. The molecular interactions in organic crystals cause their properties distinct from those of individual molecules. Single crystalline materials that exhibit bulk properties consistent with their individual building blocks, or bulk assemblies of quantum-confined materials without band formation or quantum size effect, are rare to our best knowledge. Recently, we have developed a series of bulk quantum materials containing photoactive metal halides as the building blocks, ((C4N2H14X)4SnX6, X = Br, I) and ((C9NH20)2SbX5, X = Cl), in which the metal halide octahedrons (SnX64-) and quadrangular pyramids (SbX52-) are completely isolated from each other and surrounded by the organic ligands C4N2H14X+ and C9NH20+, respectively. The isolation of the photoactive metal halide species by the wide band gap organic ligands leads to strong zero-dimensional (0D) core-shell quantum confinement without band formation between the metal halide species, allowing the bulk materials to exhibit the intrinsic properties of the individual metal halide species. These bulk quantum materials can also be considered as perfect host-dopant systems, with the metal halide species periodically doped in the wide band gap matrix. As the metal halide building blocks could be considered as either "crystal lattice points" or "molecular species", these organic-inorganic hybrid bulk quantum materials have indeed bridged molecules with crystals. Highly luminescent strongly Stokes shifted broadband emissions with photoluminescence quantum efficiencies of up to near-unity were realized, as a result of excited state structural reorganization of the individual metal halide species. Our discovery of highly luminescent single crystalline bulk quantum materials or perfect host-dopant systems opens up a new paradigm in functional materials design.

BIOGRAPHY



Dr. is currently an associate professor in the Department of Chemical & Biomedical Engineering with courtesy appointment in the Department of Chemistry and Biochemistry. He is also a faculty affiliated with the Materials Science Program. He joined FSU faculty in August 2013 through the FSU Energy and Materials Initiative.

He received his B.S. degree in Composites from Beijing University of Chemical Technology China, in July 2001, before coming to the U. S. for graduate studies. He received his Ph.D. in Materials Science from

University of Southern California in 2005 with research work in Organic Light Emitting Diodes under the guidance of Professor Mark Thompson. He then performed postdoctoral research with Professor Jean Fréchet in Plastic Electronics at the University of California, Berkeley and Lawrence Berkeley National Laboratory (LBNL) for two and a half years. He began his independent career in June 2008 as a Staff Scientist at the Molecular Foundry at LBNL.

Dr. Ma's current research focuses on the development of new functional materials with controlled chemical and physical properties for applications in a range of technological areas from energy to environmental and information technologies. Of particular interest are light emitting devices, solar energy conversion devices, energy storage devices, transistors and sensors. Two major material systems currently under investigation are low dimensional organic-inorganic hybrid metal halide perovskites and multi-excited state phosphorescent molecules with photoinduced structural change. He has authored and co-authored approximately 60 peer-reviewed publications in high impact journals with an H-index of 30 as of today.

Technical Session D1-W2-T2: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Self-assembled 2D Materials

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ABSTRACT

Dr. Zhengdong Cheng received his Ph.D. in Physics from Princeton University, USA in 1999, M.S. from Institute of High Energy Physics (Beijing) in 1993, and B.S. from University of Science and Technology of China in 1990. He was promoted to a tenured Professor in at Texas A&M University (TAMU) due to his outstanding creativity and productivity relating to research into complex fluids and soft matter. He focuses on the self-organization of intelligent colloids and anisotropic particles, the fabrication of photonic crystals and integrated photonic circuits, solar hydrogen production via water splitting, and the application of microfluidics to bio-encapsulation. The techniques developed are applicable to the modeling of phase transitions and liquid crystal materials, the engineering of nanocomposites and semiconductors of light, solar energy harvesting, and a wide range of therapeutic treatments. Dr. Cheng has authored and co-authored more than 100 textbooks, books, book chapters, and peer-reviewed journal articles. He has chaired and organized professional conferences, such as American Institute of Chemical Engineering national meetings, American Physics Society meetings, and the China Soft Matter Day Symposium. Dr. Cheng is the Associate Editor of the American Society of Gravity and Space Research Journal. He was awarded the William Keeler Memorial Award by the Dwight Look College of Engineering, TAMU in February 2015. In addition, he directed and participated in projects supported by the National Science Foundation (NSF) (USA, China), NASA, American Chemical Society Petroleum Research Funds, industrial, and TAMU as principal investigator (PI), co-PI, and senior personnel. During his 13-years at TAMU, he has taught more than 1000 students and trained more than 20 undergraduate students and nearly 20 graduate students to conduct leading-edge research. He served as proposal reviewer for DOE, NSF (center proposal site review, and Materials Research Science and Engineering Center), and National Institute of Food and Agriculture (NIFA). He has also served as a journal editor on many publications and has reviewed hundreds of peer-reviewed journal papers.

BIOGRAPHY

Despite their natural abundance and wide industrial applications, such as red blood cells and clay, disks and plates are the least studied nanoparticles compared to spheres and rods. Colloidal anisotropic platelets are model systems for discotic liquid crystal investigation. We have established methods to fabricate and control the size, aspect ratio, and polydispersity of disks and systematically investigate their effects on discotic liquid crystal phase transitions. I will discuss our recent research in preparation for the International Space Station experiments on liquid crystal phase dynamics in colloidal discotic suspensions, particularly the controlled self-assembly under external fields, such as electric and magnetic field and temperature gradient.

I will also discuss the other applications of 2D materials, including nanocomposite fabrication, and understanding of Janus platelets as nanoparticle surfactants for Pickering emulsification. We have developed method to mass produce Janus nanoplates, first using the model system of Zirconium Phosphate nanoplates, then using clay and graphene Quantum Dots with reduced cost. I will discuss the applications of these nanoplate surfactants to make stable Pickering emulsions and foams, to stable graphene suspensions, for enhanced oil recovery, and for nano-encapsulations.

Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Session Chair

Meng-Ju Renee Sher (佘孟儒)

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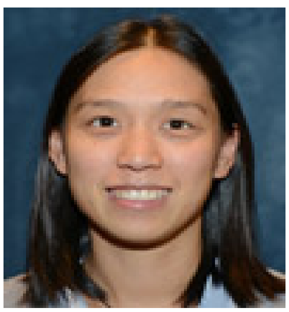
BIOGRAPHY



Meng-Ju (Renee) Sher is an assistant professor at Wesleyan University. Sher received her bachelor's degree in physics from Wesleyan in 2007 and PhD degree from Harvard in 2013. From 2013 to 2015, she was a postdoctoral scholar in Stanford Institute for Materials and Energy Science, a joint institute of SLAC national lab and Stanford University. She became acting assistant professor in the department of materials science and engineering at Stanford in 2015 before joining Wesleyan University in 2016. Her work focuses on using ultrafast spectroscopic techniques for energy materials research.

Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Optimizing Discharge Capacity of Li-O2 Batteries by Design of Air-electrode Porous Structure: Multifidelity Modeling and Optimization

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ABSTRACT

In this talk, I will present a mathematical framework to study the optimal design of air electrode microstructures for lithium-oxygen (Li-O2) batteries. The design parameters to characterize an air-electrode microstructure include the porosity, surface-to-volume ratio, and parameters associated with the pore-size distribution. A surrogate model (also known as response surface) for discharge capacity is first constructed as a function of these design parameters. In particular, a Gaussian process regression method, co-kriging, is employed due to its accuracy and efficiency in predicting high-dimensional responses from a combination of multifidelity data. Specifically, a small sample of data from high-fidelity simulations are combined with a large sample of data obtained from computationally efficient low-fidelity simulations. The high-fidelity simulation is based on a validated multiscale modeling approach that couples the microscale (pore-scale) and macroscale (device-scale) models, while the low-fidelity simulation is based on an empirical macroscale model. The constructed response surface provides quantitative understanding and prediction about how air electrode microstructures affect the discharge capacity of Li-O2 batteries. The succeeding sensitivity analysis and optimization via genetic algorithm offer reliable guidance on the optimal design of air electrode microstructures. The proposed mathematical framework can be generalized to investigate other new energy storage techniques and materials.

BIOGRAPHY

In this talk, I will present a mathematical framework to study the optimal design of air electrode microstructures for lithium-oxygen (Li-O2) batteries. The design parameters to characterize an air-electrode microstructure include the porosity, surface-to-volume ratio, and parameters associated with the pore-size distribution. A surrogate model (also known as response surface) for discharge capacity is first constructed as a function of these design parameters. In particular, a Gaussian process regression method, co-kriging, is employed due to its accuracy and efficiency in predicting high-dimensional responses from a combination of multifidelity data. Specifically, a small sample of data from high-fidelity simulations are combined with a large sample of data obtained from computationally efficient low-fidelity simulations. The high-fidelity simulation is based on a validated multiscale modeling approach that couples the microscale (pore-scale) and macroscale (device-scale) models, while the low-fidelity simulation is based on an empirical macroscale model. The constructed response surface provides quantitative understanding and prediction about how air electrode microstructures affect the discharge capacity of Li-O2 batteries. The succeeding sensitivity analysis and optimization via genetic algorithm offer reliable guidance on the optimal design of air electrode microstructures. The proposed mathematical framework can be generalized to investigate other new energy storage techniques and materials.

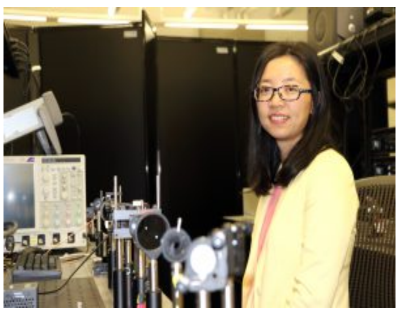
Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Zhiting Tian

Assistant Professor, Department of Mechanical Engineering
Virginia Tech

ABSTRACT

BIOGRAPHY



Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Nanostructured Inorganic Materials for Thermal Storage and Thermoelectricity Made Via Solution-Phase Synthesis

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ABSTRACT

I discuss my group's studies on thermal energy storage and thermoelectricity in colloidal nanocrystal composites. Colloidal nanocrystals consist of an inorganic crystalline core with short ligand molecules bound to the surface. These nanocrystals can be synthesized with excellent control over size, shape, and composition. In addition, modular chemistries can embed these nanocrystals into many different matrices. The ability to "mix-and-match" nanocrystals with matrices enables a vast array of materials possibilities that can impact many fields. Importantly, these materials are made via solution-phase chemistry, which naturally lends itself to scalable processing at moderate temperatures with low cost equipment.

I first present our work on phase change nanocomposites for thermal energy storage. These composites consist of phase change Bi nanocrystals embedded in a solid Ag-matrix. These composites improve upon traditional thermal energy storage materials by (i) thermally charging/discharging 100 - 1000 times faster, (ii) doubling thermal storage capacity, and (iii) exhibiting thermal storage temperature flexibility through size-dependent melting. I then present our work on using this same synthetic approach to make thermoelectric materials such as Ag-doped CuSeS and Na-doped PbTeSe. Overall, we find that the room temperature thermoelectric properties of these solution-processed materials are comparable to conventionally-processed materials. Achieving parity between solution-phase processing and conventional processing is an important milestone and demonstrates the promise of this synthetic approach.

BIOGRAPHY

Robert Wang is an assistant professor in mechanical engineering and graduate faculty member in chemical engineering and materials science engineering at Arizona State University. He received his Ph.D. in mechanical engineering from the University of California at Berkeley in 2008. Afterwards he worked as a materials science postdoctoral fellow at Lawrence Berkeley National Laboratory. He joined Arizona State University and started the Thermal Energy and Nanomaterials Laboratory in 2011. His research focuses on heat and charge transport, colloidal nanocrystals, nanocomposites, thermoelectricity, thermal management, and thermal energy storage. His work as been recognized by a CAREER award from the National Science Foundation and a Young Investigator Award

from the Air Force Office of Scientific Research.

Technical Session D1-W3-T2: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Algae-Based Sustainable Urban-Wastewater Reclamation Ecosystem (aSURE): An Integrated Approach to Sustaining Food-Energy-Water Supply

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ABSTRACT

With concerns over increased population and consequent shortage of food-energy-water (FEW) resources, there is an increasing necessity and interest in reclaiming waste streams for sustainable FEW supply. Urban wastewater is a reliable source for recycling water, energy, and nutrients. The integration of wastewater treatment and algae cultivation has garnered attention as a sustainable and multi-functional reclamation strategy to improve water quality, produce energy, and to recycle nutrients. Nevertheless, this integration has not yet been practically achieved at large-scale. One significant challenge is low productivity and high cost of algae cultivation. The other hurdle is the low value of wastewater-based algal products (algal biofuels), which negates economic feasibility.

The overall goal of our research is to develop a novel Algae-based Sustainable Urban-wastewater Reclamation Ecosystem (aSURE) for sustainable FEW supply. This will be achieved by four objectives: (1) develop a novel algae cultivation strategy for cost-efficient algal biofuel production and wastewater treatment; (2) integrate algae cultivation and urban agriculture for sustainable food production; (3) develop innovative technologies that convert post-extracted algal residue to high value nanomaterials; and (4) create a predictive and dynamic life cycle optimization (LCO) tool for sustainable management for FEW systems. This talk will overview our research in developing the aSURE approach for sustainable FEW supply through innovative algae-based biotechnologies and life-cycle modeling/optimization.

BIOGRAPHY

Dr. Yongli Zhang is an Assistant Professor in the Department of Civil and Environmental Engineering at Wayne State University (WSU). She is also the director of Detroit Water Works Park research field station funded by the US National Science Foundation (NSF), as well as the associated director of WSU's Sustainable Engineering Certificate Program. She received a B. Eng. in Food Engineering from Sichuan University, a M.Sc. in Molecular Microbiology from Guangxi University, and a Ph. D. in Environmental Engineering from the University of Virginia. Prior to joining the faculty of Wayne State University, she worked as a senior engineer and project director in the areas of energy efficiency and environmental management in China, and spent two years in University of Michigan Ann Arbor as a research scholar in water quality and public health. Her research focuses on the sustainability of the FEW nexus through the development of advanced FEW biotechnologies and system modeling/optimization. She has received research awards from National Science Foundation, the State of Michigan, the State of Montana (through Montana State University), and Wayne State University SEED Research Program. She has served on review panels for US NSF. Currently she serves as editorial board member/ associate editor in a few journals including Journal of Advanced Civil Engineering Practice and Research, Austin Tissue Engineering, and MOJ Civil Engineering.

Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Session Chair

Noninvasive Dermatological Micro-Imaging of Melanin for Histopathological Diagnosis and Treatment

Chi-Kuang Sun (孫啟光)

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BIOGRAPHY

Chi-Kuang Sun was born in Tainan, Taiwan in 1965. He received his S.B. in EE from National Taiwan University (NTU) in 1987, and S.M. and Ph.D. in applied physics from Harvard University in 1990 and 1995 respectively.

He was a visiting scientist at the Research Laboratory of Electronics, MIT, between 1992-1994, 2015-2016, and was an assistant researcher in the NSF Center for Quantized Electronics Structures (QUEST) at UCSB between 1995 and 1996. He joined the NTU faculty in 1996 and is currently life distinguished professor of electrical engineering and photonics and AmTRAN chair professor of NTU. He is also an adjunct research fellow of physics and applied sciences at Academia Sinica, Taiwan. He is the founder and a chief investigator of the Molecular Imaging Center, one of the 7 university-level excellence centers at NTU. He was Deputy Dean of the College of Electrical Engineering and Computer Science, NTU. Chi-Kuang Sun's research involves optical molecular imaging, nonlinear microscopy, ultrafast phenomena, nano-ultrasonics, THz health care, advanced femtosecond laser technologies, and applications in virtual biopsy diagnosis, treatment and therapy assessment, surgical guidance, wearable monitoring device, neural science, virus epidemic control, paleontology, interfacial water imaging, and boson peak studies.

Chi-Kuang Sun a fellow of OSA, IEEE, SPIE, and Royal Microscopical Society. He serves in the Board of Directors of Taiwan Photonics Society and Microscopy Society of Taiwan. He received the Outstanding Research Award from National Science Council (Taiwan) for 3 times, MERIT Award from National Health Research Institute (Taiwan) for 2 times, Leica Microsystems Innovation Award, C.N. Yang Outstanding Young Researcher Award, the 2010 Engineering Medal from the Taiwan Photonic Society,and Y. Z. Hsu Science Chair Professorship. He co-authored 234 journal articles, 498 international conference papers, 343 domestic conference papers, 13 book chapter, and was awarded with 17 patients.

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Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Drug-delivery Nanoparticles

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ABSTRACT

One of Dr. Ying Liu's research projects focuses on scalable generation of nanoparticles encapsulating therapeutic agents to achieve better drug functionality with reduced toxicity. The process is based on comprehensive understanding of the competitive kinetics required to reproducibly generate polymeric, or lipid, or polymer-lipid hybrid nanoparticles. Time-resolved small-angle x-ray scattering integrated with microfluidic devices has been employed to experimentally measure nanoparticle structural evolution in situ with millisecond temporal resolution.

Nanoparticles generated in Dr. Liu's laboratory have been used to deliver small molecular compounds, peptides, proteins, and siRNA and microRNAs. Examples of various nanoparticle structures and producing methods will be presented.

BIOGRAPHY

2001	B.Sc., Engineering Mechanics, Tsinghua University, Beijing, China
2004	M.A., Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ, USA
2007	Ph.D., Mechanical and Aerospace Engineering, Princeton University, Princeton, NJ, USA

She was recruited by University of Illinois at Chicago in 2006 as a tenure-track assistant professor. Liu deferred the position for a year and worked as a postdoctoral researcher at the University of Chicago from 2007-2008. From 2008 to 2017 Liu was an assistant professor at the University of Illinois at Chicago and from 2015 till now has been an associate professor in the same institute. She has published 26 journal articles, 5 patents, and 2 book chapters.

Dr. Liu is the president of Sino-American Pharmaceutical Professionals Association (SAPA)-Midwest. She is also a member of AIChE, APS, and AAPS.

Dr. Liu has received the following awards,
UIC Researcher and Scholar of the Year, Rising Star Award, UIC, IL, 2016
NSF CAREER Award, 2014 - 2019
College of Engineering Research Award, UIC, IL, 2013
OTM POC Award, UIC, IL, 2013
Chancellor Discovery Award, UIC, 2012
Technology for Developing Regions Grant, Princeton University, NJ, 2006
Howard Crathorne Phillips Graduate Fellowship, Princeton University, NJ, 2003
Engineering Fellowship, Princeton University, NJ, 2002
Graduation with Honor, Tsinghua University, Beijing, China 2001
Rong Hong National Fellowship, Tsinghua University, Beijing, China, 2000
Best Academic Performance, Tsinghua University, Beijing, China 1999
Excellent Freshman Scholarship, Tsinghua University, Beijing, China 1997

Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Smartphone-Based Imaging and Sensing Devices for Cost-Effective Molecular Diagnostics

Qingshan Wei

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ABSTRACT

Lack of diagnostic tools in resource-limited settings remains one of the major obstacles to disease diagnosis and treatment in the developing world. Although significant progress has been made in the availability of highly sensitive and specific molecular diagnostic tests, most of the current technologies are relatively complex, costly, and rely on advanced infrastructure and highly trained personnel, which restrict their applications to centralized laboratory settings. Even in developed countries, the cost of medical diagnostics can impose hurdles for patients. Imaging and sensing devices based on smartphones have been recently emerging to provide a cost-effective, field-portable, and rapid solution to meet global health challenges, both in developing and developed countries. My talk will highlight recent progress in developing highly sensitive smartphone-based fluorescence microscopy platforms and their applications for various point-of-care (POC) uses including viral particle detection, DNA imaging, and cancer point mutation analysis.

BIOGRAPHY

Qingshan Wei was born in Zhejiang Province, China. He received B.S. and M.S. degrees in Polymer Materials & Engineering from Zhejiang University (Hangzhou, China) in 2005 and 2007, respectively, and a Ph.D. degree in Chemistry from Purdue University (West Lafayette, IN) in 2012.

He finished his postdoctoral training working with Dr. Aydogan Ozcan in Bioengineering and Electrical Engineering Departments at the University of California, Los Angeles (UCLA) in 2016. He is currently an Assistant Professor of the Department of Chemical and Biomolecular Engineering at North Carolina State University.

Prof. Wei is a member of American Chemical Society (ACS), Optical Society of America (OSA), Biomedical Engineering Society (BMES), and Sigma Xi. He is the author of more than 25 peer-reviewed journal articles, 6 book chapters, and 9 conference proceedings in the areas of point-of-care diagnostics, optical imaging/sensing devices, and nanomedicine. He holds 2 issued patents and 2 pending patent applications. He is the recipient of the Bilsland Dissertation Fellowship at Purdue University and Honorable Mention of the Chancellor's Award for Postdoctoral Research at UCLA.

Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Synthetic biology approach for building artificial cell

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ABSTRACT

The field of synthetic biology has recently emerged as a result of achieving a critical mass in our knowledge of biology. While many biological molecules and systems are still too complex to be rationally designed de novo, the continued efforts in isolation and characterization of individual biological components offer the possibility of integrating them into biologically inspired devices that exhibit novel functionalities. Rather than deconstructing existing biological systems, our vision is to assemble biological parts into systems.

Assembling biological parts into a biologically functional system using a bottom-up in vitro reconstitution approach offers the possibility of designing artificial cells with the ability of sensing and responding to external stimuli. Artificial cells are defined as the encapsulation of biologically active material in a biological or synthetic membrane. Here, we describe a robust and general method to produce artificial cells for the purpose of mimicking one or more behaviors of a cell. A microfluidic double emulsion system is used to encapsulate a mammalian cell-free expression system that is able to express membrane proteins into the bilayer or soluble proteins inside the vesicles. The development of a robust platform that allows the assembly of artificial cells is valuable in understanding subcellular functions and emergent behaviors in a more cell-like environment as well as for creating novel signaling pathways to achieve specific cellular behaviors. As a test bed, we are engineering mechanosensitive vesicles to respond to the external physical environment. The platform development and inclusion of additional information processing components could potentially open up new applications in biosensing and medicine.

BIOGRAPHY

Prof. Liu was born in Taiwan and moved to Canada with his family when he was a teenager. He obtained his bachelor's degree in Honours Biochemistry from The University of British Columbia in 2001. From 2002-2007, Prof. Liu performed his doctoral research in Biophysics at University of California-Berkeley where developed interests in membrane biophysics and cell motility. Upon graduation, Prof. Liu began his post-doctoral research in the Department of Cell Biology at The Scripps Research Institute where he studied the dynamics of endocytosis in living cells. In 2012, Prof. Liu started his research group at University of Michigan-Ann Arbor where holds a position in the Department of Mechanical Engineering, the Department of Biomedical Engineering, the Cellular and Molecular Biology Program, and the Biophysics Program.

He has developed strong interests in systems biology and synthetic biology during his previous research experience and is working at the interface of biology and engineering. His previous works were published in Nature Physics, Lab on a Chip, Integrative Biology, Journal of Cell Biology, and Biophysical Journal.

Prof. Liu is a member of the Biophysical Society, American Society of Cell Biology, and Biomedical Engineering Society. Prof. Liu is a recipient of Innovator Award from National Institutes of Health, Young Innovator in Cellular and Molecular Bioengineering, Rising Star Award from BMES-Cellular and Molecular Bioengineering, and Burroughs-Wellcome Future of Biophysics Symposium Speaker.

Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

Self-clearing implantable sensors and actuators for neurological applications

Dr. Hyowon (Hugh) Lee

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ABSTRACT

Biomedical devices such as indwelling catheters, pacemakers, orthopedic implants, and biosensors suffer from significant performance degradations or premature failures due to biofouling. While many passive anti-biofouling strategies such as antibacterial coatings, drug-eluting surface, microtexture, surface charge modification have shown to be effective in delaying bioaccumulation for acute applications, the issue of biofouling-related device failure still persists in chronically implanted devices. Physical removal and prevention of bioaccumulation in situ using active transducers are particularly promising for chronic management of biofouling. In this talk, I will discuss our latest efforts to develop smart chronically implantable catheters and other biosensors that can combat biofouling using microfabricated magnetic actuators. In particular, I will discuss the application of thin-film magnetic microactuators to improve treatment for various neurological disorders that can only be managed using chronically implanted medical devices with extremely high failure rates due to biofouling. We will discuss our latest in vitro and in vivo evaluations of these self-clearing smart devices.

BIOGRAPHY

Hyowon (Hugh) Lee received his B.A. in neuroscience from Colorado College in 2004 and his M.S. and Ph.D. degrees in biomedical engineering from the University of California, Los Angeles, in 2008 and 2011, respectively. Before joining Purdue, he worked as a senior engineer for St. Jude Medical's Implantable Electronics Systems Division where he focused on using advanced fabrication technologies to overcome manufacturing challenges associated with implantable electronic devices such as pacemakers, ICDs, DBS, and other neurostimulation devices. At UCLA, he trained in the areas of neuroengineering and microfabrication under Jack Judy to develop novel implantable magnetic microactuators for hydrocephalus patients. His current research interests include development of implantable microsystems for neurological application, minimally invasive neurostimulation devices, MEMS-cell interface, and safety and reliability of implantable neurostimulation devices.

Technical Session D1-W1-T3: Emerging Technologies and Applications in Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, Mobile Health, Biomedical Optics and Imaging, Biomedical Engineering and Systems

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David Geffen School of Medicine at UCLA, Ronald Reagan UCLA Medical Center

ABSTRACT

BIOGRAPHY

Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Session Chair

Max Shtein

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BIOGRAPHY

Prof. Shtein earned his B.S. in Chemical Engineering at UC Berkeley (1998) and Ph.D. in Chemical Engineering, while working in an Electrical Engineering lab of Stephen Forrest at Princeton University (Summer 2004), where he developed Organic Vapor Phase Deposition and Organic Vapor Jet Printing techniques. He joined the Materials Science and Engineering department at the University of Michigan in Fall 2004, where he now serves as Professor of MSE, with courtesy appointments in Chemical Engineering, Applied Physics, Macromolecular Science and Engineering, and Art & Design. He also serves as faculty co-director for the Undergraduate Program in Entrepreneurship. His work has been recognized through several awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE) from the Air Force Office of Scientific Research, the MSE Department Achievement Award, College of Engineering-wide Vulcans Prize for Excellence in Education, the Holt Award for Excellence in Teaching, the Newport Award for Excellence and Leadership in Photonics and Optoelectronics, and the Materials Research Society (MRS) graduate student Gold Medal Award. He recently co-founded Arborlight, LLC (www.arborlight.com – a lighting technology company), and co-authored the book “Scalable Innovation: A Guide for Inventors, Entrepreneurs, and IP Professionals.” (Taylor & Francis, ISBN-10: 1466590971)

Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Ultrafast and Nanoscale Interfacial Charge Transport

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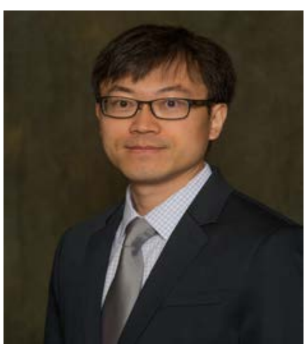
ABSTRACT

Interfacial charge and energy transport is of fundamental importance to nanoscience and devices. It is critical to the development of quantum plasmonic junctions, ultrafast photoelectron sources, and compact electromagnetic radiation sources (radio frequency to THz to x-rays). With the combination of recent advances in nanotechnology and ultrafast lasers, these novel devices may integrate with solid-state platforms to achieve exceptional performance, for various applications in imaging, communications, energy, and security. Understanding the underlying physics is crucial to control the interfacial charge transport at ultrashort spatiotemporal scales. In this talk, I will present recent advances on the modeling of electron transport at contact interfaces and ultrafast electron emission from metal surfaces. Scaling laws for current crowding and electrical contact resistance between dissimilar materials are constructed for a large range of material properties and geometrical aspect ratios. A general theory is developed for the quantum tunneling current in a nanoscale metal-insulator-metal junction, covering the direct tunneling, field emission, and space-charge-limited regimes. Also highlighted is our recent theory for laser-induced electron emission, by solving the time-dependent Schrödinger equation exactly.

BIOGRAPHY



Peng Zhang is an Assistant Professor in the Department of Electrical and Computer Engineering at Michigan State University. He received his B.Eng. and M.Eng. degrees in electrical and electronic engineering from Nanyang Technological University, Singapore, in 2006 and 2008, respectively, and his Ph.D. degree in nuclear engineering and radiological sciences from the University of Michigan (UM), Ann Arbor, in 2012. His research interests are in theoretical and computational physics in nanoelectronics, plasmas, and accelerator technology. He has authored refereed journal publications on electrical contacts, thin films, classical, ballistic, and quantum diodes, space-charge-limited current flows, beam-circuit interaction, microwave absorption on rough surfaces, multipactor and breakdown, slow wave structures, z-pinches, laser-plasma interaction, and more recently on vacuum nano devices, quantum tunneling plasmonic junctions, ultrafast photoemission, and novel miniaturized electromagnetic radiation sources. He was a recipient of the UM Richard and Eleanor Towner Prize for Outstanding Ph.D. Research, the UM Rackham Presidential Fellowship Award, and the IEEE Nuclear and Plasma Sciences Graduate Scholarship Award. He is currently serving as an Editorial Board Member of Scientific Reports, a journal by Nature.

Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Yuping Zeng

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ABSTRACT

Innovating electronic materials and related process technologies are critical in achieving advanced devices with high performances and new systems with complex functions.

III-V compound semiconductors are attractive due to their small effective masses and high electron mobility. My research has been focused on design and fabrication of electron devices with III-V compound semiconductors. In this talk, I will talk about InAs/AlSb/GaSb tunneling field effect transistors (TFETs) for low power applications. I will also talk about InAs FinFETs research work undergoing in University of Delaware. The novel material designs, fabrication process technology and device design, will be discussed.

At the end, future work will be discussed in terms of further developing new materials, devices and technology, integration of these novel devices on silicon substrates and realizing novel systems for our daily life applications.

BIOGRAPHY

Dr. Yuping Zeng is currently an assistant professor in University of Delaware. She has been working on various projects on III-V compound semiconductor electron devices, such as InAs Tunneling Field Effect Transistors (TFETs), Metal Oxide Semiconductor Field Effect Transistors (MOSFETs), Fin Field Effect Transistors (FinFETs). She received her PhD degree in Swiss Federal Institute of Technology in 2011. During her PhD study, she worked on optimizations of design and fabrication process of high speed InP/GaAsSb double heterojunction bipolar transistors (DHBTs) under Prof. Colombo Bolognesi. She obtained her Master degree in National University of Singapore where her main research was on nanoscale material process and characterizations. She is one of the 20 gift-young students who were selected to Jilin University at the age of 15 in 1994 for a gift-young university program in China and obtained her Bachelor's degree when she was less than 19. Several facets of her research activity are reflected in 30 journal papers and 15 international conference papers. Dr. Zeng is a recipient of the 2009 Chinese Government Award for Outstanding Self-financed Students Abroad. Her research interests are continued on advanced devices and systems for low power applications and high performance applications by innovations in device design, material design and fabrication technology.

Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Graphene: A Versatile Material for Mid-infrared and Terahertz Photonic and Optoelectronic Applications

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ABSTRACT

Graphene has a number of attractive material properties for photonic and optoelectronic applications, including its tunable carrier density, high carrier mobility at room temperature, compatibility with different substrate materials, as well as its capability of supporting tightly confined surface plasmons in the mid-infrared to terahertz spectral range. Therefore, graphene has attracted in recent years increasing research interests and efforts as a versatile material for various photonic and optoelectronic device applications. In this talk, I will present some of our work on developing various novel and high-performance mid-infrared and terahertz photonic and optoelectronic devices by taking advantage of the attractive material properties of graphene. Examples of the developed devices include tunable metamaterials, filters and modulators, photodetectors, sources, chemical and biological sensors. In addition, I will also show how we can use graphene surface plasmons to influence the optical phonon properties of other materials.

BIOGRAPHY

Dr. Peter Qiang Liu joined University at Buffalo Electrical Engineering in January 2017 after completing a postdoctoral research appointment at Sandia National Laboratories, working on metamaterials enhanced light-matter interactions in semiconductors and strongly correlated electron materials. Previous to that, he was appointed as a postdoctoral research fellow at the Institute for Quantum Electronics and the Department of Physics at ETH Zurich (October 2012 to September 2015). His work there focused on developing graphene-based tunable THz and Mid-infrared plasmonic and metamaterial structures for various device applications.

He obtained his Ph.D. in Electrical Engineering from Princeton University in 2012. His thesis work focused on developing high-performance Quantum Cascade lasers employing novel quantum and laser cavity designs. He was awarded the Francis Robbins Upton Fellowship and the Harold W. Dodds Honorific Fellowship for his graduate study at Princeton University. He received his B.E. in Electronic Engineering with highest honor from Tsinghua University in 2007.

Technical Session D1-W2-T3: Emerging Technologies and Applications in Electronic, Photonic, and Magnetic Materials, Ceramic Materials, Organic Polymer and Soft Materials

Local Strain Engineering and its Applications in GaN Optoelectronics

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ABSTRACT

Gallium nitride (GaN) and its related alloys are technologically important for applications in short-wavelength LEDs, lasers, photodetectors, and power electronics. GaN is a piezoelectric material. As a result, when it is strained, a strong built-in electric field is generated which has profound impacts on its applications in LEDs and lasers. In these devices, strained InGaN heterostructures are routinely employed as the light-emitting active region. The strain induced built-in electric field can significantly lower the emitter efficiency, cause efficiency droop and undesirable wavelength drift. Nanopillars can effectively relax the strain and nanopillar LEDs have attracted substantial interests in recent years. In this work, we showed that by controlling and engineering the strain in GaN nanopillars, not only can one realize benefits from strain relaxation, new degrees of control can be obtained which have potential applications for display, communication, and sensing.

BIOGRAPHY

P.C. Ku received all his degrees in electrical engineering including a BS from the National Taiwan University and a PhD from the University of California at Berkeley. He was awarded the Ross Tucker Memorial Award in 2004 as a result of his PhD research. He was with Intel from 2004 to 2005 before joining the University of Michigan in 2006 where he is currently an associate professor of electrical engineering and computer science. In 2010, he cofounded Arborlight that is dedicated to solid-state lighting system design and application. He received the DARPA Young Faculty Award in 2010.

Technical Session D1-W3-T3: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Session Chair

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BIOGRAPHY

Shien-Ping Feng is an Assistant Professor in the department of Mechanical Engineering at Hong Kong University. He received his Ph.D. in chemical engineering from National Tsing-Hua University (2003-2008), and was a postdoctoral associate at MIT (2009-2011) prior to his appointment at The University of Hong Kong. He was a principal engineer, section manager and technical manager at Taiwan Semiconductor Manufacturing Company (2001-2008), and a deputy director at Tripod Research Center (2008-2009). His current research is focused on the electrochemical fabrication of nanostructured materials and their applications in solar, thermal and electrochemical energy conversion and storage.

Technical Session D1-W3-T3: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Distribution Management and Emerging Automation Technologies

Chee-Wooi Ten

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ABSTRACT

The communication infrastructure of an electrical distribution network has undergone a major shift toward system-wide automation with "self-healing" features in technologies that would enable feeder reconfiguration against electrical fault disturbances. These sensing technologies coordinate with other communication devices such as smart meters and feeder remote terminal units. This workshop provides an architectural overview of the evolutionary changes since decades ago as well as some of the research challenges ahead. Preliminary work on networked microgrid and cybersecurity-related issues to these changes will be presented.

BIOGRAPHY

Chee-Wooi Ten received the BSEE and MSEE degrees from Iowa State University, Ames, in 1999 and 2001, respectively, and He later received the Ph.D. degree in 2009 from University College Dublin (UCD), National University of Ireland. Dr. Ten was a Power Application Engineer working in project development for EMS/DMS with Siemens Energy Management and Information System (SEMIS) in Singapore from 2002 to 2006. He is currently an Associate Professor of Electrical and Computer Engineering at Michigan Technological University. His primary research interests are modeling for interdependent critical cyberinfrastructures and SCADA automation applications for a power grid. He is a Senior Member of the IEEE. He is an active reviewer for IEEE PES transactions and has been the member of IEEE PES computer and analytical method for cybersecurity task force. Dr. Ten is currently serving as an Editor for IEEE Transactions on Smart Grid and Elsevier Journal Sustainable Energy, Grids and Networks (SEGAN).

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Terahertz spectroscopy: tracking charge carrier motions in organic solar cells

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ABSTRACT

Techniques capable of resolving ultrafast carrier dynamics are important for the development of emerging energy materials. In this work, we generate sub-picosecond terahertz pulses to detect the dynamics of free charge carriers in organic semiconducting polymers. With time-resolved terahertz (THz) spectroscopy, we selectively study the intramolecular carrier transport in poly(3-hexylthiophene) (P3HT) polymers optimized for solar cell performance. We show that local carrier mobility is three orders of magnitude higher than mobility reported using macroscopic mobility measurements. The fast local carrier mobility allows us to understand how the efficiency of charge-transfer state splitting is high in these polymers and shows that local disorder does not strongly impact intramolecular transport processes. Moreover the local carrier mobility does not exhibit changes with temperature or time within the 1 ns duration probed, indicating that local carrier transport is always fast. Finally, we will also present results on using optical-pump/THz probe techniques to probe minority carrier lifetime and surface recombination velocity in emerging thin film solar cell absorbers.

BIOGRAPHY

Meng-Ju (Renee) Sher is an assistant professor at Wesleyan University. Sher received her bachelor’s degree in physics from Wesleyan in 2007 and PhD degree from Harvard in 2013. From 2013 to 2015, she was a postdoctoral scholar in Stanford Institute for Materials and Energy Science, a joint institute of SLAC national lab and Stanford University. She became acting assistant professor in the department of materials science and engineering at Stanford in 2015 before joining Wesleyan University in 2016. Her work focuses on using ultrafast spectroscopic techniques for energy materials research.

Technical Session D1-W3-T3: Emerging Technologies and Applications in New Energy Materials and Devices, Smart Energy Systems, Energy Storage and Utilization, and Clean Vehicle Technologies

Dr. Wencong Su

Assistant Professor, Department of Electrical and Computer Engineering
University of Michigan, Dearborn

ABSTRACT

BIOGRAPHY

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