The Fourth EITA Young Investigator Conference
(The EITA-YIC 2015)

"Leadership, Innovation, Growth"

Conference Proceedings

Massachusetts Institute of Technology
Cambridge, MA, U.S.A.

Thursday-Friday, August 6 – August 7, 2015

<Final>

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Welcome Message

Conference Themes

"Leadership, Innovation, Growth"

The EITA-YIC 2015 conference consists of three parallel workshops:

- **Workshop 1 (W1):** Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science
- **Workshop 2 (W2):** Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering
- **Workshop 3 (W3):** Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Planning Committee

Conference Chairs

Yi-Hsiang (Sean) Hsu	(許益祥)	Harvard University
Li-San Wang	(王立三)	University of Pennsylvania

Conference Organizers

Yaoyu E Wang	(王耀煜)	Harvard University
I-Chun Cheng	(陳奕君)	National Taiwan University
Hau-Tieng Wu	(吳浩樬)	University of Toronto
Hsiang-Ying (Sherry) Lee	(李湘盈)	Massachusetts Institute of Technology
Wu-Hsi Li	(李務熙)	CharmPI LLC
Po-An Tsai		Massachusetts Institute of Technology
China-Chen (Debbie) Yu		Massachusetts Institute of Technology
Yihan Sheu		Harvard University
Ariel Yeh		Harvard University

Project Manager

Hsiang-Ying (Sherry) Lee	(李湘盈)	Massachusetts Institute of Technology

Program Committee

Workshop Track Co-Chairs

Workshop 1 (W1): Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Woei-Jyh (Adam) Lee	(李偉智)	University of Maryland, College Park
Chen-Hsiang (Jones) Yu	(余禎祥)	Prentice Lab

Workshop 2 (W2): Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Yen-Tsung Huang	(黃彥棕)	Brown University
Hsiang-Ying (Sherry) Lee	(李湘盈)	Massachusetts Institute of Technology

Workshop 3 (W3): Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Pei-Cheng Ku	(古培正)	University of Michigan at Ann Arbor
Jung-Tsung Shen	(沈榮聰)	Washington University in St. Louis

Publication

Conference Program:

Hsiang-Ying (Sherry) Lee	(李湘盈)	Massachusetts Institute of Technology

Conference Proceedings:

Woei-Jyh (Adam) Lee	(李偉智)	University of Maryland, College Park

Local Management

The Republic of China Student Association of M. I. T.
Harvard Taiwan Student Association

On-Site Registration

The Republic of China Student Association of M. I. T.
Harvard Taiwan Student Association

Web Development

Michael Hwa-Han Wang	(王華漢)	EBMedia, LLC

Co-Organizing Associations - TSAs

The Republic of China Student Association of M. I. T.
Harvard Taiwan Student Association

Co-organizing Associations and Co-sponsors

Taipei Economic & Cultural Office in Boston
Science and Technology Division, Taipei Economic and Cultural Representative Office the U.S.
Education Division, Taipei Economic & Cultural Office in Boston
Commercial Division, Taipei Economic & Cultural Office in Boston
Taiwan Trade Center, New York

Conference Program

Day 1 (Thursday, August 6, 2015)

8/6 (Thu) 8:30 am - 6:00 pm: Registration
Room: 4-270

8/6 (Thu) 9:30 am - 9:50 am: Opening Session

Chair: **Dr. Li-San Wang**, Associate Professor, Department of Pathology and Laboratory Medicine, University of Pennsylvania Perelman School of Medicine (賓州大學醫學院王立三教授)

Chair: **Dr. Yi-Hsiang (Sean) Hsu**, Assistant Professor, School of Medicine, Harvard University (哈佛大學醫學院許益祥教授)
Room: 4-270

Welcome Remarks:

Mr. Ming-chi Scott Lai
Director-General
Taipei Economic and Cultural Office in Boston
(駐波士頓台北經濟文化辦事處賴銘琪處長)

Plenary Sessions:
8/6 (Thu) 9:50 am - 10:35 am: Plenary Session (I):
Chair: **Dr. Li-San Wang**, Associate Professor, Department of Pathology and Laboratory Medicine, University of Pennsylvania Perelman School of Medicine (賓州大學醫學院王立三教授)
Room: 4-270

Plenary Speaker:

"Metabolic rhythm, immune signaling and obesity-related health conditions"
Dr. Chih-Hao Lee
Professor of Genetics and Complex Diseases
Harvard T.H. Chan School of Public Health
Division of Biological Sciences
Department of Genetics and Complex Diseases
Harvard University

8/6 (Thu) 10:35 am – 11:20 am: Plenary Session (II):
Chair: **Dr. Yi-Hsiang (Sean) Hsu**, Assistant Professor, School of Medicine, Harvard University (哈佛大學醫學院許益祥教授)
Room: 4-270

Plenary Speaker:

"Bioinformatic Challenges for DNA-Seq and RNA-Seq experiments"
Dr. Li-San Wang
Associate Professor, Department of Pathology and Laboratory Medicine
University of Pennsylvania Perelman School of Medicine

(賓州大學醫學院王立三教授)

8/6 (Thu) 11:20 am - 11:35 am: Break

Plenary Sessions:

8/6 (Thu) 11:35 am – 12:20 pm: Plenary Session (III):

Chair: **Dr. Hsiang-Ying (Sherry) Lee**, Postdoctoral Associate, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (麻省理工學院李湘盈博士)
Room: 4-270

Plenary Speaker:

Dr. Frank Chuan Kuo
Associate Professor of Pathology, Harvard Medical School
Director, Pathology Informatics
Director, Assay Development, Center for Advanced Molecular Diagnostics
Core Director, Pathology Specimen Locator, DF/HCC

8/6 (Thu) 12:20 pm - 2:35 pm: Lunch

Parallel Sessions:

8/6 (Thu) 2:35 pm – 4:05 pm: Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Woei-jyh (Adam) Lee**, Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business, University of Maryland, College Park (馬里蘭大學學院市分校史密斯商學院李偉智教授)
Room: 4-270

"WebMeV-A Cloud Based Platform for Genomic Analysis"
Dr. Yaoyu E. Wang
Associate Director, Center for Cancer Computational Biology
Dana-Farber Cancer Institute
Harvard University
(哈佛大學達納法伯癌症研究所王耀煜博士)

Dr. Hau-Tieng Wu
Assistant Professor, Department of Mathmatics
University of Toronto
(多倫多大學數學系吳浩樜教授)

Dr. Michael Chang
Chief Executive Officer
Kyper

Dr. Wu-Hsi Li
Founder and CEO, CharmPI LLC
(CharmPI.com 李務熙博士)

"Evidence of positive selection on type 2 diabetes associated loci in the human genome"
Dr. Yu-Ping Poh
Postdoctoral Associate, Computer Science and Artificial Intelligence Laboratory
Massachusetts Institute of Technology

8/6 (Thu) 2:35 pm – 4:05 pm: Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Yen-Tsung Huang**, Assistant Professor, Departments of Epidemiology and Biostatistics, Brown University (布朗大學流行病學系黃彥棕黃彥棕教授)
Room: 4-261

"Bio-inspired Microlenses and Microcameras for Biomedical Applications"
Dr. Hongrui Jiang
Lynn H. Matthias Professor in Engineering & Vilas Distinguished Achievement Professor
Department of Electrical and Computer Engineering
University of Wisconsin, Madison

"Biophysics of Intrinsic Left-Right Asymmetry of The Cell"
Dr. Leo Q. Wan
Assistant Professor, Department of Biomedical Engineering
Laboratory for Tissue Engineering and Morphogenesis
Rensselaer Polytechnic Institute

"Mechanobiochemical Modeling of Cell-Material Interactions"
Dr. Hongyan Yuan
Assistant Professor, Department of Mechanical, Industrial & Systems Engineering
University of Rhode Island

Dr. Xi Xie
Postdoctoral Fellow, Koch Institute for Integrative Cancer Research
Massachusetts Institute of Technology

8/6 (Thu) 2:35 pm – 4:05 pm: Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. I-Chun Cheng**, Associate Professor, Graduate Institute of Photonics and Optoelectronics. Department of Electrical Engineering, National Taiwan University (台灣大學電機工程學系陳奕君教授)
Room: 4-265

"Integrated nano optoelectronics for biomedical engineering and applications"
Dr. Alex (Ya Sha) Yi
Associate Professor, Department of Electrical and Computer Engineering
College of Engineering and Computer Science
University of Michigan, Dearborn

"Tube^2: Optical and Electrical Properties of Tube-in-a-Tube"
Dr. YuHuang Wang
Associate Professor, Department of Chemistry and Biochemistry
University of Maryland, College Park

"Short-Range Ordered-Disordered Transition of NiOOH/Ni(OH)2 Pair Induces Switchable Wettability"
Dr. Shien-Ping Feng
Assistant Professor, Department of Mechanical Engineering
The University of Hong Kong
(香港大學機械工程系馮憲平教授)

"Tackling the Problems of Lithium-Sulfur Battery: From Molecular Understanding to Nanomaterials Design"
Dr. Weiyang (Fiona) Li
Assistant Professor, Thayer School of Engineering
Dartmouth College

8/6 (Thu) 4:05 pm – 4:20 pm: Break

Parallel Sessions:

8/6 (Thu) 4:20 pm – 5:50 pm: Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Chen-Hsiang (Jones) Yu**, Founder and CEO, Prentice Lab (Prentice Lab 余禎祥博士)
Room: 4-270

Dr. Honggang Wang
Associate Professor, Department of Electrical and Computer Engineering
University of Massachusetts Dartmouth

Dr. Juia Hua Fang
Associate Professor, Division of Biostatistics and Health Services Research
Department of Quantitative Health Sciences
University of Massachusetts Medical School

"Automated image analysis: extract the thousand words from that picture"
Dr. Tiao Xie
Co-leader, Image and Data Analysis Core (IDAC)
Harvard Medical School
Harvard University

"Exploration of immune repertoire using next-generation sequencing"
Dr. Fan Gao
Supervisor of Bioinformatics, The Picower Institute for Learning and Memory
Massachusetts Institute of Technology

8/6 (Thu) 4:20 pm – 5:50 pm: Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Hsiang-Ying (Sherry) Lee**, Postdoctoral Associate, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (麻省理工學院李湘盈博士)
Room: 4-261

"Biomedical Big Data Analytics for Patient-Centric and Outcome-Driven Precision Health"

Dr. May Dongmei Wang
Associate Professor, Wallace H. Coulter Department of Biomedical Engineering
Kavli Fellow, Georgia Research Alliance Distinguished Cancer Scholar
Georgia Institute of Technology

"Translating GWAS to Pathobiology in Lungs"
Dr. Xiaobo Zhou
Director and Assistant Professor, Functional Genomics Laboratory
Channing Division of Network Medicine
Brigham and Women's Hospital, Harvard Medical School

"High-resolution, high-speed 3D optical sensing"
Dr. Song Zhang
Associate Professor, School of Mechanical Engineering
Purdue University

"A Bayesian framework for de novo mutation calling in sequencing data"
Dr. Bingshan Li
Assistant Professor, Department of Molecular Physiology and Biophysics
Vanderbilt University School of Medicine
Vanderbilt Genetics Institute

8/6 (Thu) 4:20 pm – 5:50 pm: Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. Shien-Ping Feng**, Assistant Professor, Department of Mechanical Engineering
The University of Hong Kong, (香港大學機械工程系馮憲平教授)
Room: 4-265

"Si nanocrystals for lighting and memory applications"
Dr. Chuan-Feng Shih
Associate Professor, Department of Electrical Engineering
National Cheng Kung University
(成功大學電機工程學系施權峰教授)

"Ultrafast Optical Characterization of Thermal Transport in Micro/Nanostructured Materials"
Dr. Xiaojia Wang
Assistant Professor, Department of Mechanical Engineering
University of Minnesota, Minneapolis

"Quest for High-Temperature Superconductors"
Dr. Wei-Cheng Lee
Assistant Professor, Department of Physics, Applied Physics, and Astronomy,
The State University of New York, Binghamton

"Electrochemical Materials and Devices for Energy Storage and Conversion"
Dr. Yuan Yang
Assistant Professor, Materials Science and Engineering
Department of Applied Physics and Applied Mathematics
Columbia University

Day 2 (Friday, August 7, 2015)

8/7 (Fri) 8:30 am - 6:00 pm: Registration

Room: 4-270

8/7 (Fri) 8:30 am - 9:50 am: Panel Discussions - Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Moderator: **Dr. Chen-Hsiang (Jones) Yu**, Founder and CEO, Prentice Lab (Prentice Lab 余禎祥博士)
Room: 4-270

Panelists:

Dr. Qizhi Wei
Vice President, Analytic Consulting Group
Epsilon

Dr. Judith Maro
Instructor, Department of Population Medicine
Harvard Pilgrim Health Care Institute
Harvard Medical School

Dr. Michael Chang
Chief Executive Officer
Kyper

Dr. Wan-Ping Lee
Senior Lead Scientist, R&D
Seven Bridges Genomics, Inc.
(Seven Bridges Genomics 李婉萍博士)

Parallel Sessions:

8/7 (Fri) 9:50 am - 11:20 am: Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Chen-Hsiang (Jones) Yu**, Founder and CEO, Prentice Lab (Prentice Lab 余禎祥博士)
Room: 4-270

"Multipath Search on Large Open Data"
Dr. Woei-jyh (Adam) Lee
Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business
University of Maryland, College Park
(馬里蘭大學學院市分校史密斯商學院李偉智教授)

Dr. Yingchun (Spring) Liu
Senior Bioinformatics Scientist
Mass General Hospital/Broad Institute of MIT and Harvard

"Cloud-Based Systems and Methods for Analyzing Genomic Information"

Dr. Wan-Ping Lee
Senior Lead Scientist, R&D
Seven Bridges Genomics, Inc.
(Seven Bridges Genomics 李婉萍博士)

"The effects of aging on circadian patterns of gene expression in the human prefrontal cortex"
Dr. Cho-Yi (Joey) Chen
Postdoctoral Research Fellow, Department of Biostatistics and Computational Biology
Dana-Farber Cancer Institute
Harvard University
(哈佛大學達納法伯癌症研究所陳卓逸博士)

8/7 (Fri) 9:50 am - 11:20 am: Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Yen-Tsung Huang**, Assistant Professor, Departments of Epidemiology and Biostatistics, Brown University (布朗大學流行病學系黃彥棕黃彥棕教授)
Room: 4-261

"Enriching Silver Nanocrystals with Gold"
Dr. Dong Qin
Associate Professor, School of Materials Science and Engineering
Georgia Institute of Technology

"Quantitative Analysis of Membrane Protein Binding Kinetics"
Dr. Hung-Jen Wu
Assistant Professor, Artie McFerrin Department of Chemical Engineering
Texas A&M University

"Biological and bio-inspired transparent structural materials"
Dr. Ling Li
Postdoctoral Fellow in Materials Science and Mechanical Engineering in the Wyss Institute
School of Engineering and Applied Sciences
Harvard University

"Bioinspired Active Materials: From Camouflage to Anti-biofouling"
Dr. Qiming Wang
Postdoctoral Associate, Department of Mechanical Engineering
Massachusetts Institute of Technology

8/7 (Fri) 9:50 am - 11:20 am: Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. Pei-Cheng Ku**, Associate Professor, Department of Electrical Engineering & Computer Science, The University of Michigan at Ann Arbor, (密歇根大學安娜堡分校電機學系古培正教授)
Room: 4-265

"Harnessing Soft Materials for Functionality through Deformation and Instability"

Dr. Sung Hoon Kang
Assistant Professor, Department of Mechanical Engineering
Hopkins Extreme Materials Institute
Johns Hopkins University

"One is More than Two: Electron Transfer at Organic/Graphene Hybrid Interfaces"
Dr. Wai-Lun Chan
Assistant Professor, Department of Physics and Astronomy
University of Kansas

"Mechanics and geometry in chiral structures: from nanohelices to bio-inspired structures"
Dr. Zi Chen
Assistant Professor, Thayer School of Engineering
Dartmouth College

Dr. Nanjia Zhou
Camille and Henry Dreyfus Environmental Chemistry Fellow
School of Engineering and Applied Science
Harvard University

8/7 (Fri) 11:20 am - 11:35 am: Break

Parallel Sessions:

8/7 (Fri) 11:35 am – 1:05 pm: Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Woei-jyh (Adam) Lee**, Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business, University of Maryland, College Park (馬里蘭大學學院市分校史密斯商學院李偉智教授)
Room: 4-270

"Bioinformatics Approaches for Functional Interpretation of Genome Variation"
Dr. Kai Wang
Assistant Professor, Department of Psychiatry & Behavioral Sciences and
Division of Bioinformatics, Department of Preventive Medicine
University of Southern California

"Mediation analysis for survival data using semiparametric probit models: application to integrative genomics"
Dr. Yen-Tsung Huang
Assistant Professor, Departments of Epidemiology and Biostatistics
Brown University
(布朗大學流行病學系黃彥棕黃彥棕教授)

"Cancer Genomics: when in silico research interact with in vivo experiments"
Dr. Liye Zhang
Postdoctoral Fellow, School of Medicine
Boston University

Dr. Yiming Zhou
Research Fellow in Radiology

Brigham and Women's Hospital
Harvard Medical School

8/7 (Fri) 11:35 am – 1:05 pm: Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Hsiang-Ying (Sherry) Lee**, Postdoctoral Associate, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (麻省理工學院李湘盈博士)
Room: 4-261

Dr. Chongli Yuan
Assistant Professor, Department of Chemical Engineering
Purdue University

Dr. Gang Han
Assistant Professor, Department of Biochemistry and Molecular Pharmacology
University of Massachusetts Medical School

"Colloidal Gels as Biomaterials for Regenerative Medicine"
Dr. Huanan Wang
Rubicon Postdoctoral Research Fellow
School of Engineering and Applied Sciences
Department of Physics
Experimental Soft Condensed Matter Group
Harvard University

Dr. Yi-Dong Lin
Research Fellow in Medicine
Cardiac Muscle Research Laboratory
Brigham and Women's Hospital
Harvard Medical School

8/7 (Fri) 11:35 am – 1:05 pm: Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. Jung-Tsung Shen**, Assistant Professor, Department of Electrical & Systems Engineering, Washington University in St. Louis (聖路易華盛頓大學電機暨系統工程學系沈榮聰教授)
Room: 4-265

"Development of Membranes for H2 Purification and CO2 Capture: From Material Molecular Engineering to Technology Commercialization"
Dr. Haiqing Lin
Assistant Professor, Department of Chemical and Biological Engineering
State University of New York, Buffalo

"Rational Design of Cathodes for Rechargeable Li-S and Li-O2 Batteries"
Dr. Yongzhu Fu
Assistant Professor, Department of Mechanical Engineering
Indiana University–Purdue University Indianapolis

"Dielectric Elastomers for Optics and Soft Robotics"

Dr. Samuel Shian
Research Associate, Harvard John A Paulson School of Engineering and Applied Science
Harvard University

"Design Principles for Superionic Conductors in Solid-state Lithium Batteries"
Dr. Yan Eric Wang
Senior Postdoctoral Associate, Department of Materials Science and Engineering
Massachusetts Institute of Technology

8/7 (Fri) 1:05 pm - 2:35 pm: Lunch

Parallel Sessions:

8/7 (Fri) 2:35 pm – 4:05 pm: Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Chen-Hsiang (Jones) Yu**, Founder and CEO, Prentice Lab (Prentice Lab 余禎祥博士)
Room: 4-270

"Change-point models for detecting aberrant gene expression patterns in cancers"
Dr. Zhi Wei
Associate Professor, Department of Computer Science
New Jersey Institute of Technology

"Testing for equality of variance with application to DNA methylation data"
Dr. Weiliang Qiu
Assistant Professor, Channing Division of Network Medicine
Brigham and Women's Hospital
Harvard Medical School

Dr. Qiang Liu
Assistant Professor, Department of Computer Science
Dartmouth College

Dr. Han Xu
Research Scientist
Broad Institute of MIT and Harvard

8/7 (Fri) 2:35 pm – 4:05 pm: Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Hsiang-Ying (Sherry) Lee**, Postdoctoral Associate, Whitehead Institute for Biomedical Research, Massachusetts Institute of Technology (麻省理工學院李湘盈博士)
Room: 4-261

"Twisting mice move the dystonia field forward"
Dr. Chun-Chi (Richard) Liang
Research Investigator, Departments of Neurology & Cell and Developmental Biology
University of Michigan Medical School, Ann Arbor

"NMDAR signaling in cancer: regulation by a polymorphic modifier gene and the tumor microenvironment"

Dr. Leanne Li
Postdoctoral Fellow, Koch Institute for Integrative Cancer Research
Massachusetts Institute of Technology

"Photostick: a method for selective isolation of target cells from culture"
Dr. Miao-Ping Chien
Postdoctoral fellow, Department of Chemistry & Chemical Biology
Department of Chemistry and Chemical Biology
Harvard University

"A CRISPR view of genome editing"
Mr. Winston X. Yan
MD/PhD Candidate
Biophysics Program, Harvard University
Feng Zhang Lab, Broad Institute

8/7 (Fri) 2:35 pm – 4:05 pm: Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. Shien-Ping Feng**, Assistant Professor, Department of Mechanical Engineering
The University of Hong Kong, (香港大學機械工程系馮憲平教授)
Room: 4-265

"Rapid Atmospheric-Pressure-Plasma Processed Nanomaterials for Dye-Sensitized Photovoltaic Cells"
Dr. I-Chun Cheng
Associate Professor, Graduate Institute of Photonics and Optoelectronics
Department of Electrical Engineering
National Taiwan University
(台灣大學電機工程學系陳奕君教授)

"Characterization of Nanofluidic Transport Using Hybrid Nanochannels"
Dr. Chuanhua Duan
Assistant Professor, Department of Mechanical Engineering
Boston University

"Organic Molecule Redox Flow Battery"
Dr. Qing Chen
Postdoctoral Fellow in Materials Science and Mechanical Engineering
School of Engineering and Applied Sciences
Harvard University

Dr. Hang Z. Yu
Postdoctoral Associate, Department of Materials Science and Engineering,
Massachusetts Institute of Technology

Dr. Po-Yen Chen
Research Assistant, Department of Chemical Engineering
Massachusetts Institute of Technology

8/7 (Fri) 4:05 pm – 4:20 pm: Break

Parallel Sessions:

8/7 (Fri) 4:20 pm – 5:50 pm: Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Chair: **Dr. Woei-jyh (Adam) Lee**, Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business, University of Maryland, College Park (馬里蘭大學學院市分校史密斯商學院李偉智教授)
Room: 4-270

"Decipher Regulatory Grammar from DNA Sequence"
Dr. Zhizhuo Zhang
Postdoctoral Research Associate, the Computational Biology Group
Computer Science and Artificial Intelligence Laboratory and Broad Institute
Massachusetts Institute of Technology

"Inference of transcriptional regulation in cancers"
Dr. Peng Jiang
Postdoctoral Research Fellow, Department of Biostatistics and Computational Biology
Dana-Farber Cancer Institute
Harvard University

"Embryonic Development following Somatic Cell Nuclear Transfer Impeded by Persisting Histone Methylation"
Dr. Yuting Liu
Postdoctoral Research Fellow, Department of Genetics
Harvard University

"Skim Reading and Mobile Learning: From Academic Research to Products"
Dr. Chen-Hsiang (Jones) Yu
Founder and CEO, Prentice Lab
(Prentice Lab 余禎祥博士)

8/7 (Fri) 4:20 pm – 5:50 pm: Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chair: **Dr. Yen-Tsung Huang**, Assistant Professor, Departments of Epidemiology and Biostatistics, Brown University (布朗大學流行病學系黃彥棕黃彥棕教授)
Room: 4-261

"T lymphocyte engineering with cytokine nanogels for enhanced cancer immunotherapy"
Dr. Li Tang
Irvington Postdoctoral Fellow, Koch Institute for Integrative Cancer Research
Massachusetts Institute of Technology

"Structural studies of lipid-protein interactions using electron crystallography"
Dr. Po-Lin Chiu
Postdoctoral Fellow, Department of Cell Biology
Harvard Medical School

"Identification of small-molecule probes of autophagy based-Salmonella clearance"

Ms. Meredith Szu-Yu Kuo
Ph.D. Candidate, Department of Chemistry & Chemical Biology
Harvard University
(哈佛大學化學暨生物化學系郭思妤)

"PPAR-α and glucocorticoid receptor synergize to promote erythroid progenitor self-renewal"
Dr. Hsiang-Ying (Sherry) Lee
Postdoctoral Associate, Whitehead Institute for Biomedical Research
Massachusetts Institute of Technology
(麻省理工學院李湘盈博士)

8/7 (Fri) 4:20 pm – 5:50 pm: Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Chair: **Dr. I-Chun Cheng**, Associate Professor, Graduate Institute of Photonics and Optoelectronics. Department of Electrical Engineering, National Taiwan University (台灣大學電機工程學系陳奕君教授)
Room: 4-265

"Spin Transfer Torque from the Spin Hall Effect in Magnetic Heterostructures"
Dr. Chi-Feng Pai
Postdoctoral Research Associate, Department of Materials Science and Engineering
Massachusetts Institute of Technology
(麻省理工學院白奇峰博士)

"Charge Qubit in a Single Electron Si/SiGe Double Quantum Dot"
Dr. Ke Wang
Postdoctoral Fellow, Department of Physics
Harvard University

Dr. Dengxin Ji
Nano-optics & Biophotonics Lab
Department of Electrical Engineering
State University of New York, Buffalo

"Solid State Optical Upconversion Utilizing Themally-Activated-Delayed Fluorescence"
Mr. Tony C. Wu
Ph.D. Candidate and Research Assistant, Soft Semiconductor Group
Department of Electrical Engineering and Computer Science
Massachusetts Institute of Technology
(麻省理工學院電機工程與計算機科學系吳張祺)

Abstracts and Biographies

Day 1 (August 6, 2015)

Opening Session

Opening Speech and Conference Co-Chair

Li-San Wang

Associate Professor, Department of Pathology and Laboratory Medicine
University of Pennsylvania Perelman School of Medicine
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(賓州大學醫學院王立三教授)

BIOGRAPHY

Li-San Wang received his B.S. and M.S. in Electrical Engineering from the National Taiwan University, and his Ph.D. in Computer Sciences from the University of Texas at Austin. Currently he is an Associate Professor of Pathology and Laboratory Medicine, a senior fellow of Institute for Biomedical Bioinformatics, and Chair of The Graduate Group in Genomics and Computational Biology at the University of Pennsylvania. Dr. Wang's research integrates bioinformatics, genomics, and genetics to study neurodegeneration and psychiatric disorders. He has authored more than 90 peer-reviewed book chapters and journal articles and served on the program and organizing committees of various international workshops and conferences, and NIH and NSF grant review panels and study sections. He is the Principal Investigator of the National Institute on Aging Genetics of Alzheimer's Disease Data Storage Site (NIAGADS), a national genetics data repository established by National Institute on Aging to facilitate access to genetics/genomics data for the study of late-onset Alzheimer's disease (LOAD). He chairs the data flow workgroup of the Alzheimer's Disease Sequencing Project (ADSP), a presidential initiative to analyze genomic sequences from more than 11,000 individuals and find novel genetic variants for LOAD.

Opening Session

Opening Speech and Conference Co-Chair

Yi-Hsiang (Sean) Hsu

Associate Director of Genetics Epidemiology, Institute for Aging Research
Assistant Professor of Medicine, Harvard University
(哈佛大學醫學院許益祥教授)

BIOGRAPHY

Opening Session

Welcome Remarks

Ming-chi Scott Lai

Director-General
Taipei Economic and Cultural Office in Boston
99 Summer St., Suite 801
Boston, MA 02110
Tel: 617-259-1357 E-mail: mclai@mofa.gov.tw
(駐波士頓台北經濟文化辦事處賴銘琪處長)

BIOGRAPHY

EDUCATION

2013/5 **Harvard University, John F. Kennedy School of Government**, Executive Education, Cambridge MA
Certificate of Completion, Global Change Agents Program
(May 12-18, 2013)

2011/9 **Le directuer de I'Ecolenationaled'administration**, France
Certificate of Completion, Take-Off Program for
Senior Civil Service (September 12-23, 2011)

1991/1-12 University of Ottawa, Ottawa, Canada
English Language Training

1987-1990 **National Taiwan University**, Taipei, Taiwan
Department of Political Science
Master Degree

1981-1985 **National Taiwan University**, Taipei, Taiwan
Department of Political Science
Bachelor Degree

1979-1981 **Affiliate Senior High School of National Taiwan Normal University**, Taipei, Taiwan
High School Diploma

EXPERIENCE

2014/9 – Present **Taipei Economic and Cultural Office in Boston**, Boston MA
Director-General

2012/7-2014/9 **Taipei Economic and Cultural Representative Office in the U.S.**, Washington, D.C.
Director, Administrative Division

2010/9-2012/7 **Ministry of Foreign Affairs**, Taipei Taiwan
Director, Document Authentication Division, Bureau of Consular Affairs

2010/1-2010/5 **Ministry of Foreign Affairs**, Taipei Taiwan
Division Director on Home Assignment,
Department of North American Affairs

2004/1-2010/1 **Taipei Economic and Cultural Office in Boston**, Boston, MA
Division Director

2002/5-2004/1 **Ministry of Foreign Affairs**, Taipei, Taiwan
Assistant to Minister

2000/12-2002/5 **Ministry of Foreign Affairs**, Taipei, Taiwan
Section Chief, Public Diplomacy Coordination Council

2000/5-2000/12 **Ministry of Foreign Affairs**, Taipei, Taiwan
Assistant to Deputy Minister

1997/9-2000/1 **Taipei Economic and Cultural Representative Office in the U.S.**, Washington, D.C.
Second Secretary

1994/9-1997/9 **Taipei Economic and Cultural Office in Atlanta**, Atlanta GA
Third Secretary

1992/10-1994/9 **Ministry of Foreign Affairs**, Taipei Taiwan
Assistant to Minister

1991/12-1992/10 **Ministry of Foreign Affairs**, Taipei Taiwan
Officer, Department of North American Affairs

1990/1-12 **Ministry of Foreign Affairs**, Taipei Taiwan
Officer, Department of Protocol

1988/9 Passed Foreign Service Examination

HOBBIES

Golf, table tennis, basketball, baseball, and traveling.

PERSONAL

Family: Wife Jennifer, son Thomas, and twin daughters Penny & Annie.

Plenary Session (1)

Session Chair

Li-San Wang

Associate Professor, Department of Pathology and Laboratory Medicine
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(賓州大學醫學院王立三教授)

BIOGRAPHY

Li-San Wang received his B.S. and M.S. in Electrical Engineering from the National Taiwan University, and his Ph.D. in Computer Sciences from the University of Texas at Austin. Currently he is an Associate Professor of Pathology and Laboratory Medicine, a senior fellow of Institute for Biomedical Bioinformatics, and Chair of The Graduate Group in Genomics and Computational Biology at the University of Pennsylvania. Dr. Wang's research integrates bioinformatics, genomics, and genetics to study neurodegeneration and psychiatric disorders. He has authored more than 90 peer-reviewed book chapters and journal articles and served on the program and organizing committees of various international workshops and conferences, and NIH and NSF grant review panels and study sections. He is the Principal Investigator of the National Institute on Aging Genetics of Alzheimer's Disease Data Storage Site (NIAGADS), a national genetics data repository established by National Institute on Aging to facilitate access to genetics/genomics data for the study of late-onset Alzheimer's disease (LOAD). He chairs the data flow workgroup of the Alzheimer's Disease Sequencing Project (ADSP), a presidential initiative to analyze genomic sequences from more than 11,000 individuals and find novel genetic variants for LOAD.

Plenary Session (1)

Plenary Speaker

Metabolic rhythm, immune signaling and obesity-related health conditions

Chih-Hao Lee

Professor, Department of Genetics and Complex Diseases, Division of Biological Sciences
Harvard T.H. Chan School of Public Health
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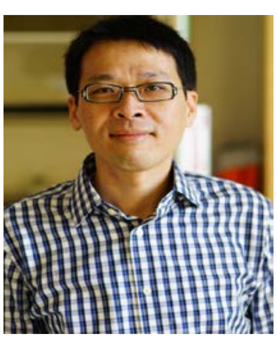
ABSTRACT

Obesity as a result of unbalanced energy uptake and utilization is associated with a cluster of chronic diseases, including insulin resistance/type 2 diabetes, hyperlipidemia, cardiovascular abnormalities, and fatty liver. These disorders are major medical and economic concerns worldwide. Nutrient surplus, physical inactivity, and altered feeding behaviors are among the main factors that contribute to the obesity pandemic and increased metabolic burdens on organelles important for fat metabolism, including mitochondria and the endoplasmic reticulum.

Chronic inflammation is often observed in states of obesity and is a key contributor to the pathologies of several metabolic diseases. Although the features of chronic metabolism-related inflammation (or meta-inflammation) differ from those of acute inflammatory responses to exogenous insults, studies have shown that several pathogen-sensing mechanisms of innate immunity are negative regulators of metabolism. Resident immune cells, such as macrophages and lymphocytes, in white adipose tissue (WAT), gut and liver are believed to have important roles in readjusting the metabolic set point and circadian rhythm of tissues.

This presentation will cover studies aiming to understand mechanisms underlying integration of metabolism and immune signaling and pathways that sustain physiological rhythms of metabolic processes. Using mouse models of diet-induced obesity, potential therapeutic implications of the findings in treating metabolic diseases will also be discussed.

BIOGRAPHY



Chih-Hao Lee received his B.S. degree in Chemical Engineer from National Tsing Hua University (Hsinchu, Taiwan) and Ph.D. degree from Department of Pharmacology, University of Minnesota. He then joined the laboratory of Dr. Ronald Evans at the Salk Institute to conduct his post-doctoral research, where he studied nuclear hormone receptors in the control of lipid metabolism.

In 2004, Dr. Lee joined the faculty of Division of Biological Sciences, Harvard T.H. Chan School of Public Health and is currently Professor of Genetics and Complex Diseases at the Department of Genetics and Complex Diseases. His research focuses on molecular physiology and mechanistic basis of metabolic regulation and disease progression. He has authored more than fifty peer-reviewed research papers and several review articles/book chapters. Dr. Lee serves a standing member of NIH study section and Principal Investigator of NIH grants.

Plenary Session (2)

Session Chair

Yi-Hsiang (Sean) Hsu

Associate Director of Genetics Epidemiology, Institute for Aging Research
Assistant Professor of Medicine, Harvard University
(哈佛大學醫學院許益祥教授)

BIOGRAPHY

Plenary Session (2)

Plenary Speaker

Bioinformatic Challenges for DNA-Seq and RNA-Seq experiments

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ABSTRACT

Recent introduction of next generation sequencing technology (NGS) has brought revolution to molecular biology and medicine. They also pose new challenges to computational biology and bioinformatics: how to analyze and store data at Peta-byte level, how to develop algorithms that fully integrate with the sequencing protocol, and how to interpret the findings. This talk is an overview of our recent work on the bioinformatics of NGS.

We have developed several algorithms that leverage various features derived from RNA-Seq experiments. CoRAL (Classification of RNAs by Analysis of Length) generates biologically interpretable features such as fragment length, cleavage specificity, and antisense transcription from small RNA-seq experiments in order to distinguish between different ncRNA classes. CoRAL could were able to classify six different types of RNA transcripts with ~80% cross-validation accuracy and independent datasets with different tissues. HAMR (High throughput Annotation of Modified Ribonucleotides) performs transcriptome-wide detections of post-transcriptional covalent modifications of ribonucleotides with single-base resolution. HAMR can differentiate between several classes of modifications via a Bayesian model. Using small RNA-seq data we were able to detect 92% of all known human tRNA modification sites that are predicted to affect RT activity, and distinguish between two classes of adenosine and two classes of guanine modifications with 98% and 79% accuracy.

The second half of my talk concerns DNA-Seq experiments, where the biggest challenges come from the enormity and complexity of genomics data. We have developed DRAW (DNA Resequencing Analysis Workflow), a standard analysis pipeline for whole-genome and whole-exome sequencing (WGS/WES) experiments. We manage the NIA Genetics of Alzheimer's Disease Data Storage Site (NIAGADS), a data repository established by the National Institute on Aging to facilitate access by qualified investigators to genotypic data in order to promote the study of the genetics of AD, including the large-scale Alzheimer's Disease Sequencing Project that will generate whole-exome/whole-genome sequencing data on more than 11,000 individuals.

BIOGRAPHY

Li-San Wang received his B.S. and M.S. in Electrical Engineering from the National Taiwan University, and his Ph.D. in Computer Sciences from the University of Texas at Austin. Currently he is an Associate Professor of Pathology and Laboratory Medicine, a senior fellow of Institute for Biomedical Bioinformatics, and Chair of The Graduate Group in Genomics and Computational Biology at the University of Pennsylvania. Dr. Wang's research integrates bioinformatics, genomics, and genetics to study neurodegeneration and psychiatric disorders. He has authored more than 90 peer-reviewed book chapters and journal articles and served on the program and organizing committees of various international workshops and conferences, and NIH and NSF grant review panels and study sections. He is the Principal Investigator of the National Institute on Aging Genetics of Alzheimer's Disease Data Storage Site (NIAGADS), a national genetics data repository established by National Institute on Aging to facilitate access to genetics/genomics data for the study of late-onset Alzheimer's disease (LOAD). He chairs the data flow workgroup of the Alzheimer's Disease Sequencing Project (ADSP), a presidential initiative to analyze genomic sequences from more than 11,000 individuals and find novel genetic variants for LOAD.

Plenary Session (3)

Session Chair

Hsiang-Ying (Sherry) Lee

Postdoctoral Associate, Whitehead Institute for Biomedical Research
Massachusetts Institute of Technology
(麻省理工學院李湘盈博士)

BIOGRAPHY

Dr. Lee was born in Tainan, Taiwan. She received her B.S. in Medical Technology from National Cheng Kung University in Taiwan. She then came to U.S. to pursue her graduate studies. She has received her M.A. in Medical Sciences from Boston University and Ph.D. in Biomolecular Chemistry from University of Wisconsin-Madison in 2011.

She is currently a Postdoctoral Fellow in Whitehead Institute for Biomedical Research located at M.I.T.. With extensive training in biochemistry, molecular and cell biology, her research interests center around red blood cell biology. She has been conducting basic research to investigate how genetic network regulates red blood cell development, as well as translational research to develop red cell-based diagnostic and therapeutic tools.

Dr. Lee has been a member of Taiwan Society of Laboratory Medicine, American Society for Cell Biology and American Association for the Advancement of Science. She has also been involved in organizing events and serving communities including Boston Taiwanese Biotechnology Association, Monte Jade Science and Technology Association of New England and MIT Biology IAP. She is a Charles H. Hood Postdoctoral Fellow. Her research work was published in major bioscience journals including Nature, Molecular Cell and PNAS.

Plenary Session (3)

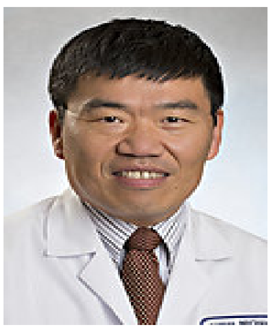
Plenary Speaker

Frank Chuan Kuo

Associate Professor of Pathology, Harvard Medical School
Director, Pathology Informatics
Director, Assay Development, Center for Advanced Molecular Diagnostics
Core Director, Pathology Specimen Locator, DF/HCC

ABSTRACT

BIOGRAPHY



Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Woei-jyh (Adam) Lee

Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business
University of Maryland, College Park
(馬里蘭大學學院市分校史密斯商學院李偉智教授)

BIOGRAPHY

Dr. Woei-jyh (Adam) Lee received BSE degree from the National Taiwan University, MS degree from the Courant Institute at New York University, and PhD degree from the University of Maryland at College Park (UMD). He worked on distributed objects and fault tolerance at the AT&T Labs - Research in 1997. He focused on network software and management at the Bell Laboratories Research from 1998 to 2000. He visited the University of Southern California specializing in continuous media streaming and multimedia networking from 2002 to 2003.

He contributed in protein domain parsing and boundary prediction at the National Cancer Institute (NCI), National Institutes of Health (NIH) from 2004 to 2005. He was a fellow focusing on human genetics and genomics at the National Center for Biotechnology Information, National Library of Medicine, NIH from 2009 to 2012. He became a special volunteer working on computational modeling for cancer progression and metastatic at the NCI, NIH from 2012 to 2013. He was also affiliated with the Center for Bioinformatics and Computational Biology and the Institute for Advanced Computer Studies at UMD.

He is currently a faculty of Information Systems at the Robert H. Smith School of Business at UMD since 2012. His research interests include information integration, data analytics and mining, literature-based discovery, performance simulation and evaluation, bioinformatics and computational biology, human genomics and genetics, and cancer biology. He has two US Patents and is a member of the IAENG and the CAPA.

Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

WebMeV-A Cloud Based Platform for Genomic Analysis

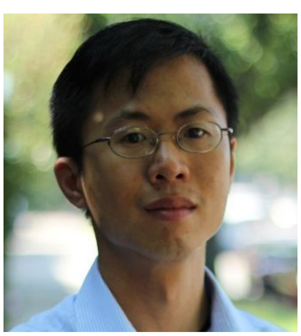
Yaoyu E. Wang

Associate Director, Center for Cancer Computational Biology
Department of Biostatistics and Computational Biology
Dana-Farber Cancer Institute, 450 Brookline Ave SM822
Boston, MA, 02215 USA
Email: yewang@jimmy.harvard.edu
(哈佛大學達納法伯癌症研究所王耀煜博士)

ABSTRACT

As the cost of sequencing technology dropping faster than Moore's law in the last decade, large amount of genomic data has been compiled in a very rapid pace. The growing size of public domain databases such as GEO as well as systematically collected large consortium data sets such as the TCGA project have presented insurmountable challenges for standalone analytical applications. First of all, these applications rely heavily on user computing environment that often does not scale with the size of data set. Also, these applications require downloading large datasets onto local machine for analysis. Lastly, the developers have limited control over application dependency, thus hamper application portability as well as delay development cycle. To this end, we developed the web-based MeV (WebMeV) with elastic computing technology with the aim that the application can be deployed on the AWS EC2 cloud-computing infrastructure for big data analysis. We focused on integrating methods from R and Bioconductor and implemented data visualization with D3.js. Strong emphasis was placed on devising tools control for analysis reproducibility, particularly for utilizing Bioconductors packages on AWS. To resolve the inherent difficulty to control R versioning and Bioconductor dependency issues, we designed Raven and InjectoR packages, both available on GitHub, to automatically archive dependency information and to control R packages versioning and dependency on distributed computing framework.

BIOGRAPHY



Yaoyu Wang is Associate Director of the Center for Cancer Computational Biology at the Dana-Farber Cancer Institute. He received his B.S. in Biological Science and Computer Science from the Carnegie-Mellon University, and his Ph.D in Bioinformatics from the Boston University. He was a postdoctoral fellow in virology and immunology at the Ragon Institute of MGH, MIT, and Harvard. He currently leads the Center for Cancer Computational Biology (CCCB; http://cccb.dfci.harvard.edu), which provides broad-based genomic research technology platform to the community with high-throughput sequencing and bioinformatics support for collaborative research. The major focuses of the Center are developing novel NGS applications, such as extracellular RNA sequencing as well as computational tools for integrated analysis and visualization of multiple types of –omic data, including transcriptome, exome, whole genome, and targeted resequencing data.

Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Hau-Tieng Wu

Assistant Professor, Department of Mathmatics
University of Toronto
(多倫多大學數學系吳浩榳教授)

ABSTRACT

BIOGRAPHY

Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Michael Chang

Chief Executive Officer
Kyper

ABSTRACT

BIOGRAPHY

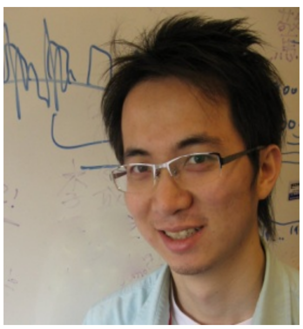
Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Wu-Hsi Li

Founder and CEO, CharmPI LLC
(CharmPI.com 李務熙博士)

ABSTRACT

BIOGRAPHY



Technical Session D1-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Evidence of positive selection on type 2 diabetes associated loci in the human genome

Yu-Ping Poh

Postdoctoral Fellow, Massachusetts Institute of Technology
32 Vassar St., Cambridge, MA 02139
Tel: +1-617-253-4278
Email: poh@mit.edu

ABSTRACT

Human environments and subsistence patterns have changed substantially during the past 10,000 years. The agriculture development resulted abundant food supply and also alter the proportion of carbohydrates in the diet of modern human. Meanwhile, type-2 diabetes (T2D), known as a metabolic disorder caused by hyperglycemia, might related to the alteration diet habit and becomes very common in modern human. The “thrifty genotype hypothesis” provides an alternative explanation for why diabetes is so common and proposes alleles which enable individuals to deposit fat during periods of food abundance may have been adaptive to early hunter-gatherers. To examine this hypothesis, here we perform selective sweeps scanning analysis on 1000 genome phase III data in multiple modern human populations. Genome-wide analysis of these data suggests each population have unique signature of selective sweeps, and mostly were selection on standing variation. Comparing with the recent meta-analysis of T2D GWAS data, we found significantly overlapping between the loci under positive selection and T2D susceptibility loci, which mostly involved in lipid metabolism and associated with obesity and atherosclerosis in diverse populations.

Keywords: Selective sweeps, type 2 diabetes, GWAS

BIOGRAPHY

Yu-Ping Poh was born in Taichung City, Taiwan R. O. C. in January 25th, 1977. I received my Ph. D. degree in population genomics from Institute of Molecular and Cellular Biology, National Tsing Hua University, Hsinchu, Taiwan in 2012.

She started to work as PostDoc at Jeffrey D. Jensen lab at University of Massachusetts medical school in 2011, and meanwhile collaborated with Hopi Hoekstra at Harvard University. Since 2014/09, she switched to work as PostDoc at Manolis Kellis lab at MIT.

Publications

Poh YP, Domingues V, Hoekstra HE, and Jensen JD. (2014) On the prospect of identifying adaptive loci in recently bottlenecked populations: a case study in beach mice. PLoS One 9(11):e110579.

Foll M*, **Poh YP*,** Renzette N, Ferrer-Admetlla A, Shim H, Malaspinas AS, Ewing G, Bank C, Liu P, Wegmann D, Caffrey DR, Zeldovich KB, Bolon DNA, Wang J, Kowalik TF, Schiffer CA, Finberg RW, and Jensen JD. (2014) Influenza virus drug resistance: a time-sampled population genetics perspective. PLoS Genet 10:e1004185. *authors contributed equally

Linnen CR, **Poh YP**, Peterson BK, Barrett RD, Larson JG, Jensen JD, Hoekstra HE. (2013) Adaptive evolution of multiple traits through multiple mutations at a single gene. Science 339:1312-1316.

Awards

Travel award from Foundation for The Advancement of Outstanding Scholarship, 2003
Graduate Students Study Abroad Fellowship from National Science Council (Taiwan), 2005
Travel award from Ministry of Education (Taiwan), 2006
Travel award from National Science Council (Taiwan), 2007
Travel award from Foundation for The Advancement of Outstanding Scholarship, 2008

Memberships and affiliations

Society of Molecular Biology and Evolution, 2012-now

Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

Yen-Tsung Huang

Assistant Professor, Departments of Epidemiology and Biostatistics
Brown University
121 South Main Street, Providence, RI 02912
Phone: 401-863-5417
Email: Yen-Tsung_Huang@brown.edu
(布朗大學流行病學系黃彥棕黃彥棕教授)

BIOGRAPHY

Yen-Tsung Huang earned a Doctor of Medicine degree from the National Taiwan University, Taiwan 2003, and Dual Degree of Doctor of Science in Epidemiology and Biostatistics at Harvard School of Public Health in 2012. He is currently an Assistant Professor of Epidemiology and Biostatistics in Brown University, Providence, RI. His research interests focus on cancer genomics, high-dimensional statistics, and molecular/genetic epidemiology. His methodology work is mostly on mediation analyses of high-dimensional data and its application to integrative genomics.

Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Bio-inspired Microlenses and Microcameras for Biomedical Applications

Hongrui Jiang

Vilas Distinguished Achievement Professor and Lynn. H. Matthias Professor in Engineering,
University of Wisconsin - Madison
1415 Engineering Drive, Madison, WI 53706, USA
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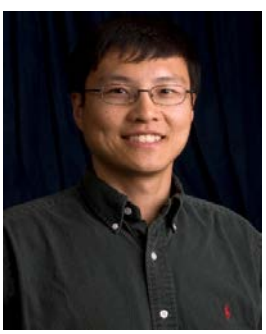
ABSTRACT

Optical detection and imaging have wide applications. With continuing miniaturization effort to realize integrated microsystems, micro-scale optical components become more and more important. On the other hand, natural visualization systems provide many intriguing optical designs and unique properties, which serve a great source of inspiration for micro-optical devices and systems. In this talk, I will present our work on bio-inspired microlenses and microcameras. I will first introduce a few types of microlenses and microlens arrays, including tunable liquid microlenses actuated by temperature-, pH- and infrared light-responsive hydrogels, and through electrowetting and dielectric force. I will also discuss about artificial compound eyes mimicking reflecting superposition compound eyes found in some decapods. I will show a few examples of microcameras integrating these optical devices. My talk will also include a few examples of biomedical applications of the microlenses and microcameras, including endoscopes, laparoscopes and accommodative contact lens for presbyopia correction.

BIOGRAPHY



Hongrui Jiang received the B.S. degree in physics from Peking University, Beijing, China, and the M.S. and Ph.D. degrees in electrical engineering from Cornell University, Ithaca, NY, in 1999 and 2001, respectively. He was a Postdoctoral Researcher at the Berkeley Sensor and Actuator Center, University of California-Berkeley, Berkeley, from 2001 to 2002.

He is currently the Lynn H. Matthias Professor in Engineering and the Vilas Distinguished Achievement Professor at the University of Wisconsin – Madison. He is with the Department of Electrical and Computer Engineering, and is also a Faculty Affiliate with the Department of Biomedical Engineering, a faculty member of the Materials Science Program, and the McPherson Eye Research Institute. His research interests are in optical MEMS, bioMEMS, biological and chemical microsensors, microactuators, smart materials and micro-/nanostructures, lab on a chip, and biomimetics and bioinspiration. He has written a monograph, one book chapter, and is editing another book. He has more than 150 peer reviewed publications and seven issued patents. He is a member of the Editorial Board of the Journal of Microelectromechannical Systems, International Journal on Theoretical and Applied Nanotechnology, and Micromachines.

Professor Jiang is a senior member of IEEE. He received numerous awards, including the US National Science Foundation CAREER Award and the US DARPA Young Faculty Award in 2008, the University of Wisconsin H.I. Romnes Faculty Fellowship in 2011, the US National

Institute of Health Director's New Innovator Award in 2011, and the University of Wisconsin Vilas Associates Award in 2013.

Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Biophysics of Intrinsic Left-Right Asymmetry of The Cell

Leo Q. Wan

Assistant Professor, Department of Biomedical Engineering
Laboratory for Tissue Engineering and Morphogenesis
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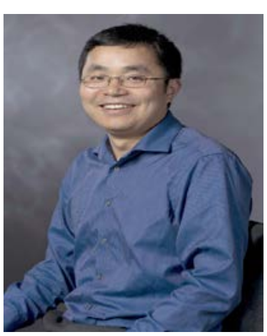
ABSTRACT

The development of the vertebrate body plan with left-right (LR) asymmetry (also known as handedness and chirality) requires the emerging chiral morphogenesis of epithelial cells at specific embryonic stages. Changes in orientation of the LR axis due to genetic or environmental factors can lead to malformations and disease. We demonstrate that the cultivation of cell populations on micropatterns with defined boundaries reveals an intrinsic cell left-right asymmetry that can be readily determined by image analysis of cell alignment and directional motion. Interestingly, drugs interfering with actin but not microtubule function altered the LR asymmetry. These results show that micropatterned cell populations exhibit phenotype-specific LR asymmetry that is dependent on the functionality of the actin cytoskeleton. Disrupting adherens junctions resulted in a decrease in velocity difference in opposing boundaries as well as the associated biased cell alignment, along with an increase in the overall random motion. The further examination of cell polarity indicated that disruption of adherens junctions did not affect cell polarization on the boundaries, but decreased the transmission of chiral bias into the interior region of the epithelial cell sheet. Overall, our results demonstrated the dependence of the scale of collective cell migration on the strength of cell-cell adhesion, and its effects on the chirality of a multicellular structure through mediating cell polarity in the vicinity of geometric boundaries. We propose that micropatterning could be used as an effective in vitro tool to study the initiation of LR asymmetry in cell populations, to diagnose disease, and to study factors involved with birth defects in laterality.

BIOGRAPHY



Dr. Leo Q. Wan was born in Yancheng, Jiangsu Province, PR China. He received his Bachelor and Master degrees in Mechanical Engineering from the University of Science and Technology of China. After completing his PhD in Biomedical Engineering at Columbia University in 2007 (with Professor Van C. Mow).

He did his postdoctoral training in the Laboratory for Stem Cells and Tissue Engineering (with Professor Gordana Vunjak-Novakovic) in 2007-2011. He is currently an assistant professor in the Department of Biomedical Engineering at the Rensselaer Polytechnic Institute in Troy, NY. His research interests focus on understanding physical biology in tissue development and regeneration, and include Tissue Morphogenesis, Stem Cell Mechanobiology, and Functional Tissue Engineering.

Dr. Leo Q. Wan is a Pew scholar (Class 2013), and recipient of the NIH Director's New Innovator Award, National Science Foundation Early Career Award, American Heart Association Scientist Development Grant, and the March of Dimes Basil O'Connor Starter Scholar Research Award.

Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Mechanobiochemical Modeling of Cell-Material Interactions

Hongyan Yuan

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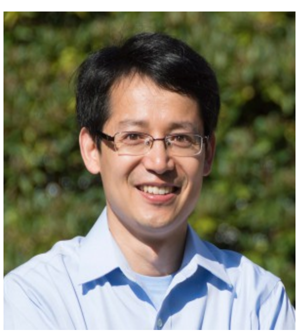
ABSTRACT

Mechanical properties of nano/micro/bio materials at the cellular level, including size, elasticity, dimensionality, and topology, play important role in regulating cell functions, such as endocytosis of nanoparticles and cell-matrix adhesion. Biologically speaking, the cell-material interactions can be either/both passive (without signal transduction) or/and active (with signal transduction). In the passive interactions, only physical/mechanical principles are involved. While in the active interactions, mechanical cues are converted into biochemical signals via mechanosensitive proteins, and subsequent biochemical signaling cascades may follow. In the complicated cases, passive physical principles and active signal transductions are coupled and integrated together to give rise to specific cell behaviors. Quantitative understanding of how cells interact with nano/micro/bio materials can provide important guidance in the rational design in bioengineering applications where mechanical properties of materials can be tailored to yield optimal outcomes. In this talk, I will present our recent and ongoing work on mechanobiochemical modeling of several different problems including (1) the endocytosis of nanoparticles in targeted drug delivery, (2) the interaction of graphene microsheets with cell membrane, and (3) cell morphogenesis in mechanical microenvironments.

BIOGRAPHY



Dr. Hongyan Yuan was born in Ezhou, Hubei Province, P.R. China. He received his Bachelor's degree from Tsinghua University at Beijing in 2002, his Master's degree from University of Alaska Fairbanks in 2007, and his PhD in Engineering Science and Mechanics from Pennsylvania State University in 2010. He did his first post-doc training in the Solid Mechanics Group at Brown University from 2011 to 2012 and the second one in School of Engineering and Applied Science (SEAS) at Harvard University from 2012 to 2014.

He is currently an Assistant Professor in the Department of Mechanical, Industrial & Systems Engineering at University of Rhode Island. His current research is focused on cellular and molecular biomechanics and its applications in bioengineering.

Technical Session D1-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Xi Xie

Postdoctoral Fellow, Koch Institute for Integrative Cancer Research
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ABSTRACT

BIOGRAPHY

Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

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(台灣大學電機工程學系陳奕君教授)

BIOGRAPHY

I-Chun Cheng received the B.S. and M.S. degrees in mechanical engineering from the National Taiwan University in 1996 and 1998, respectively. In 2004, she received a Ph.D. degree in electrical engineering from Princeton University. She was with the Macroelectronic Lab of Princeton University from 2004 to 2007 as a postdoctoral research associate, working on novel silicon thin-film devices and backplane technology for flexible displays. In 2007, she joined the Department of Electrical Engineering and Graduate Institute of Photonics and Optoelectronics at the National Taiwan University, where she is now an Associate Professor. Her current research interests include oxide-semiconductor thin-film technology, electrochemical photovoltaic devices and flexible large-area electronics. She is a member of the Institute of Electrical and Electronics Engineers (IEEE), Material Research Society (MRS), and Electrochemical Society (ECS). She has published over 70 journal articles, more than 150 conference papers and 5 book chapters and co-authored a book.

Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Integrated nano optoelectronics for biomedical engineering and applications

Alex (Ya Sha) Yi

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ABSTRACT

With the rapid development of integrated photonics technology, nano-scale photonics are having a major impact on next generation biomedical engineering applications. After giving a brief overview of integrated nanophotonics and my research focus in this field, I will talk about three representative works: a) Nano plasmonics for single bacteria sensing and detection. b) Nano photonic resonator for high-sensitivity label free DNA quantification, single nucleotide mismatch detection and single virus sensing. c) Bio-inspired nano photonic structure from nature and its applications to next generation bio medical imaging materials and devices.

BIOGRAPHY

Alex (Ya Sha) Yi, Ph.D, is currently an Associate Professor with the Department of Electrical and Computer Engineering, University of Michigan, Dearborn campus and the Energy Institute, University of Michigan, Ann Arbor campus. He received the Ph.D. degree from the Massachusetts Institute of Technology (MIT), Cambridge, MA, USA, and was a Post-Doctoral Associate with the Electronic Materials Processing Center, Massachusetts Institute of Technology, Cambridge, MA, USA, where he was involved in research on integrated nano optoelectronic materials and devices. He had extensive research experiences with the Los Alamos National Laboratory, and the 3M Corporate Research Laboratory. He is also a Research Affiliate with the Microsystems Technology/Microphotonics Center at MIT. He has authored more than 60 journal papers, has edited one book and written three book chapters, and holds 11 U.S. patents and 1 international patent. He has led several government/industry-funded projects, has been at review panel for NSF and DOE, and has been a reviewer for leading journals. His research interests are solid-state electronics, semiconducting devices, photovoltaics and energy-related optoelectronic devices, solid-state lighting (LEDs), bioinspired nanooptoelectronic structures, nanoelectronics/MEMS, and intelligent vehicle and transportation system. He is currently serving as the Vice Chair of the IEEE Southeast Michigan Section.

Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Tube^2: Optical and Electrical Properties of Tube-in-a-Tube

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ABSTRACT

Atomically-thick materials such as single-walled carbon nanotubes and graphene are prone to chemical attack because all of the constituent atoms are exposed. Conversely, at increased thicknesses, many of the remarkable properties of these materials are lost. In this talk, we will describe a novel tube-in-a-tube (Tube^2) structure with a unique combination of surface functionalities and interesting electronic and optical properties. Tube^2 is a synthetic semiconductor created from outer wall-selective functionalization of double-walled carbon nanotubes. Correlated Raman and optical absorption spectroscopy unambiguously confirm that the covalent modification is outer wall-selective. Nearly 50% of the electrical conductivity is retained in thin films of Tube^2 due to the intact inner-tube conducting channels. Lacking such channels, single-walled carbon nanotubes and graphene become insulators after similar functionalization. We further demonstrate that this chemically tailored functional structure allows simultaneous attainment of high sensitivity and selectivity in electrical detection of small molecules. These results highlight some of the structural advantages of this double-wall strategy for new materials and electronics.

BIOGRAPHY

Professor YuHuang Wang received a B.S. in chemistry from Xiamen University, China. He did his Ph.D. studies with Richard E. Smalley at Rice University, Houston, Texas and postdoctoral research with Chad A. Mirkin at Northwestern University, Evanston, Illinois.

Since fall 2008, he has been on the faculty of the University of Maryland, College Park, where he is an Associate Professor at the Department of Chemistry and Biochemistry. His research group focuses on carbon nanosciences and their energy and biomedical applications. A central theme of his current research is the creation and exploitation of fluorescent quantum defects to understand and control the coupling of electrons, excitons, phonons, and spin in reduced dimensions.

Professor Wang has received a number of honors and awards, including a National Science Foundation CAREER award in 2011. His work has been featured on 9 journal covers and by more than 40 news and perspectives in journals and news media, including Nature, Nature Chemistry, Science, The Chicago Tribune, and The New York Times.

Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Short-Range Ordered-Disordered Transition of NiOOH/Ni(OH)2 Pair Induces Switchable Wettability

Shien-Ping Feng

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ABSTRACT

By virtue of amorphous structure with short-range order feature, the inorganic nanoporous nickel oxyhydroxide (NiOOH) can reversibly and rapidly switch wettability by alternate treatments of environmental chamber (superhydrophobic) and UV/ozone (superhydrophilic). The switchable mechanism of NiOOH/Ni(OH)2 pair arising from its exceptional intrinsic short-range order-disorder transition together with chemical composition change is highlighted for the first time, which significantly differs from the current stimuli-responsive materials. This distinct multifunctional thin film not only owns reversible wettability but also is optically patternable/repairable and electrically conductive, which would be applicable in the manufacturing of various micro- and nanostructures. We demonstrate this potential in the rewritable two-dimensional (2D) microfluidic channels and wetting-contrast enhanced selective electroplating.

BIOGRAPHY

Shien-Ping Feng (another name is Hsien-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 Hong Kong University. 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 electrochemical processing and interfacial characterization of nanostructured materials, and their applications on energy conversion and storage.

Technical Session D1-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Tackling the Problems of Lithium-Sulfur Battery: From Molecular Understanding to Nanomaterials Design

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ABSTRACT

The emerging applications of electric vehicles (EV) and grid scale energy storage are pushing the limit of current energy storage technologies. To meet the US Department of Energy (DOE)'s targets for EV batteries and grid storage, battery chemistries beyond the lithium-ion systems are required. Among the many new chemistries studied, lithium-sulfur battery is extremely attractive and promising because of its high theoretical specific energy of ~2600 Wh/kg, six times higher than that of the current lithium-ion battery technology. However, successful practical applications of lithium-sulfur batteries have been impeded by challenges associated with both sulfur cathode and lithium metal anode.

Here I will present my research on tackling the problems of lithium-sulfur batteries through multifaceted approaches at different length-scales, allowing unprecedented control over the electrode architecture from the nanoscale to macroscale. For the cathode side, I will present my work on fundamental understanding of the lithium-sulfur reaction and rational design and synthesis of unique sulfur nanostructures with multifunctional coatings to overcome the issues related to electrode volume expansion, loss of active materials, and insulating nature of sulfur. For the anode side, I will present that the growth of lithium dendrites, which is the cause for battery internal short-circuit, can be effectively suppressed by chemical modification of lithium metal anodes. These research findings provide new insights and open up exciting opportunities for the next generation of cost-effective and high-energy batteries.

BIOGRAPHY

Dr. Weiyang (Fiona) Li graduated with B.S. (2004) and M.S. (2007) degrees in Chemistry from Nankai University (Tianjin, P.R. China), and a Ph.D. in Biomedical Engineering from Washington University in St. Louis (2011, with Prof. Younan Xia). She is now working with Prof. Yi Cui as a postdoctoral associate in the Department of Materials Science & Engineering at Stanford University. She will be an Assistant Professor in Thayer School of Engineering at Dartmouth College, starting from this fall. Her research primarily focuses on the development of rationally designed functional materials with finely tailored nanoscale architecture to tackle critical problems in diverse energy-related applications, including batteries, fuel cells, as well as clean and renewable energy. She has published more than 50 peer-reviewed papers in high-quality journals, including Nature Communications, Proceedings of National Academy of Science, Journal of the American Chemical Society, Angewandte Chemie International Edition, Accounts of Chemical Research, and Nano Letters, which have received over 6,000 citations.

She is the recipient of the State Natural Science Award (2011), granted by the State Council of the People's Republic of China.

Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Chen-Hsiang (Jones) Yu

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(Prentice Lab 余禎祥博士)

BIOGRAPHY

Jones Yu is an Assistant Professor of Computer Science and Networking at Wentworth Institute of Technology (WIT). He earned B.Eng. and M.S. in Computer Science and Information Engineering (CSIE) from Tamkang University in 1998 and from National Taiwan University in 2000, respectively, and Ph.D. in Computer Science from MIT under Prof. Rob Miller's guidance in 2012. His research in Human-Computer Interaction (HCI) focuses on web customization and automation, readability enhancement, and mobile learning.

He is also founder and CEO of Prentice Lab, which is a technology company focusing on designing algorithms and developing software for improving learning, including language learning and subject learning. In the past, he has worked for a few startup companies as Director of Mobile Engineering and User Experience, and developed mobile apps as products.

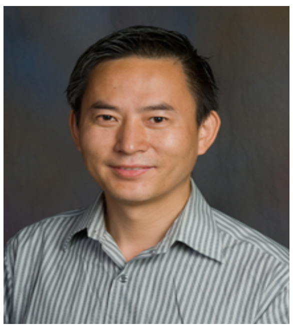
Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Honggang Wang

Associate Professor, Department of Electrical and Computer Engineering
University of Massachusetts Dartmouth

ABSTRACT

BIOGRAPHY



Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Juia Hua Fang

Associate Professor, Division of Biostatistics and Health Services Research
Department of Quantitative Health Sciences
University of Massachusetts Medical School

ABSTRACT

BIOGRAPHY

Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Automated image analysis: extract the thousand words from that picture

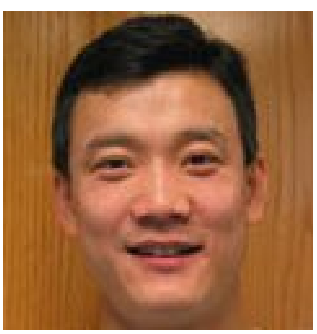
Tiao Xie

Co-leader, Image and Data Analysis Core (IDAC)
Harvard Medical School
Harvard University

ABSTRACT

With the rapid development of new imaging techniques and expansion of imaging capacity in recent years, image data analysis has continued to lag behind and became the bottleneck in applying new technology to solve biological problems. One such example is the advancement of super-resolution techniques that continues to push the limit on optical resolution, while at the same time signal detection and subsequent data analysis continues to post challenges. Being a relative young field, there aren't many well established image analysis methods. In 2012, the Image and Data Analysis Core (IDAC) of Harvard Medical School was launch with the mission to work with the biologists and help them maximize the information they can extract out of their images. At IDAC, we have access to a large collection of commercial and open-source image analysis software packages, but our main focus has been on developing and implementing novel image analysis algorithms. Our work has spanned across a great variety of imaging modalities, ranging from conventional fluorescence microscopy, super-resolution, electron microscopy (EM), to medical imaging. In this talk, I will cover a few selected projects we have worked over the years to demonstrate what and how information can be extracted out of different types of images.

BIOGRAPHY



Tiao Xie received his BS in Chemistry from Peking University in 2000, and then finished his PhD in Computational Chemistry at Emory University in 2005. After completing his PhD, he stayed at Emory and did a one-year postdoc in a molecular modeling laboratory before moving to Harvard in 2006, where he worked in a joined position between Dr. Tim Mitchison's laboratory in Systems Biology Department and ICCB-Longwood screening facility at Harvard Medical School (HMS). He worked as the Image Analyst to support all the high-content screening projects on campus for five year, and was promoted to Instructor in the Systems Biology Department in 2010. In 2012, he became the co-leader of the newly established Image and Data Analysis Core (IDAC) at Harvard Medical School to expand his service to all areas of image related data analysis at HMS and affiliated hospital in Boston area. The services provided at IDAC include image analysis consultations, software trainings, custom solution development and fellowship and other training opportunities. Over the years, he has collaborated with or supported over 100 labs/researchers on campus and as a result has published numerous research papers on various topics that involve quantitative imaging.

Technical Session D1-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Exploration of immune repertoire using next-generation sequencing

Fan Gao

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ABSTRACT

In human immune system, both innate and adaptive immune responses protect us against infection. In contrast to non-specific innate immunity, adaptive immunity is highly specific to a particular pathogen. Triggered by pathogen molecules (antigens), two common immune cells (T-cells and B-cells) are activated to produce antigen-specific binders through a programmed genomic rearrangement (V(D)J recombination). This presentation will discuss the application of next-generation sequencing together with bioinformatics analysis on systematic profiling of the V(D)J recombination events. We will report our preliminary results using the blood samples collected from meningioma patients, and underscore the potential of using this genetic profile for precision medicine.

BIOGRAPHY

Fan Gao was born in Wuhan, CHINA. He received a BS in chemical physics from University of Science and Technology of China in 2000 (CHINA), and then a PhD in biomedical engineering from Mayo Clinic College of Medicine - Mayo Graduate School in 2005 (USA).

He is currently a staff bioinformatician with the Picower Institute for Learning and Memory at MIT. He supervises and coordinates bioinformatics related activities for the institute. Prior to this role, he worked with the Zilkha Neurogenetic Institute at University of Southern California. In addition to academic working experience, he also spent several years in biotech industry, working for antibody R&D program.

Dr. Gao is interested in utilizing next-generation sequencing technology and bioinformatics approach to 1) understand basic mechanisms involved in gene transcriptional regulation; 2) delineate pathogenesis of neurological diseases, including neurological disorders and neurodegeneration; 3) monitor immune repertoire for precision medicine. Dr. Gao has authored 10 related publications in the last couple years.

Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

Hsiang-Ying (Sherry) Lee

Postdoctoral Associate, Whitehead Institute for Biomedical Research
Massachusetts Institute of Technology
(麻省理工學院李湘盈博士)

BIOGRAPHY

Dr. Lee was born in Tainan, Taiwan. She received her B.S. in Medical Technology from National Cheng Kung University in Taiwan. She then came to U.S. to pursue her graduate studies. She has received her M.A. in Medical Sciences from Boston University and Ph.D. in Biomolecular Chemistry from University of Wisconsin-Madison in 2011.

She is currently a Postdoctoral Fellow in Whitehead Institute for Biomedical Research located at M.I.T.. With extensive training in biochemistry, molecular and cell biology, her research interests center around red blood cell biology. She has been conducting basic research to investigate how genetic network regulates red blood cell development, as well as translational research to develop red cell-based diagnostic and therapeutic tools.

Dr. Lee has been a member of Taiwan Society of Laboratory Medicine, American Society for Cell Biology and American Association for the Advancement of Science. She has also been involved in organizing events and serving communities including Boston Taiwanese Biotechnology Association, Monte Jade Science and Technology Association of New England and MIT Biology IAP. She is a Charles H. Hood Postdoctoral Fellow. Her research work was published in major bioscience journals including Nature, Molecular Cell and PNAS.

Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Biomedical Big Data Analytics for Patient-Centric and Outcome-Driven Precision Health

May Dongmei Wang

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ABSTRACT

Rapid advancements in biotechnologies such as –omic (genomics, proteomics, metabolomics, lipidomics etc.), next generation sequencing, bio-nanotechnologies, molecular imaging, and mobile sensors etc. accelerate the data explosion in biomedicine and health wellness. Multiple nations around the world have been seeking novel and effective ways to make sense of biomedical "big data" for evidence-based, outcome-driven, and affordable 5P (Patient-centric, Predictive, Preventive, Personalized, and Precise) healthcare. My main research focus is on multi-modal and multi-scale (i.e. molecular, cellular, whole body, individual, and population) biomedical data analytics for discovery, development, and delivery, including translational bioinformatics in biomarker discovery for personalized care; imaging informatics in histopathology for clinical diagnosis decision support; bionanoinformatics for minimally-invasive image-guided surgery; critical care informatics in ICU for real-time evidence-based decision making; and chronic care informatics for patient-centric health.

In this talk, I will highlight major challenges in biomedical and health informatics pipeline consisting of data quality control, information feature extraction, advanced knowledge modeling, decision making, and proper action taking through feedback. I will present informatics methodological research in (i) data integrity and integration; (ii) case-based reasoning for individualized care; and (iii) streaming data analytics for real-time decision support using a few mobile health case studies (e.g. Sickle Cell Disease, asthma, pain management, rehabilitation, diabetes etc.). Last, there is big shortage of data scientists and engineers who are capable of handling Big Data. In addition, there is an urgent need to educate healthcare stakeholders (i.e. patients, physicians, payers, and hospitals) on how to tackle these grand challenges. I will discuss efforts such as patient-centric educational intervention, community-based crowd sourcing, and Biomedical Data Analytics MOOC development.

Our research has been supported by NIH, NSF, Georgia Research Alliance, Georgia Cancer Coalition, Emory-Georgia Tech Cancer Nanotechnology Center, Children's Health Care of Atlanta, Atlanta Clinical and Translational Science Institute, US CDC, and industrial partners such as Microsoft Research and HP.

BIOGRAPHY

Dr. May Dongmei Wang received PhDEE and three MSs (CS, Applied Math, and EE) from Georgia Institute of Technology (Atlanta, GA) and BSEng. From Tsinghua University (Beijing China). She is an Associate Professor in the Joint Department of Biomedical Engineering of Georgia Tech and Emory and School of Electrical and Computer Engineering of Georgia Tech. She is a Kavli Fellow, a Georgia Research Alliance Distinguished Cancer Scholar, and a Fellow of The American Institute for Biological and Medical Engineering (AIMBE). She serves as Co-Director of Biomedical Informatics Program of Georgia Tech in Atlanta Clinical and Translational Science Institute, Co-Director of Georgia-Tech Center of Bio-Imaging Mass Spectrometry, and Biocomputing and Bioinformatics Core Director in Emory-Georgia-Tech Cancer Nanotechnology Center. She is also with Emory Winship Institute, Georgia Tech IBB and and IPaT.

Prof. Wang's research is in Biomedical Big Data analytics. She focuses on Biomedical and Health Informatics (BHI) for Personalized and Predictive Health such as high throughput NGS and -omic data mining to identify clinical biomarkers, bionanoinformatics, pathological imaging informatics to assist clinical diagnosis, critical and chronic care health informatics for evidence-based decision making, and predictive systems modeling to improve health outcome. Prof. Wang published 190+ peer-reviewed articles in BHI. She is the corresponding/co-corresponding author for articles published in Journal of American Medical Informatics Association (JAMIA), Journal of Biomedical and Health Informatics (JBHI), IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB), Briefings in Bioinformatics, BMC Bioinformatics, Journal of Pathology Informatics, Proceedings of The IEEE, IEEE Transactions on Information Technology in Biomedicine (TITB), Proceedings of National Academy of Sciences (PNAS), Annual Review of Medicine, Nature Protocols, Circulation Genetics, Nanomedicine, BMC Medical Imaging, Annals of BME (ABME), and Trends in Biotechnology etc. She has led RNA-data analysis investigation within FDA-led Sequencing Consortium (SEQC) of MAQC-III.

Currently, Prof. Wang serves as the Senior Editor for IEEE Journal of Biomedical and Health Informatics (J-BHI), an Associate Editor for IEEE Transactions on Biomedical Engineering (TBME), and an Emerging Area Editor for Proceedings of National Academy of Science (PNAS). She also serves as IEEE EMBS Biomedical and Health Informatics Technical Committee Chair. She is an IEEE-EMBS 2014-2015 Distinguished Lecturer, and an EMBS Administrative Committee Officer representing North America. In addition, Dr. Wang has devoted to the training of young generation of data scientists and engineers, and is a recipient of Georgia-Tech's Outstanding Faculty Mentor for Undergraduate Research.

Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Translating GWAS to Pathobiology in Lungs

Anny Xiaobo Zhou

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ABSTRACT

With rapid progress in high-throughput sequencing, there is large amount information generated from human genetics studies, such as genome-wide association studies (GWAS) that provide an unbiased and comprehensive approach to search for susceptibility loci throughout the genome in thousands of subjects. Such studies have identified susceptibility loci for many complex diseases. However, in-depth functional and mechanistic studies targeting GWAS candidate genes in the post-GWAS era have been relatively rare, because: a) the majority of genes examined in GWAS are novel genes with few prior implications in any disease including pulmonary diseases; b) most GWAS SNPs are in non-coding regions, and linking GWAS signals to the right causal gene is not trivial but instead time- and labor-intensive. While over 20 loci have been associated with pulmonary diseases and lung function, only a couple of functional variants have been identified to link GWAS signals to specific genes. The lack of connection between functional variants and causal genes in pulmonary diseases has greatly impeded gene-focused functional investigations; c) due to these above reasons, the biological implications of genetic discoveries remain obscure to the basic pulmonary research community, which became a further hurdle for post-GWAS functional studies. Here I will give a few examples on our efforts to delineate biological function of GWAS genes in chronic obstructive pulmonary diseases (COPD), the third leading cause of death in the U.S. with increasing incidence yearly worldwide.

BIOGRAPHY

Dr. Zhou was born in Henan, P.R. China. After obtaining her bachelor of science (B.S) in Clinical Pharmacy in West China University of Medical Science (Currently part of Si Chuan University), Chengdu, China in 1998, she went to one of the most esteemed medical school in China, Peking Union Medical College, Chinese Academy of Medical Science, Beijing and obtained her Ph.D. in cell biology in 2003 She was initially trained in virology as a post-doctoral fellow in Channing Laboratory, Brigham and Women's Hospital, Harvard Medical School, Boston, MA. In 2009, she made the challenging transition from cancer cell biologist in basic science to pulmonary scientist devoted to translational research when she established the Functional Genomics Laboratory to pursue functional evaluations on the genes identified from genome-wide association studies (GWAS) in respiratory diseases. She is the Assistant Professor in Harvard Medical School and also currently serves as the Director of the Functional Genomics Laboratory, Channning Division of Network Medicine, Brigham and Women's Hospital, HMS, Boston, MA. Her research work has been published on the Human Molecular Genetics, the Journal of Allergy and Clinical Immunology and Genome Medicine (2015) et al esteemed journals in Genomics and Immunology field. Her novel work has built bridges across genetics, molecular biology, cell physiology, and pulmonary disease, which may ultimately lead to improved treatments for these conditions.

Dr. Zhou has been an active member of American Society of Human Genetics, American Thoracic Society since 2010. She has received a variety of awards in post-GWAS studies in lung diseases.

Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

High-resolution, high-speed 3D optical sensing

Song Zhang

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ABSTRACT

Advances in optical imaging and machine/computer vision have provided integrated smart sensing systems for the manufacturing industry; and advanced 3D optical sensing could have profound impact on numerous fields, with broader applications including manufacturing, biomedical engineering, homeland security, and entertainment. Our research addresses the challenges in high-speed, high-resolution 3D optical sensing and optical information processing. For example, we have developed a system that simultaneously captures, processes and displays 3D geometries at 30 Hz with over 300,000 measurement points per frame, which was unprecedented at that time (a decade ago). Our current research focuses on achieving speed breakthroughs by developing the binary defocusing techniques, and exploring novel means to store enormously large 3D sensing data by innovating geometry/video compression methods. Our ultimate goal is to provide an optical means for non-contact on-line quality control in the manufacturing industry, as well as to provide platforms for numerous other application areas. In this talk, I will present two platform technologies that we have developed: 1) 3D optical sensing; and 2) real-time 3D video telepresence. I will also cover some of the applications that we are currently exploring.

BIOGRAPHY

Professor Song Zhang was born in a small rural village (less than 200 people) in China in 1977, and received his B.S. degree in mechanical engineering from University of Science and Technology of China (Anhui, China) in 2000. He came Stony Brook University (Stony Brook, NY) for his graduate study where he received his M.S. and Ph.D. both in mechanical engineering in 2003 and 2005, respectively. He then spent three years as a postdoctoral fellow at Harvard University. His research focuses on multi-scale superfast 3D optical sensing and applications.

He took an assistant professor position at Iowa State University (Ames, IA) in the department of mechanical engineering in 2008. He stayed at Iowa State University for more than 6 years and was promoted to associate professor before he joined school of mechanical engineering at Purdue University (West Lafayette, IN) in January 2015. In this entire career, he has published over 70 journal articles, co-authored 6 book chapters, and co-invented 3 U.S. patents. He also edited a book that was published by CRC in 2013. His research interests centers around 3D optical sensing and applications including biophotonic imaging, 3D video processing, 3D video telepresence, human computer interaction, and virtual reality.

Professor Zhang is a fellow of SPIE – The International Society for Optics and Photonics, a member of Optical Society of America (OSA) and American Society of Mechanical Engineering

(ASME). He has chaired or co-chaired a number of conferences and serve as a reviewer for over twenty journals. 10 of his journal articles were selected as cover page highlights. Besides being extensively utilized in academia, the technologies he developed have been used by rock band Radiohead to create a music video House of Cards; and by the Zaftig Films to produce a movie Focus (II). He has won the AIAA Best Paper Award, the Best of SIGGRAPH by the Walt Disney, the NSF CAREER award, and the Stony Brook University's "40 under Forty Alumni Award". Due to his contributions to high-speed, high-resolution 3D optical sensing and optical information processing, he was elected as the fellow of SPIE.

Technical Session D1-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

A Bayesian framework for de novo mutation calling in sequencing data

Bingshan Li

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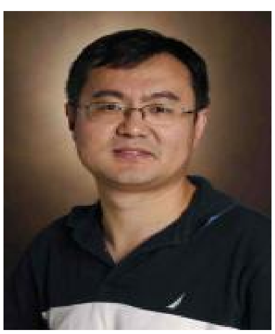
ABSTRACT

Spontaneous (de novo) mutations play an important role in the disease etiology of a range of complex diseases. Identifying de novo mutations (DNMs) in sporadic cases provides an effective strategy to find genes or genomic regions implicated in the genetics of disease. High-throughput next-generation sequencing enables genome- or exome-wide detection of DNMs by sequencing probands and their parents and siblings. Such approaches have been employed to search for genes implicated in various diseases including autism, schizophrenia and epilepsy. For sequencing studies the traditional approach to DNM calling is to call individual genotypes separately in a pedigree and then compare the offspring and parental genotypes to identify DNMs. This naïve approach is inevitably ineffective and often generates many false positive DNM calls due to sequencing error and alignment artifacts. In this talk, I will describe a novel Bayesian framework for DNM calling, which jointly models sequencing data in a pedigree and naturally overcomes some limitations inherent in other calling methods. I will describe the performance of the new framework compared to other state-of-the-art methods on both simulated and real datasets.

BIOGRAPHY



Bingshan Li received his M.D. from Peking University Health Science Center in 1999 and his M.S. from University of Houston in computer science in 2003. He received his Ph.D. from Baylor College of Medicine in computational biology in 2009, and did a postdoctoral training at the University of Michigan 2009-2011. Currently he is assistant professor of Department of Molecular Physiology and Biophysics at Vanderbilt, and an investigator in the Vanderbilt Center for Quantitative Sciences and Vanderbilt Genetics Institute. Dr. Li's general research interest lies in developing statistical methods and computational tools to understand genetic basis of human disease. His current research is focused on next-generation sequencing data and is funded by NIH to develop methods for rare variants association analysis for sequencing studies. He collaborates with local and national teams for genetic studies of various human complex disease including cancers, lipids and autism.

Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

Shien-Ping Feng

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BIOGRAPHY

Shien-Ping Feng (another name is Hsien-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 Hong Kong University. 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 electrochemical processing and interfacial characterization of nanostructured materials, and their applications on energy conversion and storage.

Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Si nanocrystals for lighting and memory applications

Chuan-Feng Shih

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ABSTRACT

Silicon is an abundant element in earth, and crystalline Si has an indirect bandgap nature. Since the discovery of luminescence from Si nanocrystals (NCs) made by porous Si in 1990, the quantum confinement in Si NCs has been approved possible and the role of oxygen deficient defects have become clear in the past years, making it great applications to memory, photovoltaic, photodetector and lighting devices. Challenge remains, mostly on the difficulty in control and balance between the defects and Si NCs. So far, technologies that have been used to synthesize the Si NCs include vacuum deposition or ion-implantation followed by a thermal annealing or a hydrogen passivation process.

A brief review of the progress of the Si NC based devices and synthesize methods will be given in this talk. A novel method that used sputtering with an ion-beam technique will be proposed. Using this process, the spontaneous white-light emission devices were fabricated. The ratio of the radiative defects and Si NCs was modulated. Memory devices with high charge-storage density and long-term retention were obtained.

BIOGRAPHY

Born in 1975-Jan, Taipei, Chuan-Feng Shih received his B.S. (1997), M.S. (1999), and Ph.D (2005) in Material Science and Technology of National Tsing-Hua University. He was an assistant professor between 2006-2010. Currently he is an associate professor in department of electrical engineering of National Cheng-Kung University (NCKU). Being an expert in III-V semiconductors in 2000-2010, he extended his research interest to more potential materials and initiated the Advanced Material Research Lab in NCKU at 2007. The Si NCs, nano-ceramics with spinel and ilmenite structures, high-k materials, organic materials, I-II-VI-VI semiconductors were attempted, and the device applications such as memory, photovoltaic, photodetector, light emitting diode, and low-loss substrate for wireless communication were presented in his publication.

Prof. Shih has published sixty SCI papers and thirty patents associated with the optoelectronic materials and devices in the past ten years. He is the principle investigator of the National Science Council (NSC) and the Ministry of Science and Technology, having more than 10 projects since 2006. Some research topics were co-worked with the Center for Micro/Nano Science and Technology in NCKU.

Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Ultrafast Optical Characterization of Thermal Transport in Micro/Nanostructured Materials

Xiaojia Wang

Assistant Professor, Department of Mechanical Engineering
University of Minnesota, Minneapolis

ABSTRACT

BIOGRAPHY

Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Quest for High-Temperature Superconductors

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ABSTRACT

Superconductor, a material losing resistivity below a critical temperature Tc, remains one of the grand challenges in physics. This field began in 1911 with the discovery of superconductivity in mercury at 4.2 K. After the birth of a complete microscopic theory of superconductivity proposed by Bardeen, Cooper, and Schrieffer in 1957, known as BCS theory, it was believed that no materials could have Tc higher than 30 K. The discovery of new classes of superconductors, cuprates in 1986 (which shatter the 30 K barrier) and iron pnictides in 2008, launched an international wave of research to find new materials with higher Tc. In this talk, I will summarize several new physical concepts we have learned from cuprates and iron-based superconductors, and the possible new routes to superconductors with higher Tc will be discussed.

BIOGRAPHY

Wei-Cheng Lee was born in Tainan, Taiwan in 1977. He received BS and MS in physics from National Taiwan University in 1999 and 2002 respectively, and obtained the PhD in physics from the University of Texas at Austin in 2008. Before joining Binghamton University as an assistant professor in Sep. 2014, he was a postdoctoral researcher at University of California, San Diego (2008-2010) and University of Illinois at Urbana-Champaign (2010-2014). He is specialized in condensed matter theory with current interests in unconventional superconductivity emerging from correlated materials.

Dr. Lee has published more than thirty papers on journals including Proceedings of National Academy of Sciences, Physical Review Letters, and Physical Review B. He is the winner of 2013 Michelson Postdoctoral Prize Lectures for his work on theoretical understanding of unconventional superconductors. His current work focuses on exploring new energy scales that can increase the superconducting transition temperature. Dr. Lee is a member of American Physical Society (APS) and served as a co-organizer of APS March meeting in 2014.

Technical Session D1-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Electrochemical Materials and Devices for Energy Storage and Conversion

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ABSTRACT

A sustainable future demands advanced materials for energy storage and conversion. The ability to understand, design and characterize materials affords great opportunities for controlling underlying physical and chemical processes, which can ultimately lead to high performance energy devices.

This talk will cover several examples on designing electrochemical materials and devices for both energy storage and conversion. In the first part, I will discuss strategies to design high-capacity sulfur electrode for energy storage. Two approaches have been demonstrated: In one approach, closed nanostructures efficiently trap soluble polysulfides and minimize electrode pulverization, leading to both long cycle life and high capacity. In the other approach, solubility of lithium polysulfides inspires us to develop a new type of hybrid flow battery for grid-level energy storage.

Besides designing high-performance batteries, it is also important to explore new characteristics and applications of batteries. In the second part, I will briefly show how to design transparent batteries and use batteries to convert heat to electricity.

BIOGRAPHY

Dr. Yuan Yang received his B.S. in physics at Peking University in 2007 and Ph.D. in materials science and engineering at Stanford University in 2012. He is currently a postdoctoral researcher in department of mechanical engineering at MIT. Dr. Yang is going to be an assistant professor in department of applied physics and applied mathematics with materials science and engineering at Columbia University this summer. His research interests include electrochemical materials and devices, thermal energy harvesting and thermal management. He received MRS Postdoctoral Award (2015), Chinese Government Award for Outstanding Self-financed Students Abroad (2012), Cubicciotti Award with Honor Mention of the Electrochemical Society (2010), O. Cutler Shepard Award of Stanford University (2010).

Day 2 (August 7, 2015)

Panel Discussions - Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Moderator

Chen-Hsiang (Jones) Yu

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BIOGRAPHY

Jones Yu is an Assistant Professor of Computer Science and Networking at Wentworth Institute of Technology (WIT). He earned B.Eng. and M.S. in Computer Science and Information Engineering (CSIE) from Tamkang University in 1998 and from National Taiwan University in 2000, respectively, and Ph.D. in Computer Science from MIT under Prof. Rob Miller's guidance in 2012. His research in Human-Computer Interaction (HCI) focuses on web customization and automation, readability enhancement, and mobile learning.

He is also founder and CEO of Prentice Lab, which is a technology company focusing on designing algorithms and developing software for improving learning, including language learning and subject learning. In the past, he has worked for a few startup companies as Director of Mobile Engineering and User Experience, and developed mobile apps as products.

Panel Discussions: Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Panelist

Qizhi Wei

Vice President, Analytic Consulting Group
Epsilon

BIOGRAPHY

Qizhi Wei received a Ph.D. in Economics (2003) and a M.S. in Statistics (2000) from Washington State University. He received a B.A. in Economics (1994) from Nanjing University in China.

Currently he is a VP within Epsilon's Analytic Consulting Group in Wakefield, Massachusetts, responsible for designing and building advanced analytic solutions for clients across industries. He has 15 years of analytic experiences, and has led projects employing a broad range of analytic methodologies including predictive modeling, segmentation, and campaign measurement and profiling.

Prior to joining Epsilon in 2011, Dr. Wei was a Director of Analytics with Merkle and also worked at Epsilon for six years during his first tenure there.

Panel Discussions: Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Panelist

Judith Maro

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Harvard Pilgrim Health Care Institute
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BIOGRAPHY

Judith C. Maro received her SM in Technology and Policy (2009) and her PhD in Engineering Systems (2013) from the Massachusetts Institute of Technology. Prior to starting her doctoral work, she served as a Surface Warfare Officer (Nuclear) for five years aboard the USS ROSS (DDG-71) and USS GEORGE WASHINGTON (CVN-73) and as Irradiation Services Coordinator for the MIT Nuclear Reactor Laboratory. Currently, she is an Instructor in the Department of Population Medicine at Harvard Medical School and Harvard Pilgrim Health Care Institute. Dr. Maro's main research interest is the modeling and simulation of large-scale engineering systems (e.g., observational database networks) with the aim to improve the efficiency of public health activities. She is currently focusing on the implementation of pharmacovigilance techniques, particularly continuous near-real time sequential statistical analysis methods and data-mining. Dr. Maro is a co-investigator in the U.S. Food and Drug Administration's Sentinel Network, a new national active surveillance system that monitors the safety of approved medical products among a distributed data network of 18 electronic healthcare databases.

Panel Discussions: Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Panelist

Michael Chang

Chief Executive Officer
Kyper

BIOGRAPHY

Panel Discussions: Big Data Analytics, Data Science and Machine Learning: Challenges and Opportunities

Panelist

Wan-Ping Lee

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BIOGRAPHY

Wan-Ping Lee received her B.B.A (2001) from Chung Yuan Christian University in Management Information System, M.S (2004) from National Sun Yat-Sen University in Computer Science, and Ph.D (2009) from National Taiwan University in Electrical Engineering. She then was a post-doc and senior research associate in Department of Biology at Boston College. She currently is a senior lead scientist at Seven Bridges Genomics and leads the R&D team.

Wan-Ping participates in the 1000 Genomes Project and contributes whole-genome DNA mapping and the discovery of mobile-element-insertion to the project since 2009. The 1000 Genomes Project is an international collaboration to produce human genetic variations in population-scale. To analyze NGS data obtained from the project, Wan-Ping has developed several pre-eminent software that are widely used from population re-sequencing projects through medical sequencing studies, and make significant contributions to the community.

With her multidisciplinary training in bioinformatics, electrical engineering, computer science, and commerce, Wan-Ping can work collaboratively and efficiently with several investigators from diverse disciplines. Wan-Ping thus now serves as a leader in the R&D at Seven Bridges Genomics for new genomic software development.

Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Chen-Hsiang (Jones) Yu

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BIOGRAPHY

Jones Yu is an Assistant Professor of Computer Science and Networking at Wentworth Institute of Technology (WIT). He earned B.Eng. and M.S. in Computer Science and Information Engineering (CSIE) from Tamkang University in 1998 and from National Taiwan University in 2000, respectively, and Ph.D. in Computer Science from MIT under Prof. Rob Miller's guidance in 2012. His research in Human-Computer Interaction (HCI) focuses on web customization and automation, readability enhancement, and mobile learning.

He is also founder and CEO of Prentice Lab, which is a technology company focusing on designing algorithms and developing software for improving learning, including language learning and subject learning. In the past, he has worked for a few startup companies as Director of Mobile Engineering and User Experience, and developed mobile apps as products.

Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Multipath Search on Large Open Data

Woei-jyh (Adam) Lee

Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business
University of Maryland, College Park
(馬里蘭大學學院市分校史密斯商學院李偉智教授)

ABSTRACT

With wired and wireless networks connecting the whole world in the 21st century, data were generated in unpredictable rates. On top of "Time is Money", data can be turned into fortunes in possible various ways. Traditionally, scientists design and conduct experiments to generate data. Since not long ago, huge amount of data have been generated and waited for scientists to analyze. Hidden knowledge will be discovered then searched in the field of data science.

Biologists are used to search specific data sources to learn and gain published results. They search knowledge of human genes on some gene database, of human diseases on some disease database, of articles on some citations database. Three most commonly used data sources about human genetics are Gene, OMIM (Online Mendelian Inheritance in Man), and PubMed hosted by the NCBI (National Center for Biotechnology Information, United States National Library of Medicine, National Institutes of Health). However, such direct searches might lead to abundant records and search results. To filter or rank among search results remain challenging tasks.

We proposed an integrated search methodology using multiple search paths (i.e. multipaths). Many data are related therefore connected in different degrees via "links". To search citations about a given term, instead of using the term to directly search on PubMed, biologists can search on the Gene database then follow links onto the PubMed. Such search steps form a search "path". We experimented multipaths using various categories of terms among Gene, OMIM and PubMed.

Our results demonstrated benefits on multipath searches that we conducted. We analyzed the "all-way intersection" of multipath results and were able to narrow down more relevant results respected to a search term. Among the above three data sources, links from OMIM records to Gene records may be least redundant. Links from and to PubMed records may augment huge number of lower ranked data. Links between PubMed records and Gene records double the size of the traditional Gene and PubMed searches.

BIOGRAPHY

Dr. Woei-jyh (Adam) Lee received BSE degree from the National Taiwan University, MS degree from the Courant Institute at New York University, and PhD degree from the University of Maryland at College Park (UMD). He worked on distributed objects and fault tolerance at the AT&T Labs - Research in 1997. He focused on network software and management at the Bell Laboratories Research from 1998 to 2000. He visited the University of Southern California specializing in continuous media streaming and multimedia networking from 2002 to 2003.

He contributed in protein domain parsing and boundary prediction at the National Cancer Institute (NCI), National Institutes of Health (NIH) from 2004 to 2005. He was a fellow focusing on human genetics and genomics at the National Center for Biotechnology Information, National Library of Medicine, NIH from 2009 to 2012. He became a special volunteer working on computational modeling for cancer progression and metastatic at the NCI, NIH from 2012 to 2013. He was also affiliated with the Center for Bioinformatics and Computational Biology and the Institute for Advanced Computer Studies at UMD.

He is currently a faculty of Information Systems at the Robert H. Smith School of Business at UMD since 2012. His research interests include information integration, data analytics and mining, literature-based discovery, performance simulation and evaluation, bioinformatics and computational biology, human genomics and genetics, and cancer biology. He has two US Patents and is a member of the IAENG and the CAPA.

Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Yingchun (Spring) Liu

Senior Bioinformatics Scientist
Mass General Hospital/Broad Institute of MIT and Harvard

ABSTRACT

BIOGRAPHY

Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Cloud-Based Systems and Methods for Analyzing Genomic Information

Wan-Ping Lee

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ABSTRACT

A person's genetic information has the potential to reveal much about their health and life. A risk of cancer or a genetic disease may be revealed by the sequences of the person's genes, as well the possibility that his or her children could inherit a genetic disorder. Genetic information can also be used to identify an unknown organism, such as potentially infectious agents discovered in samples from public food or water supplies. Next-generation sequencing (NGS) technologies are available that can sequence entire genomes quickly. Sequencing by NGS produces a very large number of short sequence reads. Each sequence read represents a short sequence of part of the genome of an organism. Unfortunately, analyzing short sequences is not an easy task.

Classical short-read mapping algorithms utilize a linear genome reference sequence to align reads from a newly sequenced individual. Many reads fail to map or are incorrectly mapped because each new genome typically contains genomic variations not present in the reference sequence. As a result, while it is possible to detect SNPs and very short INDEL variants using such mappings, longer INDELs and structural variations are often missed. Furthermore, undetected structural variants in a new sample often cause mismappings that lead to false positive variant predictions. Projects, such as the 1000 Genomes Project, have analyzed the genomes of thousands of individuals from different populations, allowing us to understand how genomes vary between humans. A key insight from these projects is that most of the variants in an individual are shared by the population. This has led to the hypothesis that, by incorporating known variants into the current linear reference we can improve short read alignments and variant calling. We thus have developed a novel whole-genome read mapper that takes known variations into account when mapping reads.

BIOGRAPHY

Wan-Ping Lee received her B.B.A (2001) from Chung Yuan Christian University in Management Information System, M.S (2004) from National Sun Yat-Sen University in Computer Science, and Ph.D (2009) from National Taiwan University in Electrical Engineering. She then was a post-doc and senior research associate in Department of Biology at Boston College. She currently is a senior lead scientist at Seven Bridges Genomics and leads the R&D team.

Wan-Ping participates in the 1000 Genomes Project and contributes whole-genome DNA mapping and the discovery of mobile-element-insertion to the project since 2009. The 1000 Genomes Project is an international collaboration to produce human genetic variations in population-scale. To analyze NGS data obtained from the project, Wan-Ping has developed several pre-eminent software that are widely used from population re-sequencing projects through medical sequencing studies, and make significant contributions to the community.

With her multidisciplinary training in bioinformatics, electrical engineering, computer science, and commerce, Wan-Ping can work collaboratively and efficiently with several investigators from diverse disciplines. Wan-Ping thus now serves as a leader in the R&D at Seven Bridges Genomics for new genomic software development.

Technical Session D2-W1-T1: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

The effects of aging on circadian patterns of gene expression in the human prefrontal cortex

Cho-Yi (Joey) Chen

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ABSTRACT

With aging, significant changes in circadian rhythms occur, including a shift in phase toward a “morning” chronotype and a loss of rhythmicity in circulating hormones. However, the effects of aging on molecular rhythms in the human brain have remained elusive. Here we employed a previously-described time-of-death analyses to identify transcripts throughout the genome that have a significant circadian rhythm in expression in the human prefrontal cortex (Brodmann’s areas (BA) 11 and 47). Expression levels were determined by microarray analysis in 146 individuals. Rhythmicity in expression was found in ~10% of detected transcripts ($p<0.05$). Using a meta-analysis across the two brain areas, we identified a core set of 235 genes ($q<0.05$) with significant circadian rhythms of expression. These 235 genes showed 92% concordance in the phase of expression between the two areas. In addition to the canonical core circadian genes, a number of other genes were found to exhibit rhythmic expression in the brain. Notably, we identified more than one thousand genes (1186 in BA11; 1591 in BA47) that exhibited age-dependent rhythmicity or alterations in rhythmicity patterns with aging. Interestingly, a set of transcripts gained rhythmicity in older individuals, which may represent a compensatory mechanism due to a loss of canonical clock function. Thus, we confirm that rhythmic gene expression can be reliably measured in human brain and identified for the first time significant changes in molecular rhythms with aging that may contribute to altered cognition, sleep and mood in later life.

BIOGRAPHY

Cho-Yi Chen is an Olympic swimmer, a bioinformatician, and a computational biologist. He majored in Computer Science, and later devoted himself to biomedical research. He received his MS and PhD degrees in Bioinformatics, Genomics and Systems Biology at National Taiwan University. He was a founding member of Taiwan’s Society of Evolution and Computational Biology. He is now a postdoctoral research fellow in the Department of Biostatistics and Computational Biology of the Dana-Farber Cancer Institute, Harvard University. He is an active scientist and software developer, striving to advance our understanding of cancer and other human diseases.

Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

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BIOGRAPHY

Yen-Tsung Huang earned a Doctor of Medicine degree from the National Taiwan University, Taiwan 2003, and Dual Degree of Doctor of Science in Epidemiology and Biostatistics at Harvard School of Public Health in 2012. He is currently an Assistant Professor of Epidemiology and Biostatistics in Brown University, Providence, RI. His research interests focus on cancer genomics, high-dimensional statistics, and molecular/genetic epidemiology. His methodology work is mostly on mediation analyses of high-dimensional data and its application to integrative genomics.

Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Enriching Silver Nanocrystals with Gold

Dong Qin

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ABSTRACT

Silver nanocrystals have fascinating optical properties known as localized surface plasmon resonance, which is essential to applications such as sensing and imaging. For example, Ag nanocubes embrace surface-enhanced Raman scattering (SERS) properties with enhancement factors up to 106 at visible excitation wavelengths for highly sensitive detection of chemical or biological species. Unfortunately, elemental Ag is highly susceptible to oxidation under conditions that involve oxidants, halide ions, and acids. Such chemical instability often results in changes to the morphology of Ag nanocrystals, particularly at corners and edges with high energies, and ultimately compromise their performance. Additionally, the toxicity of the released Ag+ ions also limits the potential applications of Ag nanocrystals in a biological system. One potential solution to improve the chemical stability of elemental Ag is to form alloys with a more stable metal such as Au or protect the Ag nanocrystals with ultrathin Au shells. However, it is difficult to form Ag-Au alloys by reducing their precursors simultaneously in a solution phase due to their substantial difference in reactivity. It is also challenging to coat Ag nanocrystals with Au shells due to galvanic replacement. This talk will report our recent developments in addressing these challenges and present a successful demonstration of Ag-Au bimetallic nanocrystals with greatly enhanced plasmonic properties and improved chemical stability for chemical and biological sensing and imaging.

BIOGRAPHY

Dr. Qin is an Associate Professor in the School of Materials Science and Engineering, with an adjunct appointment with the School of Chemistry and Biochemistry, at Georgia Institute of Technology. She was born and raised in Shanghai, China. Her academic records include a BS in Chemistry from Fudan University, a PhD in Physical Chemistry with Professor Hai-Lung Dai from the University of Pennsylvania, a postdoctoral stint in Materials Chemistry with Professor George M. Whitesides at Harvard University, and an MBA from the University of Washington. Her research interests center on the frontiers that bridge traditional fields of chemistry and materials science, with a focus on peculiar properties and applications driven by materials and systems at the nanoscale. Her expertise includes nanomaterials, surface-enhanced Raman spectroscopy (SERS), soft lithography, self-assembly, colloidal physics and chemistry, and responsible development of nanotechnology.

Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Quantitative Analysis of Membrane Protein Binding Kinetics

Hung-Jen Wu

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ABSTRACT

The attachment of peripheral membrane proteins (PMP) to cellular surfaces regulates most of a wide range of cellular events, including cell signaling, protein trafficking, and signal transduction. Quantitative analysis of PMP retention on cellular membranes is essential to determine the rate of these biochemical reactions. We have developed a nanocube sensor coupled with complex reaction analysis to quantitatively explore the PMP binding kinetics. The nanocube sensor is surrounded by lipid bilayers that possess the same physical and chemical properties as cell membranes. This biomimetic surface then enables the label-free detection of PMP bindings by observing the absorption spectra shift of localized surface plasmon resonance (LSPR) peak. This biosensor works with standard laboratory plate reader for high-throughput binding kinetic analysis. The simple protocol ("mix-and-then-detect") allows any end users performing the analysis in their own laboratories. We have successfully explored many essential PMP binding events, including pleckstrin-homology (PH)-lipid and toxin-ganglioside interactions. Moreover, we have introduced complex reaction analysis technique to model the binding cooperativity among PMPs, ligands, and accessory molecules. This sophisticated model-fitting approach can analyze rich kinetic data acquired by the high-throughput nanocube sensor and quantitatively predict the association/dissociation rate of PMP on any desired membrane environment. This technique will assist scientists in understanding basic principles of membrane protein binding and comprehensively designing new drugs to manipulate binding processes for therapeutic purposes.

BIOGRAPHY

Dr. Hung-Jen Wu received his B.S. (1998) and M.S. (2000) in Chemical Engineering from the National Cheng-Kung University, Taiwan. He received his Ph.D. in Chemical Engineering from Texas A&M University in 2006, working on developing advanced microscopy techniques to explore weak molecular interactions. From 2007 to 2011, he worked as a Postdoctoral Fellow at the University of California, Berkeley. During the postdoctoral training, he focused on studying the properties of biological membrane. Between 2011 and 2013, Dr. Hung-Jen Wu was appointed as a Research Associate in the Nanomedicine Department at the Houston Methodist Research Institute, and was involved in developing diagnostic tools for infectious diseases. Currently, he is an Assistant Professor of Chemical Engineering at Texas A&M University. Dr. Wu's research primarily focuses on the development of nanostructured materials for diagnosis of diseases, including cancer and infectious diseases.

Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Biological and bio-inspired transparent structural materials

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ABSTRACT

Transparent structural materials are widely used in both military and commercial applications, such as soldier eye/face protection, windshields and windows, blast shields, combat vehicle vision blocks, and security glass. The most widely used transparent structural materials currently are based on glass laminates, and one particular drawback of this type of materials is their low damage tolerance and lack of multi-hit capability. The ability to view through these materials after an initial impact event is dramatically reduced because of the extensive crack propagation through the composite. Many natural load-bearing materials are also essentially laminated composites composed of mineral and organic phases. Although most of them are opaque, some biological species do produce structural materials that are highly transparent to visible light. In this talk we introduce a unique transparent bioceramic material system from the mineralized shell of the bivalve Placuna placenta. This highly transparent shell exhibits remarkable resistance to mechanical damage. This behavior originates from a unique nanoscale structural motif, i.e. screw dislocation-like connection centers, which join adjacent mineral layers together in the laminate structure. This leads to a formation of a complex interconnected network of microcracks surrounding the damage zone, which allows for both efficient energy dissipation and damage localization even when the shell is completely penetrated. Both theoretical analysis and experiment-based calculations suggest that the interface fracture toughness is enhanced by almost two orders of magnitude in comparison to classic laminated composites without connection centers. Moreover, we demonstrate a successful transfer of this underlying design strategy to a bio-inspired transparent structural material system, which is able to achieves both damage localization and toughness, enabling multi-hit capability, while maintaining high levels of global optical transparency.

BIOGRAPHY

Dr. Ling Li obtained his bachelor with first-class honors (2008) and doctoral (2014) degrees in National University of Singapore and MIT, respectively, both in Materials Science and Engineering. As an undergraduate, he performed research (with Prof. Junmin Xue and Prof. Jun Ding) on nanomaterial synthesis and self-assembly, particularly focused on magnetic nanoparticle-based systems. Dr. Li's PhD research (with Prof. Christine Ortiz) was focused on a group of unique biomineralized structural materials with simultaneous mechanical and optical properties. Dr. Li is currently a postdoc fellow working in Prof. Joanna Aizenberg's group at Harvard University. His current research interests include structure-property relationships of biological structural materials, nanoscale mechanics, biomineralization, biophotonics, bio-inspired material design and self-assembly. Dr. Li has published 14 scientific papers on high-impact journals, including Nature Materials, Nature Communications, and Advanced Materials. His research has been widely reported by MIT and Harvard News Press and numerous international media, such as Fox News, Yahoo, PhysicWworld, C&EN, and NBC News.

Technical Session D2-W2-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Bioinspired Active Materials: From Camouflage to Anti-biofouling

Qiming Wang

Postdoctoral Associate, Department of Mechanical Engineering
Massachusetts Institute of Technology

ABSTRACT

BIOGRAPHY

Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

Pei-Cheng Ku

Associate Professor, Department of Electrical Engineering & Computer Science
The University of Michigan at Ann Arbor
(密歇根大學安娜堡分校電機學系古培正教授)

BIOGRAPHY

Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Harnessing Soft Materials for Functionality through Deformation and Instability

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ABSTRACT

Structures made of soft materials such as elastomers can make a large change of their architecture in response to stimuli. If excessive deformation is applied, they may become unstable. Beyond the instability threshold, structures can undergo dramatic changes of the architecture and may form new patterns. The non-linear behavior of highly deformable structures can be utilized to create a new class of tunable materials that can change their functionalities through large deformations and dramatic geometric rearrangements induced by instabilities. In my presentation, I will talk about how we can harness the behavior of soft periodic structures to tune propagation of elastic waves and energy absorption. While instabilities have been traditionally considered as failure modes to avoid, our studies show new ways of utilizing the phenomena for novel structures and devices.

BIOGRAPHY

Sung Hoon Kang received his B.S. (2000) and M.S. (2004) in materials science and engineering from Seoul National University and Massachusetts Institute of Technology, respectively. He received his Ph.D. (2012) in applied physics from Harvard University.

Currently, he is an Assistant Professor in the Department of Mechanical Engineering and Hopkins Extreme Materials Institute at Johns Hopkins University (Baltimore, MD). Prior to his appointment, he was a postdoctoral fellow in materials science and mechanical engineering at Harvard University from 2012 to 2014. Before starting his Ph.D., he worked as a Staff Scientist at EIC Laboratories, Inc. from 2004 to 2007. Throughout his career, he has co-authored over 20 peer-reviewed papers, has given over 25 presentations, and has three pending patents. He has been studying complex behaviors of material systems and structures with novel properties based on inspiration from nature as well as rational design followed by rapid prototyping using a 3D printer. By designing experimental model systems and/or using computational models, he has been working on identifying key design parameters of systems so that we can make desired structures and properties by tailoring behaviors of systems.

Prof. Kang is an editorial board member of Scientific Reports and a member of American Society of Mechanical Engineers (ASME), Materials Research Society (MRS), Society of

Engineering Science (SES), and American Physical Society (APS). His honors include the 2011 Materials Research Society Graduate Students Gold Award, First Place in Photography Category of the 2009 International Science and Engineering Visualization Challenge, and several poster awards and travel fellowships from prestigious conferences/workshops. Outside lab, he is interested in communicating science and technology to general public and fellow scientists/engineers through science-art and outreach activities.

Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

One is More than Two: Electron Transfer at Organic/Graphene Hybrid Interfaces

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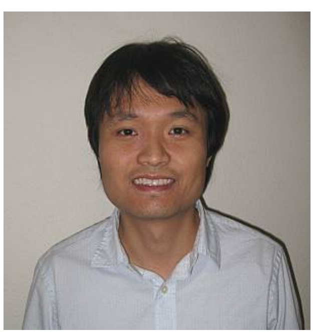
ABSTRACT

Graphene is used as flexible electrodes in various organic optoelectronic devices. In these applications, transfer of excited electrons from organic semiconductors to graphene can impact the overall device performance. Here, we propose a new mechanism in which the charge transfer rate can be controlled by varying the number of graphene layers and their stacking. Using organic semiconducting molecule as a light absorber, the charge transfer rate to graphene is measured using time-resolved photoemission spectroscopy. Compared to graphite, the charge transfer to monolayer graphene is about two times slower. Surprisingly, the charge transfer to A-B stacked bilayer graphene is slower than that to both monolayer graphene and graphite. This anomalous behavior disappears when the two graphene layers are randomly-stacked. The observation is explained by a charge transfer model that accounts for the band structure difference in mono- and bilayer graphene, which predicts that the charge transfer rate depends non-intuitively on both the layer number and stacking of graphene layers.

BIOGRAPHY



Dr. Chan was born in Hong Kong where he obtained his B. Sc. degree from the Chinese University of Hong Kong in 2001. He obtained both his M. S. and Ph. D. degree in materials science from Brown University in 2003 and 2007 respectively.

He was a postdoc researcher at University of Illinois, Urbana-Champaign (2007-2009) and then at University of Texas at Austin (2009-2012). In 2013, he became an Assistant Professor in the department of Physics and Astronomy at the University of Kansas. He has published more than 40 articles in peer-reviewed journals including Science, Nature Materials, Nature Chemistry, Physical Review Letters, Journal of the American Chemical Society, and Account of Chemical Research. His current research interests focus on studying ultrafast electronic processes in materials such as organic semiconductors, 2-dimensional crystals, and nano-materials for new generation energy applications.

Dr. Chan is a member of American Physical Society (APS), Materials Research Society (MRS). He obtained awards such as the NSF CAREER award, First Award from Kansas EPSCoR, and Graduate Student Silver Award from the Materials Research Society.

Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Mechanics and geometry in chiral structures: from nanohelices to bio-inspired structures

Zi Chen

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ABSTRACT

Mechanical forces play a key role in the shaping of versatile morphologies, especially chiral structures, in natural and synthetic systems. Helical structures in nature include DNA, lipid bilayers, cholesterol molecules, bacteria flagella, embryonic brain, heart and guts, and plant tendrils, spanning almost 9 orders of magnitudes in size. There have also been remarkable efforts in manufacturing helical nanostructures for applications in nano-elecromechanical systems, active materials, graphene devices, drug delivery, optoelectronics, and microrobotics. Here we study the relationships between mechanics and geometry in helical structures such as twisted ribbons that adopt similar shapes to helical seed pods, as well as embryonic chick brain.

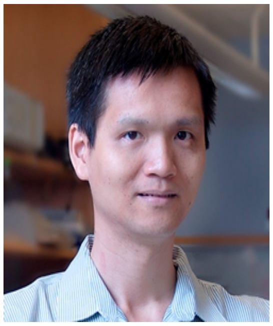
First, an elasticity theory combining differential geometry and stationarity principles is developed for the spontaneous bending and twisting of ribbons with tunable geometries in presence of mechanical anisotropy. Closed-form predictions are obtained from this theory with no adjustable parameters, and validated with simple, table-top experiments that are in excellent agreement with the theoretical predictions. Moreover, finite element simulations are performed to help interpret these findings and used as a powerful tool for designing versatile geometric shapes. We further investigate the shape transition and multistability that also arise in a number of physical systems, through both modeling and table-top experiments.

The study of large deformation and instability of chiral structures will facilitate understanding of morphology generation in natural and synthetic systems, and benefit the ongoing efforts in developing programmable micro-fabrication techniques and novel functional devices including active materials, nano-elecromechanical devices, drug delivery agents, and bio-inspired robots.

BIOGRAPHY

Dr. Zi Chen received a bachelor's and master's degree in Materials Science and Engineering from Shanghai Jiaotong University, and a PhD in Mechanical and Aerospace Engineering from Princeton University in 2012.

He is currently an Assistant Professor and Society in Science – Branco Weiss Fellow at Thayer School of Engineering at Dartmouth College. He was also a visiting scholar in Dr. Clifford Brangwynne's group at Princeton. Before joining Dartmouth, he worked as a postdoctoral fellow in Department of Biomedical Engineering at Washington University in St. Louis and a visiting scientist in Harvard School of Engineering and Applied Sciences at Harvard University. His research interests cover such diverse topics as mechanical instabilities of materials, energy



harvesting devices, stretchable electronics, biomimetic materials/devices, nanofabrication, mechanics of morphogenesis in biological systems, mechanical feedback mechanisms in biology, DNA mechanics, dislocation dynamics, and phase transitions.

Dr. Zi Chen has received a number of awards including Society in Science – Branco Weiss fellowship, Outstanding Paper Award at the ASME 2013 2nd Global Congress on NanoEngineering for Medicine and Biology (NEMB), American Academy of Mechanics Founder's Award, MRS Graduate Student Award Silver Award, etc. He is a founding co-Editor-in-Chief of Journal of Postdoctoral Research, and an editorial board member of Journal of Applied Mechanical Engineering and Journal of Material Science & Engineering. He is a member of ASME, BMES, TMS, and APS, and a fellow of Society in Science.

Technical Session D2-W3-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Nanjia Zhou

Camille and Henry Dreyfus Environmental Chemistry Fellow
School of Engineering and Applied Science
Harvard University

ABSTRACT

BIOGRAPHY

Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Woei-jyh (Adam) Lee

Tyser Teaching Fellow of Information Systems, Robert H. Smith School of Business
University of Maryland, College Park
(馬里蘭大學學院市分校史密斯商學院李偉智教授)

BIOGRAPHY

Dr. Woei-jyh (Adam) Lee received BSE degree from the National Taiwan University, MS degree from the Courant Institute at New York University, and PhD degree from the University of Maryland at College Park (UMD). He worked on distributed objects and fault tolerance at the AT&T Labs - Research in 1997. He focused on network software and management at the Bell Laboratories Research from 1998 to 2000. He visited the University of Southern California specializing in continuous media streaming and multimedia networking from 2002 to 2003.

He contributed in protein domain parsing and boundary prediction at the National Cancer Institute (NCI), National Institutes of Health (NIH) from 2004 to 2005. He was a fellow focusing on human genetics and genomics at the National Center for Biotechnology Information, National Library of Medicine, NIH from 2009 to 2012. He became a special volunteer working on computational modeling for cancer progression and metastatic at the NCI, NIH from 2012 to 2013. He was also affiliated with the Center for Bioinformatics and Computational Biology and the Institute for Advanced Computer Studies at UMD.

He is currently a faculty of Information Systems at the Robert H. Smith School of Business at UMD since 2012. His research interests include information integration, data analytics and mining, literature-based discovery, performance simulation and evaluation, bioinformatics and computational biology, human genomics and genetics, and cancer biology. He has two US Patents and is a member of the IAENG and the CAPA.

Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Bioinformatics Approaches for Functional Interpretation of Genome Variation

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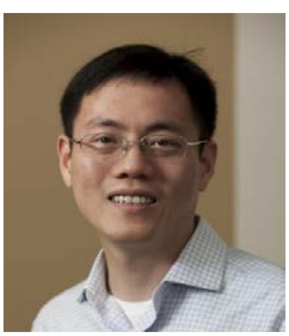
ABSTRACT

The research in our lab focuses on developing bioinformatics approaches for interpreting the functionality of genetic variants from genome sequencing data. We developed Phenolyzer, which analyzes user-supplied list of phenotype terms and assign the most likely candidate genes that are associated with the phenotypes, by integrating multiple sources of gene-pathway-disease-phenotype information. Phenolyzer has been integrated into wANNOVAR, a web server that analyzes genome sequencing data to find disease genes. Based on Phenolyzer, we also developed iCAGES (integrated CAncer GEnome Score), which is an effective tool for prioritizing cancer driver genes for a patient using genome sequencing data. iCAGES is implemented with Support Vector Machine (SVM) trained on somatic non-synonymous variants from COSMIC and UniProt databases, followed by a two-step ranking process to employ Phenolyzer-inferred information and genomic complexity of the cancer driver event. These tools will help researchers better understand the functional consequences of genetic variants in human diseases.

BIOGRAPHY



Dr. Kai Wang obtained a Bachelor's degree on biochemistry at Peking University (Beijing, China) in 2000, a master's degree on tumor biology at Mayo Clinic (Rochester, MN, USA) in 2002, and a Ph.D. on microbiology/bioinformatics at the University of Washington (Seattle, WA, USA) in 2005.

After getting Ph.D., he began to pursue postdoctoral training at the University of Pennsylvania and Children's Hospital of Philadelphia, working on genomic analysis of multiple human diseases, such as autism, type 1 diabetes, Crohn's disease and neuroblastoma. In 2010, he became an Assistant Professor at the Keck School of Medicine, University of Southern California (Los Angeles, CA, USA). His research focused on human genetics and genomics, especially bioinformatics methods development and application of next-generation DNA and RNA sequencing techniques.

Dr. Wang is a member of the American Society of Human Genetics. He is also a member of the editorial board in several scientific journals such as PLoS ONE, Scientific Reports, BMC Genomics. He has published over 100 scientific manuscripts, with over 10,000 citations. He developed PennCNV, one of the most widely used software tools to detect copy number variations from high-density SNP arrays, as well as ANNOVAR, one of the most widely used software tools for functional annotation of genetic variants from high-throughput sequencing data.

Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

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ABSTRACT

Causal mediation modeling has become a popular approach for studying the effect of an exposure on an outcome through mediators. Currently literature on mediation analyses with survival outcomes largely focused on settings with a single mediator and quantified the mediation effects on the hazard, log hazard and log survival time (Lange and Hansen 2011; VanderWeele 2011). In this paper, we propose a multi-mediator model for survival data by employing a flexible semiparametric probit model. We characterize path-specific effects (PSEs) of the exposure on the outcome mediated through specific mediators. We derive closed form expressions for PSEs on a transformed survival time and the survival probabilities. Statistical inference on the PSEs is developed using a nonparametric maximum likelihood estimator under the semiparametric probit model and the functional Delta method. Results from simulation studies suggest that our proposed methods perform well in finite sample. We illustrate the utility of our method in a genomic study of glioblastoma multiforme survival.

BIOGRAPHY

Yen-Tsung Huang earned a Doctor of Medicine degree from the National Taiwan University, Taiwan 2003, and Dual Degree of Doctor of Science in Epidemiology and Biostatistics at Harvard School of Public Health in 2012. He is currently an Assistant Professor of Epidemiology and Biostatistics in Brown University, Providence, RI. His research interests focus on cancer genomics, high-dimensional statistics, and molecular/genetic epidemiology. His methodology work is mostly on mediation analyses of high-dimensional data and its application to integrative genomics.

Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Cancer Genomics: when in silico research interact with in vivo experiments

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ABSTRACT

Oral squamous cell carcinoma (OSCC) is a prevalent form of cancer that develops from the epithelium of the oral cavity. OSCC is on the rise worldwide, and death rates associated with the disease are particularly high. Despite progress in understanding the mutational and expression landscape associated with OSCC, advances in deciphering these alterations for the development of therapeutic strategies have been limited. Further insight into the molecular cues that contribute to OSCC is therefore required. Here, we show that the transcriptional regulators YAP (YAP1) and TAZ (WWTR1), which are key effectors of the Hippo pathway, drive protumorigenic signals in OSCC. Regions of premalignant oral tissues exhibit aberrant nuclear YAP accumulation, suggesting that dysregulated YAP activity contributes to the onset of OSCC. Supporting this premise, we determined that nuclear YAP and TAZ activity drives OSCC cell proliferation, survival, and migration in vitro, and is required for OSCC tumor growth and metastasis in vivo. Global gene expression profiles associated with YAP and TAZ knockdown revealed changes in the control of gene expression implicated in protumorigenic signaling, including those required for cell cycle progression and survival. Notably, the transcriptional signature regulated by YAP and TAZ significantly correlates with gene expression changes occurring in human OSCCs identified by The Cancer Genome Atlas (TCGA), emphasizing a central role for YAP and TAZ in OSCC biology.

BIOGRAPHY

Education

PhD Penn State University, Cell and Developmental Biology May 2012

Dissertation: "CHROMATIN ORGANIZATION DURING YEAST MEIOSIS"
Advisor: Franklin Pugh, Hong Ma

BS Shanghai Jiao Tong University, Biotechnology July 2007

Research Experience

Boston University School of Medicine June 2012 -
Department of Medicine, Computational Biomedicine
Research Focus:

- Computational Cancer genomics and Biomedicine
  - Integrate multiple omics data to elucidate molecular mechanisms such as cancer immunotherapy and metastasis
  - Develop computational algorithm and pipeline for cancer genomics study

Publications

1. Samantha Hiemer, **Liye Zhang**, Vinay Kartha, Munirah Almershed, Stefano Monti, Maria Kukuruzinska, Xaralabos Varelas. A YAP/TAZ-regulated transcriptional signature associated with Oral Squamous Cell Carcinoma. Mol Cancer Research. 2015 Mar 20.(Epub)
2. Ho Sung Rhee, Alain R. Bataille, **Liye Zhang**, Benjamin F Pugh. Subnucleosomal Structures and Nucleosome Asymmetry Across a Genome. Cell. 2014 Dec 4;159(6):1377-1388
3. Inna Aphasizheva*,**Liye Zhang***, Xiaorong Wang, Robyn Kaake, Lan Huang, Stefano Monti and Ruslan Aphasizhev. RNA binding and core complexes constitute the u-insertion/deletion editosome. Mol Cell Bio. 2014 Dec 1;34(23):4329-42 * Co-first author.
4. **Liye Zhang**. Human Genome Sequencing in Disease Prevention and Treatment. Journal of Agricultural Biotechnology. 2013,21(1)
5. Jessica M. Bryant, Jérome Govin, **Liye Zhang**, Gregory Donahue, B. Franklin Pugh, Shelley L. Berger. The linker histone plays a dual role during gametogenesis in S. cerevisiae. Mol Cell Biol. 2012 Jul;32(14):2771-83
6. **Liye Zhang**, Hong Ma, Frank Pugh. Stable and dynamic nucleosome states during a meiotic developmental process. Genome Res. 2011 June 21: 875-884.
7. **Liye Zhang**, Zhu Chengguang, Zhang Xiaojun, Zhao Liping. Analysis of Gene Cassettes with Integrons from Biofilm Samples in Coking Wastewater and Phenol-degrading Bacteria. Chinese Journal of Applied & Environmental Biology, 2008 14(5): 644-649.
8. Zhu Chenguang, **Liye Zhang**, Zhao Liping. Molecular cloning, genetic organization of gene cluster encoding phenol hydroxylase and catechol 2,3-dioxygenase in Alcaligenes faecalis IS-46. World Journal of Microbiology and Biotechnology 2008 24: 1687-1695.

Technical Session D2-W1-T2: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

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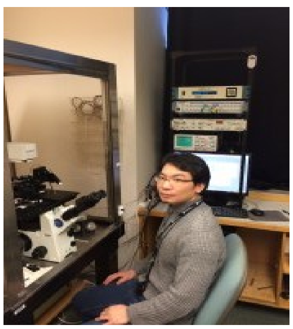
Research Fellow in Radiology
Brigham and Women's Hospital
Harvard Medical School

ABSTRACT

BIOGRAPHY



Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

Hsiang-Ying (Sherry) Lee

Postdoctoral Associate, Whitehead Institute for Biomedical Research
Massachusetts Institute of Technology
(麻省理工學院李湘盈博士)

BIOGRAPHY

Dr. Lee was born in Tainan, Taiwan. She received her B.S. in Medical Technology from National Cheng Kung University in Taiwan. She then came to U.S. to pursue her graduate studies. She has received her M.A. in Medical Sciences from Boston University and Ph.D. in Biomolecular Chemistry from University of Wisconsin-Madison in 2011.

She is currently a Postdoctoral Fellow in Whitehead Institute for Biomedical Research located at M.I.T.. With extensive training in biochemistry, molecular and cell biology, her research interests center around red blood cell biology. She has been conducting basic research to investigate how genetic network regulates red blood cell development, as well as translational research to develop red cell-based diagnostic and therapeutic tools.

Dr. Lee has been a member of Taiwan Society of Laboratory Medicine, American Society for Cell Biology and American Association for the Advancement of Science. She has also been involved in organizing events and serving communities including Boston Taiwanese Biotechnology Association, Monte Jade Science and Technology Association of New England and MIT Biology IAP. She is a Charles H. Hood Postdoctoral Fellow. Her research work was published in major bioscience journals including Nature, Molecular Cell and PNAS.

Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Chongli Yuan

Assistant Professor, Department of Chemical Engineering
Purdue University

ABSTRACT

BIOGRAPHY

Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Gang Han

Assistant Professor, Department of Biochemistry and Molecular Pharmacology
University of Massachusetts Medical School

ABSTRACT

BIOGRAPHY

Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Colloidal Gels as Biomaterials for Regenerative Medicine

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ABSTRACT

Colloidal gels, a novel class of hydrogels that allow for a “bottom-up” approach for the design of biomaterials by employing biopolymer particles as building blocks, have recently emerged as an intriguing concept in regenerative medicine. These gels exhibit properties superior to traditional bulk scaffolds, including i) accurate control over scaffold’s properties, ii) strong capacity for controlled delivery of biomolecules, and iii) physically crosslinking particulate network. Importantly, the micro-architecture of colloidal gels is in line with the construction of human tissues that can be regarded as hierarchically organized cellular constructs, characterized by a complex microstructure based on assembly of building blocks made of cells and extracellular matrix. Inspired by this concept, the current research aims to develop a class of innovative, biomimetic colloidal gels by employing mesenchymal stem cells and alginate microgels as building blocks, to create 3D cellular constructs with complex structure and tissue-specific function. Hereby, single cell-encapsulated microgels are prepared by microfuildic technique, which allows for high cell viability, high throughput production of cell-laden microgels, and preparation of multicompartment microgels as multifunctional cell carriers. By introducing strong interparticle bindings using click-chemistry, self-assembly and gel formation based on single cell contained microgels. Such cellular structures show great potential for engineering 3D tissue constructs that can steer cell fate and induce tissue regeneration.

BIOGRAPHY

Place and date of birth:
China, Dec. 1st, 1980

Education:

Ph.D. (2009 - 2013) in Medical Science: Radboud University Nijmegen Medical Center, Nijmegen, the Netherlands
Ph.D. (2004 - 2009) in Biomedical Engineering: Sichuan University, China
B.Sc. (1999 - 2003) in Materials Science and Engineering: Sichuan University, China

Working experience:
Postdoctoral Research Fellow (2014-present): School of Engineering and Applied Science, Harvard University
Postdoctoral Research Fellow (2013-2014): Harvard-MIT division of Health Sciences and Technology, Harvard Medical School

Featured publications:

H. Wang, M.B. Hansen, D.W.P.M. Löwik, J.C.M.v. Hest, Y. Li, J.A. Jansen, S.C.G. Leeuwenburgh, Oppositely charged gelatin nanospheres as building blocks for injectable and biodegradable gels. Advanced Materials 2011. 23(12): H119-124.
H. Wang, Y. Li, Y. Zuo, J. Li, S. Ma, L. Cheng. Biocompatibility and osteogenesis of biomimetic nano-hydroxyapatite/polyamide composite scaffolds for bone tissue engineering. Biomaterials. 2007;28:3338–3348. (cited 200+ times)
H. Wang, O.C. Boerman, Y. Li, J.A. Jansen, S.C.G. Leeuwenburgh. Comparison of micro- vs nano-structured colloidal gelatin gels as injectable delivery vehicles for osteogenic proteins-bone morphogenetic proteins-2 and alkaline phosphatates. Biomaterials. 2012. 33: 8695-8703.

Awards:

Best PhD Thesis Award, the Netherlands Society of Biomaterials and Tissue Engineering, the Netherlands (2013)
Nominated award of National Excellent Doctorial Dissertation, China (2011)
Top 50 Highly Cited Articles (2006-2011) Award, the journal of Biomaterials (2011)

Dr. Huanan Wang received his Bachelor and Doctor Degree in Biomedical Engineering in Sichuan University in China, and his second Doctor degree in Medical Sciences in Radboud University Nijmegen Medical Center, the Netherlands in 2013. Thereafter, he was awarded a Rubicon fellowship by the Netherlands Organisation for Scientific Research (NWO), which supported him to continue his postdoctoral research in Harvard University in USA. His research interest included colloid-based hydrogels for controlled delivery and tissue regeneration, micro-fabrication of microgels using microfluidics for biomedical applications, and polymer/ceramic composites for skeleton tissue engineering. So far, he has published more than 30 scientific articles and book chapters, with citation of more than 900 times till 2015, and H-index = 15. His pioneer works in developing functional biomaterials for applications in regenerative medicine has opened a totally new conceptional research line in his research field. Moreover, his work has been internationally recognized by many awards including the Best PhD Thesis awards of the Netherlands Society of Biomaterials and Tissue Engineering, Top50 mostly cited article award from the journal of Biomaterials, Nomination award of National excellent doctoral dissertation in China.

Technical Session D2-W2-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

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ABSTRACT

BIOGRAPHY

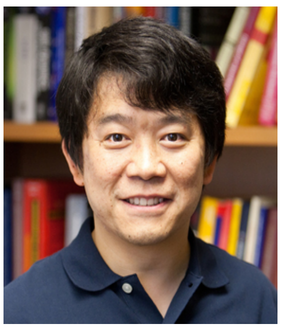
Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

Jung-Tsung Shen

Assistant Professor, Department of Electrical & Systems Engineering
Washington University in St. Louis
(聖路易華盛頓大學電機暨系統工程學系沈榮聰教授)

BIOGRAPHY



Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Development of Membranes for H2 Purification and CO2 Capture: From Material Molecular Engineering to Technology Commercialization

Haiqing Lin

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ABSTRACT

Growing evidence indicates that the CO_2 emissions from the combustion of fossil fuels are contributing to global climate change. One approach to controlling CO_2 emissions to the atmosphere is carbon capture, utilization and sequestration (CCUS) from large point sources, such as H_2 and power plants. Pre-combustion capture from syngas has been considered as an economically viable route. In this scheme, gasification of fossil fuels produces syngas, which is further converted to CO_2 and H_2. The CO_2 is removed and captured prior to H_2 utilization for refinery hydrogenation reactions or combustion in the power plant turbines.

Membrane technology is an attractive approach to H_2 purification and CO_2 capture because of inherent advantages such as high energy efficiency. This presentation will systematically examine the need of membrane technology as a low-cost and energy-efficient separation technology enabling the CCUS via pre-combustion route. I will discuss how we rationally design polymeric membrane materials to achieve the combination of high CO_2 permeability and high CO_2/H_2 selectivity. More specifically, this talk will discuss the molecular engineering of poly(ethylene oxide) (PEO) containing polymers for improvement in mixed-gas CO_2/H_2 separation performance. Interestingly, these materials exhibit unconventional increase in mixed-gas CO_2/H_2 selectivity as CO_2 feed partial pressure increases. This talk will also provide a glimpse of how the molecular understanding in membrane material science can be translated to large scale membrane product to solve practical problems. Three phases of technology development will be described, laboratory concept proving, small scale field testing, and complete system demonstration. The economics of membrane process will be discussed.

BIOGRAPHY

Haiqing Lin received his B.S. (1996) and M.S. (1999) in Chemical Engineering from Xiamen University, China. He receives M.S. (2001) from North Carolina State University and Ph.D. from the University of Texas, Austin, both in chemical engineering. He served a stint at Membrane technology and Research, Inc. (MTR) as a Senior Research Scientist and Group Leader of the Gas Separations Group. Currently, he is an Assistant Professor at the Department of Chemical and Biological Engineering at University at Buffalo (SUNY). Dr. Lin's research focuses on the study of advanced polymer-based membrane materials and processes for gas and vapor separation and water purification, with an end goal of solving practical problems and advancing fundamental understanding of structure-property correlation. He is the coauthor of 33 publications, and is listed as co-inventor on eight US patents and applications. Dr. Lin received Distinguished Alumni Award from the Department of Chemical Engineering at Xiamen University in 2011, and University of Texas CO-OP Research Excellence Award for Best Research Paper in 2006.

Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Rational Design of Cathodes for Rechargeable Li-S and Li-O2 Batteries

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ABSTRACT

As the petroleum resources are being depleted and concern on the environmental pollution increases, electric vehicles (EVs) and renewable energies like solar and wind are becoming highly desirable. It is a big challenge to develop electrical energy storage systems that can meet the rigorous requirements on the weight and volume in EVs, and cycle life and efficiency for grid energy storage. Lithium-ion (Li-ion) batteries, representing the highest energy density battery chemistry, are believed to be one of the most promising systems for these applications. However, the capacities in the current cathode materials have reached their limits of <250 mAh/g. To further increase the energy density of Li-ion batteries, alternative high capacity cathode materials are being actively developed.

Sulfur and oxygen, two abundant elements on earth, are promising cathode materials with high theoretical capacities by taking two electrons per sulfur atom or oxygen molecule. The high capacities can significantly enhance the energy density of batteries. However, the rechargeable lithium-sulfur (Li-S) and lithium-oxygen (Li-O2) batteries are impeded by several technical challenges, such as poor cycle life and low electrochemical utilization of active material in the cathodes. This presentation will focus on a number of strategies that have been developed to overcome these problems, e.g., lithium-dissolved polysulfide cells and lithium sulfide cathodes in Li-S batteries, and lithium peroxide (Li2O2) cathodes in Li-O2 batteries.

BIOGRAPHY

Dr. Fu obtained his B. E. (2000) and M. S. (2003) in chemical engineering from Tsinghua University and Dalian Institute of Chemical Physics, respectively, in China, and Ph.D. in materials science and engineering from the University of Texas at Austin (UT-Austin) in 2007. He was a Chemist Postdoctoral Fellow at Lawrence Berkeley National Laboratory, Research Scientist at Lynntech, Inc., and Research Associate at UT-Austin before joining Indiana University-Purdue University Indianapolis (IUPUI) as an Assistant Professor in 2014. He has published over 45 peer-reviewed journal papers in leading scientific journals, such as Angew. Chem., J. Am. Chem. Soc., Adv. Energy Mater., Nat. Commun., and Acc. Chem. Res. Dr. Fu holds 1 U.S. patent on proton-conducting membranes and 2 pending U.S. patents on lithium-sulfur batteries. His current research efforts focus on the development of new materials including ion-conducting electrolytes and ion-storage electrodes for electrochemical energy storage and conversion devices, and the study of materials' structure-property-performance relationship through advanced material and electrochemical characterization.

Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Dielectric Elastomers for Optics and Soft Robotics

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ABSTRACT

The similarity of elastomer's mechanical properties, for instance low elastic modulus and large strain capability, as human skin, has driven considerable interest in using the elastomers, in particular dielectric elastomers, as artificial muscles for multitude of applications including soft-robotics. Dielectric elastomers are essentially soft capacitors that deform in response to the electrostatic attraction between opposing charges upon application of voltage. The direct coupling between electric field and mechanical deformation has several attractive performances including giant deformation in the order of hundreds of percent of areal strain, fast response, and high energy density. To exploit these advantages, however, the deformation mode, the flow of electrical charges, and electro-mechanical properties of the elastomer and the electrodes need to be controlled and tailored, depending on the applications. In this talk I will show strategies in controlling and exploiting the deformation of elastomer for creating functional devices for optics and soft robotics applications. For optics applications, the use of transparent electrodes enables fabrication of transparent actuators that can be directly used in the light path, resulting in compact and fast light modulators, such as tunable lenses and smart windows. For soft robotics, the use of few stiff fibers enable control of deformation, in particular to break the symmetry of equi-biaxial lateral strain in the absent of pre-stretch and create novel designs for gripping actuators.

BIOGRAPHY

Samuel Shian is a Research Associate at the Harvard John A Paulson School of Engineering and Applied Sciences. He earned his bachelor degree from Bandung Institute of Technology in Indonesia, master degree from the Ohio State University, and doctoral degree from Georgia Institute of Technology. At Georgia Tech, Samuel focused on processing and characterization of functional ceramics derived from silica bio-templates, such as diatoms, and studied biomineralization processes for synthesizing functional oxides directly using biomolecules. At Harvard, in addition to working on soft electroactive materials, he is developing functional ceramics for next-generation thermal barrier coating materials. His research interests include bioinspired materials and devices, high-temperature structural ceramics, smart and multifunctional materials, and energy harvesting devices.

Technical Session D2-W3-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Design Principles for Superionic Conductors in Solid-state Lithium Batteries

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ABSTRACT

Solid-state batteries have been developed rapidly due to their promising applications in safe, high-density energy storage technologies. Development of lithium superionic conductors with high conductivity and low activation energy is the most essential part in all solid-state lithium batteries. Significant progress has been made recently with discoveries of various superionic Li-ion solid electrolytes having ionic conductivity comparable with liquid electrolytes, but an in-depth understanding of the factors governing ionic diffusion properties in these materials was lacking. In this talk I will present our recent advances in revealing fundamental relationship between crystal structure and ionic transport in fast Li-ion conductors using first-principles modeling based on density functional theory. Our study highlights the critical influences of the anion-hosted matrix on the ionic conductivity. The findings not only provide valuable insights towards the understanding of ionic transport in discovered Li-ion conductors, but also serve as a design principle for the future discovery of new conducting materials for Li-ion batteries.

BIOGRAPHY

Yan Wang was born in 1983 in Huangshi, Hubei province, China. He received his B.S. in Mathematics and Physics from Tsinghua University in 2004, and obtained his Ph.D. from Institute of Physics, Chinese Academy of Sciences in 2009. From 2009 to 2013, he worked as a Postdoctoral Associate at the Physics department of University of Florida. Since 2013 he became a Senior Postdoctoral Associate at the Department of Materials Science and Engineering, Massachusetts Institute of Technology, and Program Manager for the Samsung-MIT Alliance in Materials Design for Energy Applications.

Dr. Wang's research integrates physics, chemistry and computer science for materials design. His interest includes electronic structure and spin-dependent transport in spintronics and molecular-electronics materials, computational materials design for energy applications with a focus on all solid-state Li-ion batteries.

Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Chen-Hsiang (Jones) Yu

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Tel: +1 617.989.4288
E-mail: yuj6@wit.edu

Founder and CEO, Prentice Lab LLC
E-mail: jones.yu@prentice-lab.com
(Prentice Lab 余禎祥博士)

BIOGRAPHY

Jones Yu is an Assistant Professor of Computer Science and Networking at Wentworth Institute of Technology (WIT). He earned B.Eng. and M.S. in Computer Science and Information Engineering (CSIE) from Tamkang University in 1998 and from National Taiwan University in 2000, respectively, and Ph.D. in Computer Science from MIT under Prof. Rob Miller's guidance in 2012. His research in Human-Computer Interaction (HCI) focuses on web customization and automation, readability enhancement, and mobile learning.

He is also founder and CEO of Prentice Lab, which is a technology company focusing on designing algorithms and developing software for improving learning, including language learning and subject learning. In the past, he has worked for a few startup companies as Director of Mobile Engineering and User Experience, and developed mobile apps as products.

Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Change-point models for detecting aberrant gene expression patterns in cancers

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ABSTRACT

In cancer cells, the protein products of oncogenes can be overexpressed without alteration of the proto-oncogene but with shorter 3' untranslated regions (UTRs). During the past few years, RNA-seq has matured as a powerful tool for characterizing gene expressions because of its affordable cost and highly accurate digital resolution. For cancer study, the introduction of RNA-Seq technology, equipped with new analytic methods, makes it possible to capture aberrant shortening or lengthening expression patterns of oncogenes.

Change-point models are a classical approach to determine whether a change has taken place and where the changes occur. In this talk I will introduce change-point models for detecting aberrant gene expression patterns. We develop appropriate parametrical models for characterizing RNA-seq data. In the multiple-testing framework, we will introduce Type I error control and testing efficiency issues for pattern recognition. The numerical performances of the approaches will be illustrated using both simulation study and applications to real cancer data.

BIOGRAPHY

Zhi Wei receives his M.S. (2004) from the Rutgers University-New Brunswick Ph.D. and Ph.D. (2008) from the University of Pennsylvania. Currently he is an associate professor at the Department of Computer Science, New Jersey Institute of Technology. His research interests include multiple testing, statistical modelling, machine learning and data mining with applications to Bioinformatics and genetics. His recent research focuses on developing statistical models and data mining algorithms for analysis of high dimensional data. His research is funded by the National Institutes of Health, Department of Defense, the Pheo Para Alliance, the Henry M. Jackson Foundation, and the Robert Mapplethorpe Foundation. His methodology works have been published in prestigious journals and conferences including JASA, Biometrika, AJHG, AOAS, Bioinformatics, Biostatistics, PLoS Genetics, NAR and NIPS. He is an editorial board member of PLoS ONE, Frontiers in Bioinformatics and Computational Biology, and Frontiers in Applied Genetic Epidemiology.

Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Testing for equality of variance with application to DNA methylation data

Weiliang Qiu

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ABSTRACT

Epigenetics could regulate gene expression by adding a methyl group to DNA, the process of which is called DNA methylation. DNA methylation can inhibit gene expression. Variable DNA methylation has been associated with cancers and many complex diseases, such as cancers, cardiovascular diseases and diabetes. High-throughput DNA methylation platforms could measure methylation levels of hundreds of thousands of DNA methylation marks. Hence researchers could detect differentially methylated DNA methylation marks in whole genome scale. Recently, researchers found that differentially variable DNA methylation marks could also have biological meanings. A couple of new methods have been proposed to detect differentially variable DNA methylation marks, which are robust to the violation of normality assumption in testing for equality of variability. In this talk, we present the results of systematic simulation studies that compared the performance of these new methods with existing robust methods.

BIOGRAPHY

Weiliang Qiu received his B.S. (1996) in Applied Mathematics and M.S. (1999) in Statistics from Beijing Polytechnic University, Beijing China. He received his Ph.D. in Statistics (2004) from the University of British Columbia at Vancouver, Canada, and was a postdoctoral research fellow at Channing Laboratory between 2004 and 2006. Currently he is an Assistant Professor of Medicine, a faculty member of Brigham and Women's Hospital/Harvard Medical School. Dr. Qiu's research interests include using biostatistical and holistic approaches to uncover the relationships between environmental, genetic, and epigenetic factors and complex diseases to facilitate the personalized prevention, diagnosis, and treatment of complex diseases. He has (co-)authored over fifty peer-reviewed papers. Dr. Qiu has strong computer computing skills and has contributed several software packages to R/Bioconductor websites.

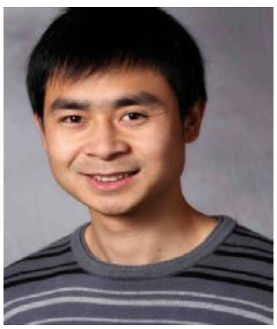
Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Qiang Liu

Assistant Professor, Department of Computer Science
Dartmouth College

ABSTRACT

BIOGRAPHY



Technical Session D2-W1-T3: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Han Xu

Research Scientist
Broad Institute of MIT and Harvard

ABSTRACT

BIOGRAPHY

Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

Hsiang-Ying (Sherry) Lee

Postdoctoral Associate, Whitehead Institute for Biomedical Research
Massachusetts Institute of Technology
(麻省理工學院李湘盈博士)

BIOGRAPHY

Dr. Lee was born in Tainan, Taiwan. She received her B.S. in Medical Technology from National Cheng Kung University in Taiwan. She then came to U.S. to pursue her graduate studies. She has received her M.A. in Medical Sciences from Boston University and Ph.D. in Biomolecular Chemistry from University of Wisconsin-Madison in 2011.

She is currently a Postdoctoral Fellow in Whitehead Institute for Biomedical Research located at M.I.T.. With extensive training in biochemistry, molecular and cell biology, her research interests center around red blood cell biology. She has been conducting basic research to investigate how genetic network regulates red blood cell development, as well as translational research to develop red cell-based diagnostic and therapeutic tools.

Dr. Lee has been a member of Taiwan Society of Laboratory Medicine, American Society for Cell Biology and American Association for the Advancement of Science. She has also been involved in organizing events and serving communities including Boston Taiwanese Biotechnology Association, Monte Jade Science and Technology Association of New England and MIT Biology IAP. She is a Charles H. Hood Postdoctoral Fellow. Her research work was published in major bioscience journals including Nature, Molecular Cell and PNAS.

Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Twisting mice move the dystonia field forward

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ABSTRACT

DYT1 dystonia, the most common form of the primary dystonia, is an autosomal dominant inherited disease that manifests as involuntary twisting movements in childhood. This movement disorder, reflecting selective dysfunction of CNS motor circuits, is caused by a deletion mutation that removes a single glutamic acid from torsinA ("ΔE-torsinA"). Although torsinA is broadly expressed, only ~30% of DYT1 mutation carriers (TOR1AΔE/+) develop symptoms. The phenotypic consequences of this mutation are also highly variable, even between siblings, ranging from clinically silent to profound dystonia causing severe disability, suggesting the importance of additional factors for disease progression. Lack of a preclinical model of primary dystonia that exhibits dystonic-like twisting movements has stymied identification of the cellular and molecular underpinnings of the disease. Our recent study indicates that conditional CNS ablation of torsinA or isolated CNS expression of ΔE-torsinA in neural progenitor cells cause striking abnormal twisting movements, establishing torsinA loss-of-function (LOF) as a key pathogenic mechanism. These animals exhibited peri-nuclear accumulation of ubiquitin and the E3 ubiquitin ligase HRD1 in discrete sensorimotor regions, followed by neurodegeneration. Similar to the neurodevelopmental onset of DYT1 dystonia in humans, the behavioral and histopathological abnormalities emerged and became fixed during CNS maturation in the murine models. Our research establishes a genetic model of primary dystonia that is overtly symptomatic, and links torsinA hypofunction to neurodegeneration and abnormal twisting movements. These findings provide a cellular and molecular framework for how impaired torsinA function selectively disrupts neural circuits and raise the possibility that discrete foci of neurodegeneration may contribute to the pathogenesis of DYT1 dystonia. Our more recent in vivo studies have begun to identify novel molecular factors that determine both the timing and neural selectivity of torsinA-related toxicity.

BIOGRAPHY

Dr. Liang received his early education in Taichung city till he pursued a bachelor degree in Agricultural Chemistry at National Taiwan University. During his college years, Dr. Liang found his passion in biomedical sciences. After severing his country as a military training officer for 2 years, Dr. Liang decided to devote himself to the field of cancer research to begin his career. He studied cell motility and metastasis, and published two first-authorship research articles while he was employed as a research assistant at National Chung Hsing University. In 2002, Dr. Liang went to Cornell University to enroll a PhD program and earned his terminal degree in Comparative Biomedical Sciences in 2009. During this studying period, Dr. Liang established a protocol, in-vitro scratch assay, which has been widely adopted in various fields to analyze cell motility and become a highly cited publication (~100 times/year).

Since 2007, Dr. Liang has been focusing on the pediatric neurological diseases, particularly in neurodegenerative movement disorders. He conducted a project of fetal alcohol spectrum disorders at the Rockefeller University and several research plans of primary dystonias at the University of Michigan for his postdoctoral training. He is currently a research faculty in the Department of Neurology. He studies the molecular mechanisms underlying the pathogenesis during CNS development. Several of his recent publications have linked the aberrant protein homeostasis to the developmental neurodegeneration in the motor system. In 2014, his research generated the first genetically engineered DYT1 dystonia mouse model, accurately mimicking human dystonia symptoms such as patterned twisting and fixed postures in the limbs, since the identification of the disease mutation (ΔE-torsinA) in 1997. American Neurological Association invited him to present this exciting scientific breakthrough in the Derek Denny-Brown Young Neurological Scholar symposium.

Dr. Liang is a current member in Society of Neuroscience, American Neurological Association, and American Society for Cell Biology. He also serves as a scientist committee member in the University Committee on Use and Care of Animals at the University of Michigan.

Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

NMDAR signaling in cancer: regulation by a polymorphic modifier gene and the tumor microenvironment

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ABSTRACT

Cancer invasion and metastasis are likely the most complicated hallmark of cancer. Our laboratory utilizes transgenic mouse models to dissect mechanisms of cancer progression, with particularly focus on the genetic regulation of invasion and metastasis. Using genetic linkage analysis, we identified a chromosome locus to be associated with tumor invasion in the RIP1Tag2 mouse model of pancreatic neuroendocrine tumor (PanNET). More than fifty genes are located on this locus. Basing on their expression patterns between tumors from the invasive and non-invasive mouse strain backgrounds, seven genes were proposed as potential "invasion modifiers". Among these, one pro-invasion modifier gene is known as a major scaffold protein of the NMDA receptor.

NMDA receptor pathway is a crucial signaling pathway in the central nervous system, and plays a major role in learning and memory; its role in other cell types besides neuron is less explored. Unexpectedly, we found NMDA receptor pathway to be activated in mouse PanNETs as well as in various other types of cancer to promote tumor growth and invasion. Moreover, NMDA receptor signaling in cancer could be both modified by the aforementioned modifier gene, and regulated by interstitial fluid pressure and flow omnipresent in the tumor microenvironment. Therefore, targeting this pathway may provide therapeutic benefits in selected cancer patients.

BIOGRAPHY

Leanne Li received her M.D. (2008) from National Taiwan University and Ph.D. (2014) in Molecular Life Science from École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland. She is currently a postdoctoral fellow at the Koch Institute, MIT. She is interested in translational research using genetically engineered mouse models, which facilitate dissecting mechanisms of cancer progression and performing preclinical trials. In Dr. Douglas Hanahan's laboratory in EPFL, she studied the interaction between genetic polymorphism and tumor microenvironment in pancreatic cancer. Currently, she is investigating how tumor heterogeneity contributes to lung cancer metastasis in Dr. Tyler Jacks' laboratory at MIT. Dr. Li is a recipient of the Junior Debiopharm Life Science Award in 2013, and the Pfizer Research Award in the field of Oncology in 2014.

Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Photostick: a method for selective isolation of target cells from culture

Miao-Ping Chien

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ABSTRACT

Sorting of target cells from a heterogeneous pool is technically difficult when the selection criterion is complex, e.g. a dynamic response, a morphological feature, or a combination of multiple parameters. At present, mammalian cell selections are typically performed either via static fluorescence (e.g. fluorescence activated cell sorter), via survival (e.g. antibiotic resistance), or via serial operations (flow cytometry, laser capture microdissection). Here we present a simple protocol for selecting cells based on any static or dynamic property that can be identified by video microscopy and image processing. The "photostick" technique uses a cell-impermeant photochemical crosslinker and digital micromirror arraybased patterned illumination to immobilize selected cells on the culture dish. Other cells are washed away with mild protease treatment. The crosslinker also labels the selected cells with a fluorescent dye and a biotin for later identification. The photostick protocol preserves cell viability, permits genetic profiling of selected cells, and can be performed with complex functional selection criteria such as neuronal firing patterns.

BIOGRAPHY

Miao-Ping Chien obtained her B.C and Master degrees from Taiwan and received her Ph.D from UC San Diego in the Department of Chemistry and Biochemistry, studying stimuli-responsive smart materials for drug delivery. She is currently a post-doctoral research fellow in the Cohen lab at Harvard University, focusing on selective isolation of target cells and deterministic cell patterning by chemical and optical methods. From her training background and experience, she is an interdisciplinary scientific fellow including biologist, molecular biologist, bioorganic chemist, and material scientist and biophysician.

Miao-Ping Chien has been the recipient of several prestigious awards and fellowships, among which the Martin Kamen Prize, the Inamori Research fellowship, the ACS award for excellence in Graduate polymer research and the UCSD outstanding dissertation award. Most recently she was awarded a Life Research Foundation fellowship. She is also a co-PI on two patents.

List of experience, awards and publications

A. PROFESSIONAL MEMBERSHIPS AND EXPERIENCE

2014-present Reviewer of Journal of American Chemical Society
2012-present American Physical Society
2012-present UC San Diego Chapter of the Bouchet Graduate Honor Society
2009-present American Chemical Society

B. AWARDS AND HONORS

International and Professional Society
2015 Life Sciences Research Foundation fellowship, by Life Sciences Research Foundation
2014 Martin D. Kamen prize; Outstanding thesis award
2013 Inamori Graduate Research Fellow; by Inamori Foundation
2013 Outstanding Graduate Research Presentation Award; American Chemical Society POLY

Symposium
2013 ACS Award for Excellence in Graduate Polymer Research; American Chemical Society

At UCSD
2014 Outstanding Dissertation Award
2012 Teddy Traylor Graduate Research Award
2012 UCSD Travel Award
2012 Taiwan Study Abroad Graduate Research Fellowship; Taiwan National Award
2012 UC San Diego Chapter of the Bouchet Graduate Honor Society
2010 Poster & Presentation Award; Biochemistry Retreat

In Taiwan
2006 Outstanding Thesis Award; Annual Thesis Competition, National Yang-Ming University

C. PATENTS

1.SD2010-007 (PCT application pending): Method for Synthesizing Smart Materials Capable of Programmed Shape Change: PIs: Gianneschi, Chien

2. H0824.70201US00: Optical selection of cells: PIs: Cohen, Chien

D. PUBLICATIONS

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2. Werley, C.A.*, **Chien M.P.***, Alex. E., Cohen, A.E. “Island-size dependent cardiac maturation.” In preparation (*joint first author)

3. Proetto M.T., Rush A.M., **Chien M.P.**, Baeza P.A., Thompson M.P., Olson N.H., Andolina C., Millstone J., Moore C.E., Rheingold A.L., Howell S.B., Browning N.D., Evans J.E., Gianneschi N.C. “Transmission Electron Microscopy of a Synthetic Soft Material in Liquid Water.” J Am Chem Soc. 2014 Jan 29;136(4):1162-5.

4. **Chien M.P.,** Hu D., Barback C.V., Rush A.M., Orr G., Hall D.J., and Gianneschi N. C. “Enzyme-Directed Assembly of Nanoparticles in Tumors Monitored by In Vivo Whole Animal and Ex Vivo Super Resolution Fluorescence Imaging.” J Am Chem Soc. 2013 Dec 18;135(50):18710-3.

5. **Chien M.P.,** Thompson M.P., Ku T.H., Barback C. and Gianneschi N. C. “Enzyme-Directed Assembly of a Nanoparticle Probe in Tumor Tissue.” Advanced Materials. 2013, DOI:

10.1002/adma.201300823

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Technical Session D2-W2-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

A CRISPR view of genome editing

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ABSTRACT

Genome editing is the process of inserting, replacing, or removing the DNA sequences that make up the code of life. The ability to decode and edit the DNA of various organisms holds enormous promise for science, medicine, and biotechnology. As our ability to “read” DNA becomes faster and cheaper with advanced sequencing technologies, we need tools that allow us to easily “write” the genome to fully utilize that knowledge.

Two years ago, our lab harnessed an adaptive immune system from the bacterium Streptococcus pyogenes and repurposed it for editing the mammalian genome. This has enormously reduced the time and costs required for making mutations in cells and creating novel model organisms, allowing scientists to better study the function of genes and mutations by systematically perturbing them. This talk will be an overview of key aspects of the system that have enabled the 'CRISPR revolution’, describe exciting recent applications using CRISPR, and outline what impact this will have on animal modeling of diseases, gene therapy, and other clinical challenges.

BIOGRAPHY

Winston received his bachelor’s degree magna cum laude with high honors in physics from Harvard University in 2010. He is currently an MD/PhD student at Harvard Medical School and MIT in the Health Sciences and Technology (HST) Program, as well as Paul & Daisy Soros Fellow, working in the research group of Professor Feng Zhang at the Broad Institute/MIT.

In expanding the CRISPR-Cas genome engineering toolbox, Winston hopes to develop more sophisticated in vivo models of human disease (in particular neuropsychiatric and neurodegenerative diseases) and pave the way towards therapeutic applications of genome engineering. Recently, he and his colleagues developed a smaller Cas9 protein that makes the system readily packaged into therapeutically-relevant viral vectors, and demonstrated efficient gene editing in adult animals (Ran, Cong, Yan et al., Nature 2015), opening the door for rapid genetic perturbations in model organisms and opportunities for gene therapy.

Outside of research, Winston is engaged in an online neuroscience course that strives to push the boundaries of online education. MCB80x (www.mcb80x.org) is an introduction to neuroscience that uses rich interactive experiences, fun presentations, field-trips, and do-it-yourself experiments to make a more engaging and completely different educational experience.

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

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BIOGRAPHY

Shien-Ping Feng (another name is Hsien-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 Hong Kong University. 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 electrochemical processing and interfacial characterization of nanostructured materials, and their applications on energy conversion and storage.

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Rapid Atmospheric-Pressure-Plasma Processed Nanomaterials for Dye-Sensitized Photovoltaic Cells

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ABSTRACT

Dye-sensitized photovoltaic cells possess the advantages of low-cost and environmental friendliness. The key components of a typical dye-sensitized photovoltaic cell include a dye-adsorbed nanoporous TiO2 photoanode, an electrolyte with a redox couple, and a counter electrode for reduction of redox species. The fabrication of photoanodes and counter electrodes usually involves high-temperature furnace calcination processes. To lower the thermal budget for device fabrication, reducing the processing time is highly desirable. In this study, an ultrashort process was developed for the fabrication of photoanodes and counter electrodes of dye-sensitized photovoltaic cells by using an atmospheric pressure plasma jet (APPJ) technology. Owing to the synergistic effect of the temperature and the reactivity of the plasma jet, comparable cell performance was successfully demonstrated when the conventional furnace calcination processes for the nanoporous TiO2 photoanodes and solution-processed counter electrodes were replaced by ultrashort N2 APPJ treatments. To determine the endpoint of the APPJ treatment, optical emission spectroscopy analysis was carried out during the process.

For photoanode fabrication, APPJ treatments as short as 1 to 2 min were successfully used to sinter the nanoporous TiO2 layer, to simultaneously deposit particulate TiO2 scattering layer along with the sintering process, and to produce a dual-scale porous TiO2 layer from a mixture of TiO2 nanoparticle paste and NaCl solution. For catalytic counter electrode fabrication, APPJ processes with treatment durations of 1 min, 11 sec, 5 sec have been applied to facilitate the formation of Pt nanoparticles, reduced graphene oxide foams, and carbon nanotube – TiO2 composites from solution-processed precursor films. In particular, we observed the morphology of the carbon-based material could be modified by the APPJ treatment, by which the catalytic activity of the carbon nanomaterial-based counter electrode could be enhanced. This new methodology reduces the processing time and thermal budget, providing a facile approach for cost-effective dye-sensitized photovoltaic cell production.

BIOGRAPHY

I-Chun Cheng received the B.S. and M.S. degrees in mechanical engineering from the National Taiwan University in 1996 and 1998, respectively. In 2004, she received a Ph.D. degree in electrical engineering from Princeton University. She was with the Macroelectronic Lab of Princeton University from 2004 to 2007 as a postdoctoral research associate, working on novel silicon thin-film devices and backplane technology for flexible displays. In 2007, she joined the Department of Electrical Engineering and Graduate Institute of Photonics and Optoelectronics at the National Taiwan University, where she is now an Associate Professor. Her current research interests include oxide-semiconductor thin-film technology, electrochemical photovoltaic devices and flexible large-area electronics. She is a member of the Institute of Electrical and Electronics Engineers (IEEE), Material Research Society (MRS), and Electrochemical Society (ECS). She has published over 70 journal articles, more than 150 conference papers and 5 book chapters and co-authored a book.

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Characterization of Nanofluidic Transport Using Hybrid Nanochannels

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ABSTRACT

Liquid and vapor transport through nanoscale conduits, which is typically referred to as nanofluidic transport, is critical in a variety of applications, including energy conversion/storage, water desalination, phase-change thermal management, biological and chemical separations, and lab-on-a chip devices. However most of the nanofluidic transport has remained poorly understood and characterized due to the lack of accurate measurement techniques that can quantify ultra small flow rates at the nanoscale. Current membrane-based measurement techniques suffer from possible leakage from defects and boundaries as well as inaccurate quantification due to pore size and length non-uniformity.

In this talk, I will first present a novel hybrid nanochannel design that can be used as a universal platform for characterizing nanofluidic transport in single nanoscale conduits. I will then discuss our recent studies on two elusive nanofluidic transport using this hybrid channel design, including water transport in hydrophilic nanochannels and kinetic limited capillary evaporation, i.e. the maximum vapor transport from nanoscale liquid/vapor interfaces. In the first study, we use the hybrid channel design and capillary filling to quantify mass flow resistance in 2-D silica nanochannels with heights down to 7 nm. We find that the mass flow resistance increases compared to theoretical prediction based on classical hydrodynamics and bulk water properties. Such increase of mass flow resistance reaches 45% for 7-nm nanochannels and decreases with the increasing channel height, becoming negligible in ~60 nm nanochannels. In the second study, the hybrid channel design is used to precisely measure the kinetic-limited maximum evaporation rate in the test channel and provide sufficient liquid supply to the liquid/vapor interface. We find that the maximum evaporation rate per projected area decreases with the increasing channel height and relative humidity, but increases as the temperature decreases. A 16-nm-high nanochannel show a maximum evaporation rate of 21287 ± 2414 mm/s at 40 ℃ and 0% relative humidity, corresponding to a heat flux of 4804 ± 545 W/cm2. The accommodation coefficient varies from 0.5 to 0.75, which is found to be independent on geometrical confinement, but shows a clear dependence on temperature and vapor pressure. These new findings enables us to understand the underlying mechanisms of nanofluidic transport and shed light on further development of nanofluidic structures/devices for both energy- and bio-related applications.

BIOGRAPHY

Chuanhua Duan was born in Yueyang, Hunan Province, China in 1979. He received his B.S. and M.S. degrees in engineering thermophysics from Tsinghua University (Beijing, China) in 2002 and 2004. He obtained his Ph.D. degree in mechanical engineering from the University of California, Berkeley in 2009. After staying in Berkeley for two more years as a postdoctoral

research fellow at the Lawrence Berkeley National Laboratory, Dr. Duan joined the department of Mechanical Engineering at Boston University as an Assistant Professor in January 2012. His current research interests include micro/nanofluidics, phase change heat transfer and energy conversion/storage. Dr. Duan is a member of ASME and MRS.

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Organic Molecule Redox Flow Battery

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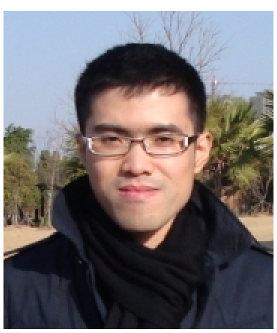
ABSTRACT

The cost of photovoltaic and wind electricity has dropped so much that the greatest technical barrier to us getting the vast majority of our electricity from these renewable sources is their intermittency. Redox flow battery is a promising means to solve this issue via electricity storage, but the most mature systems remain too costly to be economical. In our lab, commodity organic molecules, instead of the more commonly used metal ions, are explored as energy storage media. When coupled with bromide/bromine redox, the organic molecule redox battery offers a high power output and outstanding cycling efficiencies. In this talk, I will discuss our investigation into kinetic limiting mechanisms of the battery, and the search for alternative molecules as well as electrode and membrane materials. I will introduce the latest progress on replacing bromine with high redox-potential molecules, making the battery safer for future residential electricity storage.

BIOGRAPHY



Qing Chen received his PhD in Materials Science from Arizona State University in 2013.

Qing currently works as a postdoctoral researcher in the John A. Paulson School of Engineering and Applied Science in Harvard University. His graduate research concerned morphological instability in lithium alloy anodes in lithium-ion batteries, and its correlation to the classic dealloying (alloy selective dissolution) theory. Qing's ongoing work in Harvard is focused on electricity storage with redox flow batteries. He and his colleagues are using inexpensive organic molecules to construct high performance aqueous flow batteries, aiming at cost-effective grid-scale energy storage and a solution to the intermittency of solar and wind energy.

Dr. Qing Chen is a member of the Electrochemical Society and Materials Research Society. Details of his research can be found in following publications:

Qing Chen, Karl Sieradzki "Spontaneous Evolution of Bicontinuous Nanostructures in Dealloyed Li-based
Systems". Nature Mater. 2013, 12, 1102–1106.
Qing Chen "Bi-continuous Nanoporous Structure Formation via Compound Decomposition". J. Electrochem.

Soc. 2014, 161, H643-H646.
Qing Chen, Michael Gerhardt, Lauren Hartle, Michael J. Aziz "A Quinone-bromide Flow Battery with 1
W/cm2 Power Density". J. Electrochem. Soc. 2016, 163, A5010-A5013.

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

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Postdoctoral Associate, Department of Materials Science and Engineering,
Massachusetts Institute of Technology

ABSTRACT

BIOGRAPHY

Technical Session D2-W3-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

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ABSTRACT

BIOGRAPHY

Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Session Chair

Woei-jyh (Adam) Lee

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University of Maryland, College Park
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BIOGRAPHY

Dr. Woei-jyh (Adam) Lee received BSE degree from the National Taiwan University, MS degree from the Courant Institute at New York University, and PhD degree from the University of Maryland at College Park (UMD). He worked on distributed objects and fault tolerance at the AT&T Labs - Research in 1997. He focused on network software and management at the Bell Laboratories Research from 1998 to 2000. He visited the University of Southern California specializing in continuous media streaming and multimedia networking from 2002 to 2003.

He contributed in protein domain parsing and boundary prediction at the National Cancer Institute (NCI), National Institutes of Health (NIH) from 2004 to 2005. He was a fellow focusing on human genetics and genomics at the National Center for Biotechnology Information, National Library of Medicine, NIH from 2009 to 2012. He became a special volunteer working on computational modeling for cancer progression and metastatic at the NCI, NIH from 2012 to 2013. He was also affiliated with the Center for Bioinformatics and Computational Biology and the Institute for Advanced Computer Studies at UMD.

He is currently a faculty of Information Systems at the Robert H. Smith School of Business at UMD since 2012. His research interests include information integration, data analytics and mining, literature-based discovery, performance simulation and evaluation, bioinformatics and computational biology, human genomics and genetics, and cancer biology. He has two US Patents and is a member of the IAENG and the CAPA.

Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Decipher Regulatory Grammar from DNA Sequence

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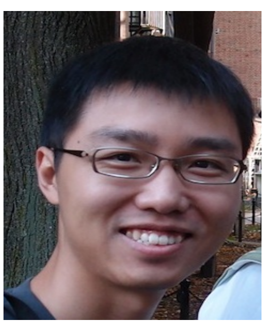
ABSTRACT

The regulation of gene expression is mediated by the binding of sequence-specific transcription factor (TF). Increasingly vast genomic datasets have created enormous opportunities for exploring those TF binding motifs and their functions in different biological context. In this talk, I will introduce machine learning and integrated approaches to discover the driver motif and their co-TFs motifs by utilizing the additional experimental-specific or TF-specific information. These approaches are especially powerfully to recover co-TF motifs, which are usually not overrepresented. By analyzing epigenetic data across 127 different cell types, driver TFs and cell types association network can be clearly derived from their motifs enrichment pattern across datasets. Using deep learning, I will demonstrate how the complex regulatory grammar can be encoded in recurrent neural network, which has much better performance in predicting chromatin state comparing to other traditional methods.

BIOGRAPHY



Zhizhuo received his Bachelor's of Science degree, in Compute Science from the South China University of Technology, Guangzhou in 2008. He then shifted his academic focus towards bioinformatics and began his Ph.D. work in school of computing at the National University of Singapore under Prof. Ken Sung. His thesis focused on the Protein-DNA interactions with high-throughput next generation data like ChIP-seq and ChIA-PET, as well as the development of computational pipeline for DNA motif discovery. Zhizhuo was awarded his Ph.D. in 2013 and joined the MIT Manolis Kellis Lab in early 2014.

His current research focuses on the understanding complex regulatory grammar of the DNA sequence and the role of regulatory mutation in complex diseases. He developed a pure probabilistic motif discovery tool SEME and motif enrichment method CENTDIST for ChIP-seq data, and also 3D structure modeling method ChromSDE for Hi-C data.

Dr. Zhang published his works in both prestige bioinformatics conferences like RECOMB and biology journals like Nature, Cell, Nature Cell biology etc. Dr. Zhang is the recipient of Dean's Graduate Research Excellence Award from National University of Singapore and a member of ENCODE project and NIH epigenome roadmap project.

Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Inference of transcriptional regulation in cancers

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ABSTRACT

Despite the rapid accumulation of tumor profiling data and transcription factor (TF) ChIP-seq profiles, efforts integrating TF binding with the tumor profiling data to understand how TFs regulate tumor gene expression are still limited. To systematically search for cancer-associated TFs, we comprehensively integrated 686 ENCODE ChIP-seq profiles representing 147 TFs with 7857 TCGA tumor data in 21 cancer types. For efficient and accurate inference on gene regulatory rules across a large number and variety of datasets, we developed an algorithm RABIT (Regression Analysis with Background InTegration). In each tumor sample, RABIT tests whether the TF target genes from ChIP-seq show strong differential regulation after controlling for background effect from copy number alteration (CNA) and DNA methylation. When multiple ChIP-seq profiles are available for a TF, RABIT prioritizes the most relevant ChIP-seq profile in each tumor. In each cancer type, RABIT further tests whether the TF expression and somatic mutation variations are correlated with differential expression patterns of its target genes across tumors. Our predicted TF impact on tumor gene expression is highly consistent with the knowledge from cancer related gene databases, and reveals many novel aspects of transcriptional regulation in tumor progression. We also applied RABIT on RNA binding protein motifs and found some alternative splicing factors could affect tumor-specific gene expression by binding to target gene 3'UTR regions. Thus, RABIT (http://rabit.dfci.harvard.edu) is a general platform for predicting the oncogenic role of gene expression regulators.

BIOGRAPHY

Dr. Jiang received his Ph.D. in Computer Science from Princeton University in 2013 and his B.E. in Computer Science from Tsinghua University in China in 2007. His research focuses on building up computational frameworks to integrate big biological data resources from public domain and discover driver events of transcriptional regulation in diverse cancer types. He started working in the Department of Biostatistics and Computational Biology and Harvard School of Public Health as a Research Fellow on September 3, 2013. He has published several papers and reviews related with computational modeling and analysis of transcriptional and post-transcriptional regulation in biology system. Besides scientific research, Dr. Jiang is also actively involved in Chinese music performance and participated in several music ensembles.

Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Embryonic Development following Somatic Cell Nuclear Transfer Impeded by Persisting Histone Methylation

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ABSTRACT

Mammalian oocytes can reprogram somatic cells into a totipotent state enabling animal cloning through somatic cell nuclear transfer (SCNT). However, the majority of SCNT embryos fail to develop to term due to undefined reprogramming defects. Here, we identify histone H3 lysine 9 trimethylation (H3K9me3) of donor cell genome as a major barrier for efficient reprogramming by SCNT. Comparative transcriptome analysis identified reprogramming resistant regions (RRRs) that are expressed normally at 2-cell mouse embryos generated by in vitro fertilization (IVF) but not SCNT. RRRs are enriched for H3K9me3 in donor somatic cells and its removal by ectopically ex- pressed H3K9me3 demethylase Kdm4d not only reactivates the majority of RRRs, but also greatly improves SCNT efficiency. Furthermore, use of donor somatic nuclei depleted of H3K9 methyltransferases markedly improves SCNT efficiency. Our study thus identifies H3K9me3 as a critical epigenetic barrier in SCNT-mediated reprogramming and provides a promising approach for improving mammalian cloning efficiency.

BIOGRAPHY

Yuting Liu was born in Shan Dong, China on May 5 1985. In 2012, He got a PhD degree in Computational Biology at the Partner Institute for Computational Biology between Chinese Academy Sciences and the Max Plank Genomics Institute, Chinese Academy Sciences, Shanghai, China.

Since Jan 2013, he worked as a postdoctoral fellow in Prof. Yi Zhang lab, Harvard medical school, Boston. I have been involved in most of the high-throughput data analysis of the lab that address epigenetic functions in regulating gene expression during stem cell reprogramming and differentiation. Specifically, I have been involved in characterizing the function of Tet1 in imprinting erasure (Nature 2013); identifying epigenetic barrier for SCNT reprogramming (Cell 2014); characterizing the function of Tet proteins in enhancer function (Gene Dev. 2014), and characterizing the function of Tet3 in zygotic DNA demethylation (Cell Stem Cell 2014). My long-term interest is to use my bioinformatics skills to understand epigenetic and chromatin functions in normal development as well as the disease state.

Technical Session D2-W1-T4: Business Venture and Research, In Silico Research, Big Data and Analytics, Machine Learning, and Data Science

Skim Reading and Mobile Learning: From Academic Research to Products

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(Prentice Lab 余禎祥博士)

ABSTRACT

With the forever growing amount of information that people need to digest daily, Prentice Lab was created to build tools that save people valuable time and help them process more data with less effort. We are a team of MIT PhDs and experienced manager. Our first line of tools concentrates on key information extraction from text, such as skim reading support and summary creation. Our products include Core (a RESTful API service for key information extraction), Antelope (a Chrome extension for skim reading support) and Gaur (a RSS mobile reader with readability enhancement). In addition to reading support, we also investigate techniques to help users learn human languages efficiently. In this talk, I will share our experiences in product development and how to convert research results into available products.

BIOGRAPHY

Jones Yu is an Assistant Professor of Computer Science and Networking at Wentworth Institute of Technology (WIT). He earned B.Eng. and M.S. in Computer Science and Information Engineering (CSIE) from Tamkang University in 1998 and from National Taiwan University in 2000, respectively, and Ph.D. in Computer Science from MIT under Prof. Rob Miller's guidance in 2012. His research in Human-Computer Interaction (HCI) focuses on web customization and automation, readability enhancement, and mobile learning.

He is also founder and CEO of Prentice Lab, which is a technology company focusing on designing algorithms and developing software for improving learning, including language learning and subject learning. In the past, he has worked for a few startup companies as Director of Mobile Engineering and User Experience, and developed mobile apps as products.

Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Session Chair

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BIOGRAPHY

Yen-Tsung Huang earned a Doctor of Medicine degree from the National Taiwan University, Taiwan 2003, and Dual Degree of Doctor of Science in Epidemiology and Biostatistics at Harvard School of Public Health in 2012. He is currently an Assistant Professor of Epidemiology and Biostatistics in Brown University, Providence, RI. His research interests focus on cancer genomics, high-dimensional statistics, and molecular/genetic epidemiology. His methodology work is mostly on mediation analyses of high-dimensional data and its application to integrative genomics.

Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

T lymphocyte engineering with cytokine nanogels for enhanced cancer immunotherapy

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ABSTRACT

Adoptive cell transfer (ACT) with autologous tumor-reactive T cells is a promising strategy in cancer immunotherapy, but treatment of solid tumors is limited by the rapid decline in function of the transplanted T cells. In order to maintain high numbers of viable antigen-specific cytotoxic T cells in tumors, co-administration of supporting immunostimulant agents together with transferred cells is often necessary in clinical practice. However, the high systemic doses of such agents needed to enhance T cell functionality can also result in serious side effects. Here, we developed a carrier-free strategy to deliver cytokines specifically to adoptively transferred T cells for cancer immunotherapy. IL2-Fc or an IL-15 superagonist were chemically crosslinked with a disulfide linker to form protein nanogels (NGs), which were conjugated to the plasma membrane of ACT T-cells. These NGs had exceptionally high loading of cytokines (~70 wt%) and released native protein in physiological conditions in a sustained manner through breakdown of the degradable disulfide linker in response to the activated T cell surface reduction activity. Cytokine-NGs were chemically conjugated onto the plasma membrane of donor T cells, enabling continuous pseudo-autocrine release of cytokine for stimulation of transferred CD8+ T cells. Transferred pmel-1 CD8+ T cells with optimized number of NGs conjugated per cell showed enhanced expansion and long persistence in B16F10 tumor bearing mice. Quantification of transferred Thy1.1+CD8+ T cells in tumors at Day 13 showed that T cells with conjugated cytokine-NGs expanded ~80 fold more than the T cells with systemically administered free cytokine. We demonstrated that the cytokine-NG-T cell conjugation strategy could augment transferred T-cell expansion efficiently and specifically in vivo, and thus improve the therapeutic efficacy. This T cell-NG “back pack” approach provides a readily generalizable strategy to provide autocrine protein drug support to donor cells to enhance the safety and efficacy of ACT.

BIOGRAPHY

Li Tang was born in Ganzhou, Jiangxi Province, China, June 26, 1986. He received his B.S. in Chemistry at Peking University in China in 2007, and his Ph.D. in Materials Science and Engineering at University of Illinois at Urbana-Champaign in 2012. He is currently an Irvington Postdoctoral Fellow at Koch Institute at Massachusetts Institute of Technology. His primary research interests lie in developing novel and translational biomaterials to advance the diagnosis and therapy of cancer. Particular interests include modulation of immune response using engineered biomaterials for the development of novel and effective immunotherapies for cancer, infectious diseases and autoimmune disorders. Dr. Tang has been the recipient of Irvington

Postdoctoral Fellowship from Cancer Research Institute, Marlena Felter Bradford Research Travel Fellowship, M-CNTC Fellowship from NCI, and Racheff-Intel Award.

Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Structural studies of lipid-protein interactions using electron crystallography

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Email: Po-Lin_Chiu@hms.harvard.edu

ABSTRACT

Structural studies of lipid-protein interactions using electron crystallography
Po-Lin Chiu[1] and Thomas Walz[1,2]

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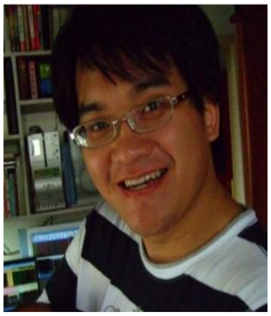
Aquaporin-0 (AQP0) permeates water molecules and also forms thin junctions between the lens fiber cells. AQP0 forms a two-dimensional array in the native lens membranes. The previous structural studies of AQP0 with dimyristoyl phosphatidylcholine (DMPC) and E. coli polar lipid (EPL) found that the reconstituted AQP0 2D crystals are double layered, and the interacting tetramers in two opposing crystalline layers are exactly in register, resulting in a p422 plane symmetry. Comparison of the DMPC and EPL bilayers suggested that the lipid head groups do not play an essential role in the interaction of annular lipids with AQP0. However, the 2D crystals of AQP0 with dimyristoyl phosphatidylglycerol (DMPG) showed different plane symmetries other than the normal p422 symmetry, resulting from translational shifts between the two crystalline layers. To test if the net negative charge on the PG head group was the reason to this destabilization of the interactions between two crystalline layers, we also reconstituted AQP0 with other anionic phospholipids, dimyristoyl phosphatidylserine (DMPS) and dimyristoyl phosphatidic acid (DMPA), and the results suggested that the crystalline layer shift is due to the specific chemistry of PG head group, not simply the negative charge. Next, to answer the question of how AQP0 forms membrane array in vivo, we crystallized AQP0 with lens lipids, which are mostly sphingomyelin and cholesterol, the raft lipids. Two crystal structures of AQP0 with raft lipids at the lower and the higher cholesterol ratios have been determined at 2.5-Å resolution using electron crystallography. The overlapping positions of the annular cholesterols may suggest the cholesterol specific binding sites, and this specific lipid-protein interaction may be the driving force of the native array formation in lens membranes. This finding may help us to extend the knowledge of how the formation of lipid raft domain occurs.

Keywords: cryoEM, lipid-protein interaction, electron crystallography, aquaporin-0, lipid raft

BIOGRAPHY



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Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

Identification of small-molecule probes of autophagy based-Salmonella clearance

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ABSTRACT

Macroautophagy (hereafter referred as autophagy) is an evolutionarily conserved catabolic process in eukaryotes, which involves the formation of double-membrane vesicles that enclose cellular components and fuse with lysosomes. In most cell types, autophagy occurs at basal level to maintain cellular homeostasis by degrading cytosolic materials and redistributing nutrients to essential metabolic pathways. Autophagy can also be activated through distinct signaling cascades in response to various stress conditions, including starvation, accumulation of damaged organelles or aggregate proteins, and pathogen invasion. In particular, clearance of invasive bacteria by autophagy has been identified as an important innate immune mechanism with implications for both infectious disease and inflammatory bowel disease. Salmonella enterica serotype Typhimurium (hereafter Salmonella) is an invasive bacterium targeted by autophagy and often used as a model for study this mechanism.

In order to acquire a deeper understanding in mechanisms underlying anti-Salmonella autophagy, we conducted a high-throughput screen that aimed to identify novel small-molecule autophagy modulators; in particular, those that promote anti-Salmonella autophagy. We screened 60,000 small molecules prepared by stereoselective, diversity oriented, chemical synthesis. We identified 998 probes emerging from the screen and further prioritized five of them based on their activities, chemical structures and their toxicities to mammalian cells. A subset of these prioritized probes were able to promote the clearance of invasive Salmonella in an autophagy-dependent manner. Future efforts are undergoing to further explore the mechanisms of action of these small-molecule probes and explore their potentials in therapeutics.

BIOGRAPHY

Meredith (Szu-Yu) Kuo received her B.S. in life sciences from National Taiwan University, Taipei, Taiwan in 2010. She is currently a PhD candidate in molecular and cellular biology at Harvard University. Her research focuses on the discovery and identification of small-molecule probes of autophagy, and studying these autophagy-modulating probes in mammalian cellular models of bacterial infection and inflammatory diseases. Two research articles summarizing Ms. Kuo's works in these fields were published in Journal of the American Chemical Society and

Proceedings of the National Academy of Sciences. She was awarded the Studying Abroad Scholarship by the Ministry of Education, Taiwan in 2011.

Technical Session D2-W2-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Biomedical Sciences and Engineering

PPAR-α and glucocorticoid receptor synergize to promote erythroid progenitor self-renewal

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ABSTRACT

Many acute and chronic anemias, including hemolysis, sepsis, and genetic bone marrow failure diseases such as Diamond-Blackfan Anemia (DBA), are not treatable with erythropoietin (Epo), because the colony-forming unit erythroid progenitors (CFU-Es) that respond to Epo are either too few in number or are not sensitive enough to Epo to maintain sufficient red blood cell production. Treatment of these anemias requires a drug that acts at an earlier stage of red cell formation and enhances the formation of Epo-sensitive CFU-E progenitors. Recently we showed that glucocorticoids specifically stimulate self-renewal of the early erythroid progenitor, the burst-forming unit erythroid (BFU-E), and increase the production of terminally differentiated erythroid cells. Here we demonstrate that activation of the peroxisome proliferator-activated receptor alpha (PPAR-α) by PPAR-α agonists, GW7647 and fenofibrate, synergizes with glucocorticoid receptor (GR) to promote BFU-E self-renewal. Over time these agonists greatly increase production of mature red blood cells in cultures both of mouse fetal liver BFU-Es and of mobilized human adult CD34+ peripheral blood progenitors, the latter employing a new and effective culture system that generates normal enucleated reticulocytes. While PPARα-/- mice show no hematological difference from wild-type mice in both normal and phenylhydrazine (PHZ)-induced stress erythropoiesis, PPAR-α agonists facilitate recovery of wild-type mice, but not PPARα-/- mice, from PHZ-induced acute hemolytic anemia. We also showed that PPAR-α alleviates anemia in a mouse model of chronic anemia. Finally, both in control and corticosteroid- treated BFU-E cells PPAR-α co-occupies many chromatin sites with GR; when activated by PPAR-α agonists, additional PPAR-α is recruited to GR-adjacent sites and presumably facilitates GR-dependent BFU-E self-renewal. Our discovery of the role of PPAR-α agonists in stimulating self-renewal of early erythroid progenitor cells suggests that the clinically tested PPAR-α agonists we used may improve the efficacy of corticosteroids in treating Epo resistant anemias.

BIOGRAPHY

Dr. Lee was born in Tainan, Taiwan. She received her B.S. in Medical Technology from National Cheng Kung University in Taiwan. She then came to U.S. to pursue her graduate studies. She has received her M.A. in Medical Sciences from Boston University and Ph.D. in Biomolecular Chemistry from University of Wisconsin-Madison in 2011.

She is currently a Postdoctoral Fellow in Whitehead Institute for Biomedical Research located at M.I.T.. With extensive training in biochemistry, molecular and cell biology, her research interests center around red blood cell biology. She has been conducting basic research to investigate how genetic network regulates red blood cell development, as well as translational research to develop red cell-based diagnostic and therapeutic tools.

Dr. Lee has been a member of Taiwan Society of Laboratory Medicine, American Society for Cell Biology and American Association for the Advancement of Science. She has also been involved in organizing events and serving communities including Boston Taiwanese Biotechnology Association, Monte Jade Science and Technology Association of New England and MIT Biology IAP. She is a Charles H. Hood Postdoctoral Fellow. Her research work was published in major bioscience journals including Nature, Molecular Cell and PNAS.

Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Session Chair

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BIOGRAPHY

I-Chun Cheng received the B.S. and M.S. degrees in mechanical engineering from the National Taiwan University in 1996 and 1998, respectively. In 2004, she received a Ph.D. degree in electrical engineering from Princeton University. She was with the Macroelectronic Lab of Princeton University from 2004 to 2007 as a postdoctoral research associate, working on novel silicon thin-film devices and backplane technology for flexible displays. In 2007, she joined the Department of Electrical Engineering and Graduate Institute of Photonics and Optoelectronics at the National Taiwan University, where she is now an Associate Professor. Her current research interests include oxide-semiconductor thin-film technology, electrochemical photovoltaic devices and flexible large-area electronics. She is a member of the Institute of Electrical and Electronics Engineers (IEEE), Material Research Society (MRS), and Electrochemical Society (ECS). She has published over 70 journal articles, more than 150 conference papers and 5 book chapters and co-authored a book.

Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Spin Transfer Torque from the Spin Hall Effect in Magnetic Heterostructures

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ABSTRACT

The theory of spin transfer torque (STT) in magnetic multilayer systems was first proposed by Slonczewski and Berger in 1996. Later it has been proved by experiments on submicron-sized devices (spin valves) that the current-induced “damping-like” STT can be employed to induce magnetization reversal and magnetic oscillation, with the former discovery gave birth to the so-called STT-MRAM industry.

More recently, the spin Hall effect (SHE) from certain transition metals (Pt, Ta, and W), which describes the creation of a transverse spin current via spin-orbit interaction by applying a longitudinal charge current, was shown to be efficient enough to drive magnetic reversal and magnetic oscillation in the adjacent ferromagnetic layer through STT scenario. However, unlike the STT in conventional spin valves, which is mainly dominated by the “damping-like” torque, the SHE-induced STT in magnetic heterostructures consists of both a damping-like component and a comparable “field-like” component in certain cases. To enhance the efficiency of these SHE-STT devices, a better understanding of the origins of these two components, together called “spin-orbit” torques, is required.

In this talk I’ll present our recent endeavor on unveiling the nature of these spin-orbit torques from magnetic heterostructures with DC (magnetic switching), AC (2nd harmonic voltages), and RF (spin-torque ferromagnetic resonance) probing techniques. I will also discuss the current trend in STT-MRAM industry and the possibility of harnessing various spin-orbital effects to improve contemporary spintronic devices.

BIOGRAPHY

Chi-Feng Pai received his B.Sc. in Physics and B.Eng in Materials Science and Engineering from National Taiwan University (2007). After fulfilling his duty of military service, he started his graduate studies at School of Applied and Engineering Physics, Cornell University, and received his Ph.D. in late 2014. Currently he is a postdoctoral research associate in Department of Materials Science and Engineering at MIT, working in the Spin Dynamics Group led by Prof. Geoffrey Beach. Dr. Pai's research focuses on probing the spin transport and dynamic properties in materials, especially on the spin Hall effect from transition metals and novel spin-orbital effects from magnetic heterostructures, with both electrical and optical techniques.

Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Charge Qubit in a Single Electron Si/SiGe Double Quantum Dot

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ABSTRACT

Artificial two-level quantum systems are widely investigated as the fundamental building blocks of future quantum computers. These quantum bits (qubits) can be realized in many solid state systems, including Josephson junction based devices, nitrogen vacancy centers in diamond, and electron spins in semiconductor quantum dots. Among these systems, Si is very promising since it can be isotopically purified to eliminate random fluctuating fields from lattice nuclei, leading to quantum coherence times exceeding several seconds. However, lower electron mobility and higher electron effective mass present many challenges in realizing high quality qubits in Si double quantum dots (DQD).

Here we demonstrate consistent fabrication of robust single-electron silicon qubits with high yield. With optimized device designs and DC/RF measurement techniques, we have achieved versatile quantum control of a single electron, as well as sensitive read-out of its quantum state. By applying microwave radiation to the gate electrodes, we can probe the energy level structure of the system with high precision. We apply bursts of microwave radiation to extract the qubit life time, T1. By experimentally tuning the qubit, we demonstrate a four order of magnitude variation of T1 with gate voltages. We show that our experiment results are consistent with phonon-mediated charge relaxation theory.

BIOGRAPHY

Ke Wang was born in Chengdu, China. He obtained his undergraduate degree in Physics from University of Science and Technology of China and his Ph.D. in Physics from Princeton University working under the guidance of Prof. Jason R. Petta.

He is a post-doctoral fellow with Prof. Philip Kim in the Department of Physics at Harvard University. His current research interests include correlated electrons at the quantum limit and transport properties of novel 2D functional materials.

Dr. Wang has written a book chapter in "Quantum dots: optics, electron transport and future applications" (Cambridge University Press, 2012) and his recent work on silicon quantum devices has been chosen as editors' suggestion in physical review letters (K. Wang et al., PRL 111 (4), 046801).

Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

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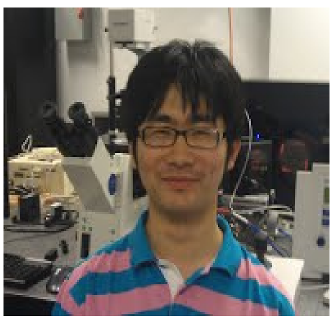
ABSTRACT

BIOGRAPHY



Technical Session D2-W3-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials, Ceramic Materials, Metallurgy and Materials, Nanotechnology, Clean Energy and Water Purification Technology

Solid State Optical Upconversion Utilizing Themally-Activated-Delayed Fluorescence

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ABSTRACT

Optical upconversion is a process for emitting higher energy photons than the incident photon energies. Upconversion for photons could be promising for overcoming Shockley-Queisser limit by collecting lost photons with energy lower than solar cell's bandgap. Researches have shown optical upconversion through second harmonic generation or two-photon absorption emission. However, triplet-triplet annihilation (TTA) in organic semiconductors could be a low power solution for optical upconversion.

To incorporate TTA in optical up conversion, the process will need a sensitizer that absorbs low energy photons () and generate triples that can then Dexter transfer to TTA molecules. In most TTA up conversion system, phosphors are used as the low energy triplet sensitizer for TTA materials. However, in our scheme, we utilize thermally-activated-delayed-fluorescence (TADF) molecules to generate triplets for TTA. In TADF molecules, the splitting between singlet and triplet are small enough () that has large intersystem crossing. From Adachi et al, it is shown that TADF molecules can efficiently generate triplet excitons up to 70%, making it suitable for phosphor substitutes. TADF molecules have many advantages as alternatives for phosphors. Many TADF molecules are heavy metal free. This could be an environmental friendly and cheaper solution than phosphor based upconversion system. Also, TADF molecules are designed with smaller that has smaller Stoke shift than phosphor. Our molecules are also evaporable, which could lead to higher device life time, better stability and more interesting device structure.

We demonstrated TADF-TTA upconversion system with diphenyl-anthracene (DPA, TTA organic molecule) and 4CzTPN-Ph (TADF organic molecule). We measured 450nm blue emission with 530nm green excitation laser. The system is estimated around 1.1% of upconversion efficiency (from 4CzTPN-Ph excitons). This is a demonstration for non-heavy metal solid state upconversion system. This work is under review in Applied Physics Letter.

BIOGRAPHY

Tony Wu received his B.S. in Electrical Engineering from National Taiwan University in 2011. He is currently studying his Ph.D. at Massachusetts Institute of Technology in Electrical Engineering and Computer Science. His research focus is on organic photovoltaics and organic light-emitting diodes, especially in studying exciton physics and transportation. He has published singlet fission organic photovoltaic research in "Singlet fission efficiency in tetracene-based organic solar cells," APL 2014, etc.

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