



**The EITA International Conference on New Materials,  
Nanotechnology and New Green Energy 2014**  
(EITA-New Materials 2014) or (EITA-EITC 2014)

**"Recent Research Advances in New Materials,  
Nanotechnology and New Green Energy"**

**Conference Proceedings**

**National Cheng Kung University**  
Tainan, Republic of China (Taiwan)

**Saturday-Sunday, November 22-23, 2014**

<Draft: 11/20/14>

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**Welcome Message**

## **Conference Themes**

### **"Recent Research Advances in New Materials, Nanotechnology and New Green Energy"**

The EITA-New Materials 2014 conference consists of four parallel workshops:

- **Workshop 1 (W1):** Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology
- **Workshop 2 (W2):** Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials
- **Workshop 3 (W3):** New Green Energy Materials, Ceramic Materials, Metallurgy and Materials
- **Workshop 4 (W4):** Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings

## **Planning Committee**

### **General Conference Chairs**

Ta-Hui Lin (林大惠) National Cheng-Kung University

### **Conference Organizers**

Pei-Cheng Ku (古培正) University of Michigan at Ann Arbor  
Jung-Tsung Shen (沈榮聰) Washington University in St. Louis  
Aichi Chien (簡艾琪) University of California at Los Angeles  
Yu-Bin Chen (陳玉彬) National Cheng Kung University  
Chia-Yuan Chen (陳嘉元) National Cheng Kung University

### **Project Manager and Conference Manager**

Yu-Bin Chen (陳玉彬) National Cheng Kung University

### **Program Steering Committee**

Ta-Hui Lin (林大惠) National Cheng-Kung University  
Cheng-Hsien Liu (劉承賢) National Tsing Hua University  
Fang-Chung Chen (陳方中) National Chiao-Tung University  
Ching-Fuh Lin (林清富) National Taiwan University  
Pei-Wen Li (李佩雯) National Central University  
Yu-Bin Chen (陳玉彬) National Cheng-Kung University

### **Program Committee**

### **Workshop Track Co-Chairs**

#### **Workshop 1 (W1): Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Cheng-Hsien Liu (劉承賢) National Tsing Hua University

#### **Workshop 2 (W2): Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Fang-Chung Chen (陳方中) National Chiao-Tung University

#### **Workshop 3 (W3): New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

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Ching-Fuh Lin (林清富) National Taiwan University

**Workshop 4 (W4): Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings**

Pei-Wen Li (李佩雯) National Central University

**Publication**

**Conference Programs:**

Yu-Bin Chen (陳玉彬) National Cheng Kung University

**Conference Proceedings:**

Chia-Yuan Chen (陳嘉元) National Cheng Kung University

**Local Management**

Hui-Er Shen (沈慧娥) National Cheng Kung University

Chih-Ling Huang (黃芷翎) National Cheng Kung University

**On-Site Registration**

<TBD>

**Web Development**

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

## **Conference Program**

### **Day 1 (Saturday, November 22, 2014)**

#### **11/22 (Sat) 8:00 am - 4:00 pm: Registration**

Room: Chung Hwa Hall Atrium (2F)

#### **11/22 (Sat) 10:00 am - 10:30 am: Opening Session**

Chair: **Dr. Ta-Hui Lin**, Distinguished Professor, Department of Mechanical Engineering and Director, the Research Center for Energy Technology and Strategy, National Cheng Kung University (成功大學機械工程學系兼能源科技與策略研究中心主任林大惠特聘教授)

Room: Chung Hwa Hall (2F)

#### **Opening Remarks:**

##### **Dr. Hwung-Hweng Hwung**

President, National Cheng Kung University

(成功大學黃煌輝校長)

#### **Opening Remarks:**

##### **Dr. Yueh-Min Huang**

Distinguished Professor, Department of Engineering Science

Associate Dean, College of Engineering

National Cheng Kung University

(成功大學工程科學系兼工學院副院長黃悅民特聘教授)

### **Plenary Sessions:**

#### **11/22 (Sat) 10:30 am - 11:10 am: Plenary Session (I):**

Chair: **Dr. Fang-Chung Chen**, Professor, Department of Photonics, National Chiao Tung University (交通大學光電工程學系陳方中教授)

Room: Chung Hwa Hall (2F)

#### **Plenary Speaker:**

“Resolve the Mystery of Interfacial Water and Water Splitting by Using Advanced Nano-Imaging and Sensing Technologies”

##### **Dr. Chi-Kuang Sun**

Distinguished Professor, Department of Electrical Engineering and

Chief Director, Molecular Imaging Center

National Taiwan University

(台灣大學電機工程學系與分子生醫影像研究中心主任孫啟光特聘教授)

#### **11/22 (Sat) 11:10 am - 11:30 am: Coffee Break**

Room: Chung Hwa Hall Atrium (2F)

#### **11/22 (Sat) 11:30 am - 12:10 pm: Plenary Session (II)**

Chair: **Dr. Pei-Wen Li**, Professor, Department of Electrical Engineering, Director, Center for



**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
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NANO Science and Technology, and Associate Dean of Academic Affairs, National Central University (中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)  
Room: Chung Hwa Hall (2F)

**Plenary Speaker:**

”Chances and challenges for Taiwan in low carbon and green energy”

**Dr. Chin Pan**

Distinguished Professor, Institute of Nuclear Engineering and Science and Department of Engineering and System Science  
National Tsing Hua University

(清華大學核子工程與科學研究所與工程與系統科學系潘欽特聘教授)

**11/22 (Sat) 12:10 pm - 1:30 pm: Lunch Break**

Room: Chung Hwa Hall (2F)

**11/22 (Sat) 1:30 pm – 2:10 pm: Plenary Session (III)**

Chair: **Dr. Ching-Fuh Lin**, Distinguished Professor, Department of Electrical Engineering and Director, Innovative Photonics Research Center, National Taiwan University (台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

Room: Chung Hwa Hall (2F)

**Plenary Speaker:**

“Overview of Phase II of Taiwan’s National Energy Program”

**Dr. Faa-Jeng Lin**

Chair Professor, Department of Electrical Engineering, National Central University  
Committee Chair, National Energy Plan (NEP-II) Smart Grid Focus Center  
Ministry of Science and Technology, R.O.C. (Taiwan)

(中央大學電機工程學系兼科技部第二期能源國家型科技計畫智慧電網主軸計畫召集人林法正講座教授)

**Parallel Sessions:**

**11/22 (Sat) 2:10 pm – 3:30 pm: Technical Session D1-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Cheng-Hsien Liu**, Professor, Department of Power Mechanical Engineering, Chief Executive Officer, Industrial Liaison Program, College of Engineering, National Tsing Hua University (清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

Room: Conference Room I (3F)

**Dr. Da-Jeng Yao**

Professor and Director, The Institute of NanoEngineering and MicroSystems  
National Tsing Hua University

(清華大學奈米工程兼微系統研究所所長饒達仁教授)

“Blood flow improvement by stents with biocompatible material”

**Dr. Aichi Chien**

Assistant Professor, Department of Radiological Sciences, Ronald Reagan UCLA Medical Center

David Geffen School of Medicine at UCLA  
(加州大學洛杉磯分校大衛格芬醫學院簡艾琪教授)

“Using Patterned Physical Confinement to Develop Lipid Bilayer Platforms Insensitive to Air Bubbles”

**Dr. Ling Chao**

Assistant Professor, Department of Chemical Engineering  
National Taiwan University  
(臺灣大學化學工程學系趙玲教授)

“Control Gaseous Microenvironments in vitro: Microfluidic Cell Culture”

**Dr. Yi-Chung Tung**

Associate Research Fellow, Research Center for Applied Sciences  
Academia Sinica  
(中央研究院應用科學研究中心董奕鍾博士)

**11/22 (Sat) 2:10 pm – 3:30 pm: Technical Session D1-W2-T1: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Chair: **Dr. Fang-Chung Chen**, Professor, Department of Photonics, National Chiao Tung University (交通大學光電工程學系陳方中教授)

Room: Conference Room II (3F)

“Tunable graphene based optics, electronics and photonics”

**Dr. Chun-Wei Chen**

Distinguished Professor, Department of Materials Science and Engineering  
National Taiwan University  
(臺灣大學材料科學與工程學系陳俊維特聘教授)

“Carbon Nanotubes as Penetrating Electrodes for Promoting the Efficiency of Organic Solar Cells”

**Dr. Pen-Cheng Wang**

Associate Professor, Department of Engineering and System Science  
National Tsing Hua University  
(清華大學工程與系統科學系王本誠教授)

“Controlled Growth of Strained Si in Silicide/Silicon Nanoheterostructures from Point Contact Reactions”

**Dr. Gordon Kuo-Chang Lu**

Assistant Professor, Department of Materials Science and Engineering  
National Cheng Kung University  
(成功大學材料科學及工程學系呂國彰教授)

“Plasmonic Nanostructures for Light Trapping in Organic Photovoltaic Devices”

**Dr. Fang-Chung Chen**

Professor, Department of Photonics  
National Chiao-Tung University  
(交通大學光電系陳方中教授)

**11/22 (Sat) 2:10 pm – 3:30 pm: Technical Session D1-W3-T1: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

Chair: **Dr. Ching-Fuh Lin**, Distinguished Professor, Department of Electrical Engineering and Director, Innovative Photonics Research Center, National Taiwan University (台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

Room: Conference Room III (3F)

“ZnO-based Nanostructures for Sensing Devices”

**Dr. Bohr-Ran Huang**

Distinguished Professor and Vice Dean, College of Electrical Engineering & Computer Science National Taiwan University of Science and Technology  
(台灣科技大學光電工程研究所兼電資學院副院長黃柏仁特聘教授)

“Organic/Inorganic Thermoelectric Chips: from Quantum Mechanics to System Dynamics”

**Dr. Che-Wun Hong**

Professor, Department of Power Mechanical Engineering  
National Tsing Hua University  
(清華大學動力機械工程學系洪哲文教授)

“Rational Molecular Design of Efficient Porphyrins for Dye-Sensitized Solar Cells”

**Dr. Chen-Yu Yeh**

Professor, Department of Chemistry  
National Chung Hsing University  
(中興大學化學系葉鎮宇教授)

“High-Efficiency Hybrid Organic/Silicon Nanowire Heterojunction Solar cells”

**Dr. Peichen Yu**

Professor, Department of Photonics  
National Chiao Tung University  
(交通大學光電學系余沛慈教授)

**11/22 (Sat) 2:10 pm – 3:30 pm: Technical Session D1-W4-T1: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Pei-Wen Li**, Professor, Department of Electrical Engineering, Director, Center for NANO Science and Technology, and Associate Dean of Academic Affairs, National Central University (中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

Room: Conference Room IV (3F)

“Strategies on Development of Offshore Wind Technology”

**Dr. Jing-Tang Yang**

Distinguished Professor, Department of Mechanical Engineering  
National Taiwan University  
(台灣大學機械工程學系楊鏡堂特聘教授)

**Dr. Tsai-Fu Wu**

Professor and Director of Elegant Power Electronics Applied Research Laboratory (EPEARL)  
Department of Electrical Engineering

National Tsing Hua University

(清華大學電機工程學系精緻電力電子應用研究室主持人吳財福教授)

“The Self-Adaptation MPPT Method for a PV System”

**Dr. Yie-Tone Chen**

Professor, Department of Electrical Engineering  
National Yunlin University of Science and Technology  
(雲林科技大學電機工程學系陳一通教授)

“Power Quality and Development of Smart Grid”

**Dr. Cheng-I Chen**

Assistant Professor, Department of Electrical Engineering  
National Central University  
(中央大學電機工程學系陳正一教授)

**11/22 (Sat) 3:30 pm – 3:50 pm: Coffee Break**

Room: Chung Hwa Hall Atrium (2F)

**Parallel Sessions:**

**11/22 (Sat) 3:50 pm – 5:10 pm : Technical Session D1-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Da-Jeng Yao**, Professor and Director, The Institute of NanoEngineering and MicroSystems, National Tsing Hua University (清華大學奈米工程兼微系統研究所所長饒達仁教授)  
Room: Conference Room I (3F)

“Biomimetic surface treatment and some novel applications”

**Dr. Yi-Chang Chung**

Professor, Department of Chemical and Materials Engineering,  
National University of Kaohsiung  
(高雄大學化學工程及材料工程學系鍾宜璋教授)

“Manipulation of Hydrogel Bio-Materials on an Electromicrofluidic Platform”

**Dr. Shih-Kang Fan**

Associate Professor, Department of Mechanical Engineering  
National Taiwan University  
(台灣大學機械工程學系范士岡教授)

“Novel Bio-Inspired Zwitterion Dopamine Molecule for Anti-Biofouling and Photocleavable Properties”

**Dr. Chun-Jen Huang**

Assistant Professor, Graduate Institute of Biomedical Engineering  
National Central University  
(中央大學生物醫學工程研究所黃俊仁教授)

“CMOS-CHIP BASED PARTICLE DEPOSITION FOR SYNTHESIS OF HIGH-DENSITY PEPTIDE ARRAYS”

**Dr. Yun-Chien Cheng**

Assistant Professor, Department of Medical Engineering

National Chiao-Tung University  
(交通大學機械工程學系鄭雲謙教授)

**11/22 (Sat) 3:50 pm – 5:10 pm: Technical Session D1-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Chair: **Dr. Chun-Wei Chen**, Distinguished Professor, Department of Materials Science and Engineering, National Taiwan University (臺灣大學材料科學與工程學系陳俊維特聘教授)  
Room: Conference Room II (3F)

“Control of Morphology and Charge Recombination Kinetics for Perovskite Solar Cells”

**Dr. Eric Wei-Guang Diau**

Professor, Department of Applied Chemistry  
National Chiao Tung University  
(交通大學應用化學系刁維光教授)

“Rational Design of Interfacial Materials for Solid-State Dye-Sensitized Solar Cells”

**Dr. Lee-Yih Wang**

Professor of Polymer Science and Engineering  
Associate Research Fellow of Condensed Matter Sciences  
National Taiwan University  
(臺灣大學高分子研究所王立義教授)

“Pd-Catalyzed Direct C-H Arylation of Thieno[3,4-c]pyrrole-4,6-dione (TPD): A Step-Economical Synthetic Alternative to Access TPD-Centred p-Functional Materials”

**Dr. Ching-Yuan Liu**

Assistant Professor, Department of Chemical and Materials Engineering  
National Central University  
(中央大學化學工程與材料工程學系劉青原教授)

“Exploration of piezophotocatalyst of ZnSnO<sub>3</sub> nanowires using two-step hydrothermal synthesis”

**Dr. Kao-Shuo Chang**

Assistant Professor, Department of Materials Science and Engineering  
National Cheng Kung University  
(成功大學材料科學及工程學系張高碩教授)

**11/22 (Sat) 3:50 pm – 5:10 pm : Technical Session D1-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

Chair: **Dr. Bohr-Ran Huang**, Distinguished Professor and Vice Dean, College of Electrical Engineering & Computer Science, National Taiwan University of Science and Technology (台灣科技大學光電工程研究所兼電資學院副院長黃柏仁特聘教授)  
Room: Conference Room III (3F)

“Application of DFT methods to design highly efficient organic sensitizers for Dye-Sensitized Solar Cells”

**Dr. Jyh-Chiang Jiang**

Professor and Vice Chairman, Department of Chemical Engineering  
National Taiwan University of Science and Technology  
(臺灣科技大學化學工程學系兼副系主任江志強教授)

“Fabrication of Colloidal Crystals and Their Inverse Opals for Engineering Applications”

**Dr. Pu-Wei Wu**

Professor, Department of Materials Science and Engineering  
National Chiao-Tung University  
(交通大學材料科學與工程學系吳樸偉教授)

**Dr. Hsing-Yu Tuan**

Professor, Department of Chemical Engineering  
National Tsing Hua University  
(清華大學化學工程學系段興宇教授)

**Dr. Cheng-Che(Jerry) Hsu**

Associate Professor, Department of Chemical Engineering  
National Taiwan University  
(臺灣大學化學工程學系徐振哲教授)

**11/22 (Sat) 3:50 pm – 5:10 pm : Technical Session D1-W4-T2: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Faa-Jeng Lin**, Chair Professor, Department of Electrical Engineering, National Central University, Committee Chair, National Energy Plan (NEP-II) Smart Grid Focus Center Ministry of Science and Technology, R.O.C. (Taiwan) (中央大學電機工程學系兼科技部第二期能源國家型科技計畫智慧電網主軸計畫召集人林法正講座教授)  
Room: Conference Room IV (3F)

“Development and Implementation of Remote Supervisory Control System for Transmission Line Under Pollution of Weather and Salt-Fog Invasion”

**Dr. Ming-Yuan Cho**

Distinguished Professor, Department of Electrical Engineering  
Dean, College of Electrical Engineering and Computer Science  
National Kaohsiung University of Applied Sciences  
(高雄應用科技大學電機工程系兼電資學院院長卓明遠特聘教授)

“Current Status of Smart and Green Technology Development in Taipower”

**Dr. Jin-Shyr Yang**

Deputy General Manager, Taiwan Power Research Institute  
Taiwan Power Company  
(台灣電力公司綜合研究所副所長楊金石博士)

**Dr. Shyh-Jier Huang**

Distinguished Professor, Department of Electrical Engineering  
National Cheng Kung University  
(成功大學電機工程學系黃世杰特聘教授)

“Electromagnetic Interference (EMI) Noise Reduction Techniques in Switching Power Circuits for Renewable Energy Applications”

**Dr. Hung-I Hsieh**

Assistant Professor, Department of Electrical Engineering  
National Chiayi University

(嘉義大學電機系謝宏毅教授)

**Day 2 (Sunday, November 23, 2014)**

**11/23 (Sun) 8:00 am - 4:00 pm: Registration**

Room: Chung Hwa Hall Atrium (2F)

**11/23 (Sun) 9:30 am - 10:10 am: Plenary Session (IV): Panel Discussions**

Moderator: **Dr. Cheng-Hsien Liu**, Professor, Department of Power Mechanical Engineering, Chief Executive Officer, Industrial Liaison Program, College of Engineering, National Tsing Hua University (清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

Room: Chung Hwa Hall (2F)

**Panelists:**

**Dr. Ching-Yao (Hank) Huang**

Professor, Department of Electronics Engineering  
Associate Dean, College of Electrical and Computer Engineering  
Director, Center of Industry Accelerator and Patent Strategy  
National Chiao Tung University  
Chairman, Chinese Business Incubation Association

(交通大學電子工程學系兼電機學院副院長兼產業加速器暨專利開發策略中心主任及中華創業育成協會理事  
長黃經堯教授)

**Dr. Sheng-Jye Hwang**

Professor and Associate Head of Department  
Department of Mechanical Engineering  
National Cheng-Kung University

(成功大學機械工程學系兼副系主任黃聖杰教授)

**Dr. Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering  
Chief Executive Officer, Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

**Parallel Sessions:**

**11/23 (Sun) 10:10 am – 11:30 am: Technical Session D2-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Cheng-Hsien Liu**, Professor, Department of Power Mechanical Engineering, Chief Executive Officer, Industrial Liaison Program, College of Engineering, National Tsing Hua University (清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

Room: Conference Room I (3F)

“Screening of microalgae with different lipid contents by using dielectrophoretic microfluidic device”

**Dr. Yi-Je Juang**

Associate Professor, Department of Chemical Engineering  
National Cheng Kung University

(成功大學化學工程學系莊怡哲教授)



“Paper-based immunoaffinity devices for accessible isolation and characterization of extracellular vesicles”

**Dr. Chihchen Chen**

Assistant Professor, Institute of NanoEngineering and MicroSystems (NEMS)  
National Tsing Hua University  
(清華大學奈米工程與微系統研究所陳致真教授)

“Microelectrode Array Biosensors for the Near Real-Time Monitoring of Glutamate in Vitro and in Vivo”

**Dr. Tina T.-C. Tseng**

Assistant Professor, Department of Chemical Engineering  
National Taiwan University of Science and Technology  
(台灣科技大學化學工程學系曾婷芝教授)

**11/23 (Sun) 10:10 am – 11:30 am: Technical Session D2-W2-T1:  
Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft  
Materials**

Chair: **Dr. Fang-Chung Chen**, Professor, Department of Photonics, National Chiao Tung University (交通大學光電工程學系陳方中教授)  
Room: Conference Room II (3F)

“Nickel oxide p-type electrode interlayer in CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite/fullerene planar-heterojunction hybrid solar cells”

**Dr. Tzung-Fang Guo**

Distinguished Professor and Chairman, Department of Photonics  
National Cheng Kung University  
(成功大學光電科學與工程學系兼系主任郭宗枋特聘教授)

“Passivation of Cu(In, Ga)Se<sub>2</sub> solar cell with Trioctylphosphine Sulfide”

**Dr. Jiun-Haw Lee**

Professor, Graduate Institute of Photonics and Optoelectronics  
National Taiwan University  
(臺灣大學光電工程學研究所李君浩教授)

“Stretched Contact Printing of One-Dimensional Nanostructures for Nano and Organic Transistors”

**Dr. Chien-Wen Hsieh**

Assistant Professor, Institute of Lighting and Energy Photonics  
National Chiao Tung University  
(交通大學照明與能源光電所謝建文教授)

“GeSn waveguide light-detectors and emitters for Si micron- and nano-photonics”

**Dr. Guo-En Chang**

Assistant Professor, Department of Mechanical Engineering  
National Chung-Cheng University  
(中正大學機械工程學系張國恩教授)

**11/23 (Sun) 10:10 am – 11:30 am: Technical Session D2-W3-T1: New  
Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

Chair: **Dr. Ching-Fuh Lin**, Distinguished Professor, Department of Electrical Engineering and

Director, Innovative Photonics Research Center, National Taiwan University (台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)  
Room: Conference Room III (3F)

**Dr. Chih-Huang Lai**

Distinguished Professor and Chair  
Department of Materials Science and Engineering  
National Tsing Hua University  
(清華大學材料科學工程系系主任賴志煌特聘教授)

“Photocatalysis and Photoluminescence of Graphene Oxide Quantum Dots”

**Dr. Hsi-Sheng Teng**

Professor, Department of Chemical Engineering  
National Cheng Kung University  
(成功大學化學工程學系鄧熙聖教授)

“Heterostructure & strain-enhanced performance of ZnO-based photodetectors”

**Dr. Ruey-Chi Wang**

Professor, Department of Chemical and Materials Engineering  
National University of Kaohsiung  
(高雄大學化學工程及材料工程學系王瑞琪教授)

“Microstructured Cobalt Sulphide in Photoelectrochemical Water Splitting”

**Dr. Chia-Yu Lin**

Assistant Professor, Department of Chemical Engineering  
National Cheng Kung University  
(成功大學化學工程學系林家裕教授)

**11/23 (Sun) 10:10 am – 11:30 am: Technical Session D2-W4-T1: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Pei-Wen Li**, Professor, Department of Electrical Engineering, Director, Center for NANO Science and Technology, and Associate Dean of Academic Affairs, National Central University (中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

Room: Conference Room IV (3F)

“Characterization and Activity of S,Zn Co-doped TiO<sub>2</sub> with Visible Light”

**Dr. Hsin Chu**

Distinguished Professor and Fellow  
National Cheng Kung University  
Department of Environmental Engineering and Academy of Educators  
(成功大學環境工程學系朱信特聘教授)

“Design of a SOFC/GT hybrid power generation system by consuming greenhouse gases”

**Dr. Wei Wu**

Professor, Department of Chemical Engineering  
National Cheng Kung University  
(成功大學化學工程學系吳煒教授)

“Using microfluidic and optical technologies to aid the optimization and integration of bioenergy production processes”

**Dr. Hsiang-Yu Wang**

Associate Professor, Department of Engineering and System Science  
National Tsing Hua University  
(清華大學工程與系統科學系王翔郁教授)

**Dr. Si-Yu Li**

Assistant Professor, Department of Chemical Engineering  
National Chung Hsing University  
(中興大學化學工程學系李思禹教授)

**11/23 (Sun) 11:30 am – 1:00 pm: Lunch Break**

Room: Chung Hwa Hall (2F)

**Parallel Sessions:**

**11/23 (Sun) 1:00 pm – 2:20 pm: Technical Session D2-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Cheng-Hsien Liu**, Professor, Department of Power Mechanical Engineering, Chief Executive Officer, Industrial Liaison Program, College of Engineering, National Tsing Hua University (清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

Room: Conference Room I (3F)

“A novel micro/nano hybrid structured chitosan nerve conduit for proliferation enhancement and growth direction guidance of neuroblastoma B35”

**Dr. Gou-Jen Wang**

Distinguished Professor, Department of Mechanical Engineering and Graduate Institute of Biomedical Engineering  
National Chung-Hsing University  
(中興大學機械工程學系王國禎特聘教授)

“Effect of anions on the redox reaction of hydrogen peroxide of the nanostructured gold”

**Dr. Chiun-Jye Yuan**

Professor, Department of Biological Science and Technology  
National Chiao Tung University  
(交通大學分子醫學與生物工程研究所袁俊傑教授)

**Dr. Hsu-Wei Fang**

Professor, Department of Chemical Engineering and Biotechnology  
National Taipei University of Technology  
(台北科技大學化學工程與生物科技系方旭偉教授)

“Mass spectrometry sensitivity and selectivity enhancement on nanostructured silicon surface”

**Dr. Chia-Wen (Kevin) Tsao**

Associate Professor, Department of Mechanical Engineering  
National Central University  
(中央大學機械工程學系曹嘉文教授)

**11/23 (Sun) 1:00 pm – 2:20 pm: Technical Session D2-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Chair: **Dr. Tzung-Fang Guo**, Distinguished Professor and Chairman, Department of Photonics, National Cheng Kung University (成功大學光電科學與工程學系兼系主任郭宗枋特聘教授)

Room: Conference Room II (3F)

“Good light based on organic light-emitting diodes”

**Dr. Jwo-Huei Jou**

Professor, Department of Materials Science and Engineering  
National Tsing Hua University

(清華大學材料工程學系周卓輝教授)

**Dr. Zingway Pei**

Associate Professor, Graduate Institute of Optoelectronic Engineering &  
Department of Electrical Engineering  
Director, Center for Research and Development of Engineering Technology,  
National Chung Hsing University

(中興大學電機工程學系暨光電工程研究所裴靜偉教授)

“New Alternatives of Contact Materials for Transistor”

**Dr. Cheng-Lun Hsin**

Assistant Professor, Department of Electrical Engineering  
National Central University

(中央大學電機工程學系辛正倫教授)

“An Epitaxy Approach to Explore Photoelectrochemistry of Complex Oxide Heterostructures”

**Dr. Ying-Hao Eddie Chu**

Assistant Professor, Department of Materials Science and Engineering  
National Chiao Tung University

(交通大學材料科學與工程學系所朱英豪教授)

**11/23 (Sun) 1:00 pm – 2:20 pm: Technical Session D2-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

Chair: **Dr. Chih-Huang Lai**, Distinguished Professor and Chair, Department of Materials Science and Engineering, National Tsing Hua University (清華大學材料科學工程系兼系主任賴志煌特聘教授)

Room: Conference Room III (3F)

“Solar energy harvesting scheme utilizing three-dimensional hierarchical nano- and micro-structures”

**Dr. Yu-Lun Chueh**

Associate Professor, Department of Material Science and Engineering  
National Tsing Hua University

(清華大學材料科學工程學系闕郁倫教授)

“First Principles Study of Band Alignment at the Rutile-Anatase TiO<sub>2</sub> Interface”

**Dr. Chin-Lung Kuo**

Associate Professor, Department of Materials Science and Engineering

National Taiwan University  
(台灣大學材料科學與工程學系郭錦龍教授)

“Investigation on the photocatalytic characteristics of Ag and B doped TiO<sub>2</sub> nanophotocatalysts”

**Dr. Chun-Pei Cho**

Assistant Professor, Department of Applied Materials and Optoelectronic Engineering  
National Chi Nan University

(暨南國際大學應用材料及光電學系卓君珮教授)

“Alloy phase stability under current stressing”

**Dr. Shih-kang Lin**

Assistant Professor, Department of Materials Science and Engineering  
National Cheng Kung University

(成功大學材料科學及工程學系林士剛教授)

**11/23 (Sun) 1:00 pm – 2:20 pm: Technical Session D2-W4-T2: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Hsin Chu**, Distinguished Professor and Fellow, National Cheng Kung University, Department of Environmental Engineering and Academy of Educators (成功大學環境工程學系朱信特聘教授)

Room: Conference Room IV (3F)

“Photocatalytic conversion of sunlight to renewable energy”

**Dr. Jeffrey Chi-Sheng Wu**

Professor, Department of Chemical Engineering  
National Taiwan University

(臺灣大學化學工程學系吳紀聖教授)

“Recent Studies on Vanadium Redox Flow Battery for Energy Storage Applications”

**Dr. Kan-Lin Hsueh**

Associate Professor and Department Head, Department of Energy Engineering  
National United University

(聯合大學能源工程學系系主任薛康琳教授)

“Metabolic Engineering for the production of renewable fuel and chemical”

**Dr. Claire Roa-Pu Shen**

Assistant Professor, Department of Chemical Engineering  
National Tsing Hua University

(清華大學化學工程系沈若樸教授)

“Heterogeneous catalysis in biomass conversion to fuels and chemicals”

**Dr. Yu-Chuan Lin**

Assistant Professor, Department of Chemical Engineering  
National Cheng Kung University

(成功大學化學工程系林裕川教授)

**Parallel Sessions:**

**11/23 (Sun) 2:20 pm – 3:40 pm: Technical Session D2-W1-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Gou-Jen Wang**, Distinguished Professor, Department of Mechanical Engineering and Graduate Institute of Biomedical Engineering, National Chung-Hsing University

(中興大學機械工程學系王國禎特聘教授)

Room: Conference Room I (3F)

“A CMOS Based Polysilicon Nanowire Biosensor Platform for Biomarkers of Heart Disease”

**Dr. Chih-Ting Lin**

Associate Professor, Department of Electrical Engineering  
National Taiwan University

(台灣大學電機工程學系林致廷教授)

“Novel Filter-like SERS Substrate for Biomedical Application”

**Dr. Chi-Chang Lin**

Associate Professor, Department of Chemical and Materials Engineering  
Tunghai University

(東海大學化學工程與材料工程學系林其昌教授)

“Organic Conductive Biointerfaces for Cell Engineering”

**Dr. Shyh-Chyang Luo**

Assistant Professor, Department of Materials Science and Engineering  
National Cheng Kung University

(成功大學材料科學及工程學系羅世強教授)

“Engineered Tissue on Lab Chip”

**Dr. Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering  
Chief Executive Officer, Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系暨工學院產學聯盟執行長劉承賢教授)

**11/23 (Sun) 2:20 pm – 3:40 pm: Technical Session D2-W2-T3: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Chair: **Dr. Jiun-Haw Lee**, Professor, Graduate Institute of Photonics and Optoelectronics

National Taiwan University (臺灣大學光電工程學研究所李君浩教授)

Room: Conference Room II (3F)

“Effects of Characteristic Photoelectrode and Mixed Dyes on Dye-Sensitized Solar Cells”

**Dr. Chien-Hsin Yang**

Professor, Department of Chemical and Materials Engineering  
National University of Kaohsiung

(高雄大學化學工程及材料工程學系楊乾信教授)

“SiGe-based nanomaterials for thermoelectric applications”

**Dr. Sheng-Wei Lee**

Associate Professor, Institute of Materials Science and Engineering  
National Central University

(中央大學材料科學工程研究所李勝偉教授)

"Design of ionic liquids-based polymers and composite materials for optoelectronic applications"

**Dr. Tzi-yi Wu**

Assistant, Professor, Department of Chemical and Materials Engineering  
National Yunlin University of Science and Technology

(雲林科技大學化學工程與材料工程系吳知易教授)

"The Growth of GaN Nanodots on Si (111) by Droplet Epitaxy"

**Dr. Ing-Song Yu**

Assistant Professor, Department of Materials Science and Engineering  
National Dong Hwa University

(東華大學材料科學與工程學系余英松教授)

**11/23 (Sun) 2:20 pm – 3:40 pm: Technical Session D2-W3-T3: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

Chair: **Dr. Hsi-Sheng Teng**, Professor, Department of Chemical Engineering, National Cheng Kung University (成功大學化學工程學系鄧熙聖教授)

Room: Conference Room III (3F)

"Gadolinia-doped Ceria Nanoparticles as Electrolytes by Atmospheric Pressure Plasma Jet"

**Dr. Yu-Lin (Joseph) Kuo**

Associate Professor, Department of Mechanical Engineering (Materials Division)  
Vice Dean of Student Affairs Office  
National Taiwan University of Science and Technology

(台灣科技大學機械系材料組暨學生事務處副學務長郭俞麟教授)

"Symbiotic' Semiconductors: Unusual and counter-intuitive Ge/Si interactions!"

**Dr. Thomas George**

Department of Electrical Engineering  
National Central University

**Dr. Mei-Li Hsieh**

Associate Professor, Department of Photonics  
National Chiao Tung University

(交通大學光電學系謝美莉教授)

"Thermally-Assisted-Occupation Density Functional Theory"

**Dr. Jeng-Da Chai**

Associate Professor, Department of Physics  
National Taiwan University

(臺灣大學物理學系蔡政達教授)

"Modeling Anode Gas Distribution of Proton Exchange Membrane Fuel Cells with a Dead-Ended Anode"

**Dr. Yong-Song Chen**

Assistant Professor, Department of Mechanical Engineering  
National Chung Cheng University

(中正大學機械工程學系陳永松教授)

**11/23 (Sun) 2:20 pm – 3:40 pm: Technical Session D2-W4-T3: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Jeffrey Chi-Sheng Wu**, Professor, Department of Chemical Engineering, National Taiwan University (臺灣大學化學工程學系吳紀聖教授)

Room: Conference Room IV (3F)

“The Evolution to Smart Grid of Taiwan Power System”

**Dr. Bruce Yen-Feng Hsu**

Senior Specialist, Electric Power Research Lab.  
Taiwan Power Research Institute, Taiwan Power Company  
(台灣電力公司綜合研究所電力研究室許炎豐博士)

“Communication-Efficient Decentralized Demand Side Management: A Dual Consensus ADMM Approach”

**Dr. Tsung-Hui Chang**

Assistant Professor, Department of Electronic and Computer Engineering,  
National Taiwan University of Science and Technology  
(台灣科技大學電子工程學系張縱輝教授)

“The Study and Development of Smart Grid Standards in Taiwan”

**Dr. Shih-Che (Anthony) Hsu**

Assistant Professor, Department of Electrical Engineering  
Chung Yuan Christian University  
(中原大學電機工程學系許世哲助理教授)

“The offshore wind resources assessment application of floating LiDAR in the Taiwan Strait”

**Dr. Chung-Yao Hsuan**

Assistant Researcher, Research Center for Energy Technology and Strategy  
National Cheng Kung University  
(成功大學能源科技與策略研究中心宣崇堯博士)

**11/23 (Sun) 3:40 pm – 4:00 pm: Coffee Break**

Room: Chung Hwa Hall Atrium (2F)

**Parallel Sessions:**

**11/23 (Sun) 4:00 pm – 5:20 pm: Technical Session D2-W1-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology**

Chair: **Dr. Chih-Ting Lin**, Associate Professor, Department of Electrical Engineering  
National Taiwan University (台灣大學電機工程學系林致廷教授)

Room: Conference Room I (3F)

“Biomedical Diagnosis and Detection in Resource-Limited Settings”

**Dr. Chien-Fu (Steve) Chen**

Assistant Professor, Graduate Institute of Biomedical Engineering  
National Chung Hsing University  
(中興大學生物醫學工程研究所陳建甫教授)



“Multifunctional Gold Nanostructures in Biomedical Engineering”

**Dr. Dehui Wan**

Assistant Professor, Institute of Biomedical Engineering  
National Tsing Hua University

(清華大學生物醫學工程研究所萬德輝教授)

“Optoelectrokinetically-Enabled Signal Enhancement for a Bead-Based FRET Fluorescence Immunoassay”

**Dr. Han-Sheng (Oswald) Chuang**

Assistant Professor, Department of Biomedical Engineering  
National Cheng Kung University

(國立成功大學 生物醫學工程系莊漢聲教授)

**Dr. Chia-Yuan Chen**

Assistant Professor, Department of Mechanical Engineering  
National Cheng Kung University

(成功大學機械工程學系陳嘉元教授)

**11/23 (Sun) 4:00 pm – 5:20 pm: Technical Session D2-W2-T4: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials**

Chair: **Dr. Jwo-Huei Jou**, Professor, Department of Materials Science and Engineering,  
National Tsing Hua University (清華大學材料工程學系周卓輝教授)

Room: Conference Room II (3F)

“Nanostructure Conducting Polymer for Energy-Related Applications”

**Dr. Chih-Wei Chu**

Research Fellow, Research Center for Applied Sciences  
Academia Sinica

(中央研究院應用科學研究中心朱治偉博士)

“Lead-free ZnS Nanogenerator and Active Sensor”

**Dr. Jyh Ming Wu**

Associate Professor, Department of Materials Science and Engineering  
National Tsing Hua University

(清華大學材料工程學系吳志明教授)

“Spintronic Materials Explored by Modern X-ray Absorption Spectroscopy”

**Dr. Yuan-Chieh Tseng**

Associate Professor, Department of Materials Science and Engineering  
National Chiao Tung University

(交通大學材料科學與工程學系曾院介教授)

“Inorganic Nanotube-Polymer Composite Membranes for Separation Technology”

**Dr. Dun-Yen Kang**

Assistant Professor, Department of Chemical Engineering  
National Taiwan University

(臺灣大學化學工程學系康敦彥教授)

**11/23 (Sun) 4:00 pm – 5:20 pm: Technical Session D2-W3-T4: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials**

**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
**National Cheng Kung University, Tainan, Republic of China (Taiwan)**

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Chair: **Dr. Ching-Fuh Lin**, Distinguished Professor and Director, Innovative Photonics Advanced Research Center, Graduate Institute of Photonics and Optoelectronics  
National Taiwan University (台灣大學光電工程學研究所所長暨電機工程學系林清富特聘教授)  
Room: Conference Room III (3F)

“Designer germanium quantum dots for functional sensing/metrology devices”

**Dr. Pei-Wen Li**

Professor, Department of Electrical Engineering  
Director, Center for NANO Science and Technology  
Associate Dean of Academic Affairs  
National Central University  
(中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

**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)

“Sequential Vacuum Sublimation: A New Method to Fabricate Perovskite Solar Cells”

**Dr. Hao-Wu Lin**

Associate Professor, Advanced Optoelectronic Materials Research Group  
Department of Materials Science and Engineering  
National Tsing Hua University  
(清華大學材料工程學系林皓武教授)

“Environmentally Benign and Health-caring Fluorescence Nano-composites for Warm-white Lighting”

**Dr. Ching-Fuh Lin**

Distinguished Professor and Director, Innovative Photonics Advanced Research Center  
Graduate Institute of Photonics and Optoelectronics  
National Taiwan University  
(台灣大學光電工程學研究所所長暨電機工程學系林清富特聘教授)

**11/23 (Sun) 4:00 pm – 5:20 pm: Technical Session D2-W4-T4: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Building**

Chair: **Dr. Ta-Hui Lin**, Distinguished Professor, Department of Mechanical Engineering and Director, the Research Center for Energy Technology and Strategy, National Cheng Kung University

(成功大學機械工程學系兼能源科技與策略研究中心主任林大惠特聘教授)

Room: Conference Room IV (3F)

**Dr. Ching-Ming Lai**

Assistant Professor, Department of Vehicle Engineering  
National Taipei University of Technology  
(台北科技大學車輛工程系賴慶明教授)

“Transportation and living by green energy in campus”

**Dr. Jih-Hsin Liu**

Assistant Professor, Department of Electrical Engineering  
TungHai University

(東海大學電機工程學系劉日新教授)

“A large-eddy simulation framework for wind energy studies”

**Dr. Yu-Ting Wu**

Assistant Professor, Department of Engineering Science

National Cheng Kung University

(成功大學工程科學系吳毓庭教授)

“Development and Optimization of a New Energy-saving Glass”

**Dr. Yu-Bin Chen**

Associate Professor, Department of Mechanical Engineering

National Cheng Kung University

(成功大學機械工程學系陳玉彬教授)

## **Abstracts and Biographies**

### **Day 1 (November 22, 2014)**

#### *Opening Session*

### **Opening Speech and General Conference Chair**

#### **Ta-Hui Lin**

Distinguished Professor, Department of Mechanical Engineering and  
Director, the Research Center for Energy Technology and Strategy  
National Cheng Kung University

(成功大學機械工程學系兼能源科技與策略研究中心林大惠特聘教授)

#### **BIOGRAPHY**



Opening Session

**Welcome Remarks**

**Hwung-Hweng Hwung**

President, National Cheng Kung University  
(成功大學黃煌輝校長)

BIOGRAPHY



Opening Session

**Welcome Remarks**

**Yueh-Min Huang**

Distinguished Professor, Department of Engineering Science  
Associate Dean, College of Engineering  
National Cheng Kung University

(成功大學工程科學系兼工學院副院長黃悅民特聘教授)

BIOGRAPHY



Opening Session

**Project Manager and Conference Manager**

**Yu-Bin Chen**

*Associate Professor, Department of Mechanical Engineering*  
*National Cheng Kung University*  
*No. 1, University Rd., Tainan City 70101, Taiwan*  
*Tel: +886-6-2757575#62119; Fax: +886-6-2352973*  
*E-mail: ybchen@mail.ncku.edu.tw*  
(成功大學機械工程學系陳玉彬教授)

BIOGRAPHY



Dr. Yu-Bin Chen was born in Taipei, Taiwan in 1975. He received his BS degree and MS degree from the Department of Mechanical Engineering at National Taiwan University, Taiwan, in 1998 and 2000, respectively. He received his PhD degree in Mechanical Engineering from Georgia Institute of Technology, USA in 2007.

He is currently an associate professor in the Department of Mechanical Engineering, National Cheng Kung University, Tainan, Taiwan. His research interests cover optical and radiative properties. He has authored over 30 journal publications.

In 2013, Dr. Chen got the outstanding reviewer award of Journal of Heat Transfer, ASME. Dr. Chen is associate editor-in-chief of Smart Science and associate editor of Journal of Heat Transfer Augmentation. Moreover, he is a reviewer of many SCI journals, such as Optics Express, Optics Letters, Journal of Quantitative Spectroscopy and Radiative Transfer, and International Journal of Heat and Mass transfer.

*Plenary Session (I)*

**Workshop Co-chair and Session Co-chair**

**Fang-Chung Chen**

Professor, Department of Photonics, National Chiao Tung University  
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**BIOGRAPHY**



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

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA, from Oct. to Dec. in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include polymer solar cells, organic photodetectors, organic memories, organic light-emitting diodes, and organic thin-film transistors.

Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 80 Journals papers, three book chapter, 90 conference papers and owned 14 patents. He is currently on the Editorial Boards of Active and Passive Electronic Components. He frequently serves as a referee for many high-quality Journals, such as JACS, Adv. Mat., Adv. Funct. Mat., ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..



*Plenary Session (1)*

**Plenary Speaker**

**Resolve the Mystery of Interfacial Water and Water Splitting by Using  
Advanced Nano-Imaging and Sensing Technologies**

**Chi-Kuang Sun**

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(台灣大學電機工程學系與分子生醫影像研究中心主任孫啟光特聘教授)

**ABSTRACT**

Water represents more than 70 percent of body weight, and is the most important liquid in life, energy, and environment. In biological systems, liquid water defines the environment for biological activity by supporting and mediating biochemical reactions. Understanding the physical and chemical properties of liquid water, and, in particular, the interfacial water, is therefore often considered a prerequisite for understanding biology and chemistry in aqueous solutions on a molecular level. Liquid water possesses many anomalous properties, and it is often speculated whether the unique role of water in defining biological activity is caused by these unusual properties. It is thus highly desired to find a way to sense or even to image the physical properties and relaxational responses of different water molecule layers, in order to define different status of the liquid water, especially when liquid water molecules approach an interface wherein the first few water molecular layers govern interface-mediated properties, including surface wetting, energy transfer, protein folding, supercool phenomena, water splitting, and water purification. A variety of techniques have been employed to investigate the physical properties of interfacial water. However, the ångström-scale feature and the picosecond relaxation dynamics of water have made it challenging to experimentally understand how the water molecules interact with the substrate and with each other.

In this presentation, I will review our past efforts on the development of different nanotechnologies in order to resolve the mystery of interfacial water, and to provide a way for remote sensing. These efforts include the development of a sub-nanometer resolution ultrasonic imaging technique for interfacial water imaging, and for real-time monitoring of photo-chemical reaction occurring at the semiconductor-water interface. We will discuss the layering properties of the interfacial water, and the observation of a mysterious layer during photochemical reaction. Taking advantage of the known layering properties, we further performed THz absorption spectroscopy study on liquid water confined in mesoporous silica materials MCM-41-S-15 and MCM-41-S-24. With a high sensitivity of mobility of liquid water molecules, THz absorption spectroscopy analysis reveals a bulk-water-like THz absorption spectrum in the core water region and a solid-like THz absorption spectrum in the interfacial water region, agreeing with the nanoultrasonic imaging results. The high sensitivity of THz spectroscopy on water was further developed as a sensing and imaging technology for in vivo monitoring of different water states in different animal models. The potential applications for clinical uses and for wearable devices will be discussed.

**BIOGRAPHY**



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

He was a Visiting Scientist at the Research Laboratory of Electronics, Massachusetts Institute of Technology, between 1992 and 1994, and was with the NSF Center of Quantized Electronics Structures, University of California, Santa Barbara, from 1995 to 1996 as an assistant research fellow. In 1996, he joined the Graduate Institute of Photonics and Optoelectronics and Department of Electrical

Engineering at NTU, where he is now a life distinguished professor and the Y. Z. Hsu science chair professor. He served as the Deputy Dean of College of Electrical Engineering and Computer Science and was the founding Chief Director of NTU Molecular Imaging Center. He is an adjunct research fellow at the Institute of Physics and Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan. He leads the NTU Ultrafast Optics Group and his research interest is primarily concerned with biomedical optics, nano-acoustics, femtosecond laser technology, and THz optoelectronics.

Dr. Sun is a fellow of the Optical Society of America, a fellow of the International Society for Optical Engineering (SPIE), and a fellow of the IEEE Photonics Society. He was the recipient of year 2000 C.N. Yang Outstanding Young Researcher Award from Association of Asian Pacific Physical Society, the 2001 Academia Sinica Research Award for Junior Researchers from Academia Sinica of Taiwan, the 2003 Leica Microsystems Innovation Award, the MERIT Award from the National Health Research Institute of Taiwan (2003-2009; 2010), the 2004 NTU Research Achievement Award, the Outstanding Research Award (2004-2006; 2009-2015) and the Outstanding Research Grant Award (2008-2011) from National Science Council of Taiwan, the 2008 Y. Z. Hsu Scientific Paper Award, the 2008 Outstanding Electrical Engineer Award from the Chinese Institute of Electrical Engineering, and the 2010 Engineering Medal from the Taiwan Photonic Society.

*Plenary Session (II)*

**Workshop Co-chair and Session Co-chair**

**Pei-Wen Li**

Professor, Department of Electrical Engineering  
Director, Center for NANO Science and Technology  
Associate Dean of Academic Affairs  
National Central University

(中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

BIOGRAPHY



Pei-Wen Li was born in Taiwan in 1967 and received the Bachelor degree in electrophysics from National Chiao-Tung University, Taiwan in 1989, and the Master and Ph.D. degree in electrical engineering from Columbia University in New York city in 1991 and 1994, respectively.

Her Ph.D. dissertation was focused on the study of low temperature oxidation of SiGe alloys and she has successfully demonstrated the first pure SiGe-channel pMOSFETs. In 1995, she joined Vanguard International Semiconductor Corporation working on the process integration of 64M DRAM. Then, she joined I-Shou University as a faculty in the department of Electronic Engineering in 1996. She joined the department of Electrical Engineering, National Central University as an associate professor in 2000, was promoted to be a professor since August 2005, and served as the department chair during 2007-2010. Currently she is the associate dean of Academic Affairs and the director of the Center for Nanoscience and Technology, National Central University.

Dr. Li's main research theme focuses on experimental silicon-germanium nanostructures and devices. Her present research encompasses germanium quantum dot single-electron transistors, photodetectors, nonvolatile memory, and energy saving (photovoltaic and thermoelectric) devices, making use of self-assembly nanostructures in silicon integration technology. Her research group has successfully developed a novel CMOS-compatible, self-organized approach for the generation of germanium quantum dots on Si-containing layers through thermal oxidation of silicon-germanium-on-insulator structures. Of particular, the successful demonstration of precise placement and size control of the self-assembled germanium quantum dots shed light on the practical creation of new nano-electronic, nano-photonic, and electromechanical devices. She has published more than 70 journal papers and holds 5 patents in Si device processing.

*Plenary Session (II)*

**Plenary Speaker**

**Chances and challenges for Taiwan in low carbon and green energy**

**Chin Pan**

Distinguished Professor, Department of Engineering and System Science  
National Tsing Hua University

(清華大學工程與系統科學系潘欽教特聘教授)

ABSTRACT

BIOGRAPHY



*Plenary Session (III)*

**Workshop Co-chair and Session Co-chair**

**Ching-Fuh Lin**

Distinguished Professor, Department of Electrical Engineering and  
Director, Innovative Photonics Research Center  
National Taiwan University

(台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

BIOGRAPHY



Prof. Ching-Fuh Lin obtained the B.S. degree from National Taiwan University in 1983, and the M.S. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1989 and 1993, respectively, all in electrical engineering.

He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University. His major research area is in photonics, including organic-inorganic composites for light-emission devices and solar cells, single-crystal Si thin-film solar cells, Si-based photonics, and physics in broadband semiconductor lasers and optical amplifiers.

He is a Fellow of IEEE, a Fellow of SPIE, Member of Asia-Pacific Academy of Materials, and a member of OSA. He has published over 160 journal papers and 450 conference papers and holds more than 50 patents. He is also the sole author of two books, “Optical Components for Communications: Principles and Applications”, published by Kluwer Academic Publishers (USA 2004), and “Optics and Photonics: Fundamentals and Applications” (in Chinese, 2012), and co-authors a book, “Organic, Inorganic and Hybrid Solar Cells –Principles and Practice”, published by John Wiley & Sons, Inc. and IEEE Press, 2012. He had obtained the Distinguished Research Award and several Class A Research Awards from National Science Council of Taiwan, ROC, and the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering. He and his students had also been granted the 18th Acer Research Golden Award, 18th Acer Research Excellent Award, 14th Acer Research Excellent Award, 6th Y. Z. Hsu Technology Invention Award, Outstanding R&D Innovation Award of NTU 2014, Collins Thesis Awards for years of 1998, 2001, 2002, 2004, 2007, 2009, 2010, and 2012.

Prof. Lin has served in the International Scientific Committee of 27th, 28th & 29th European Photovoltaic Solar Energy Conference and Exhibition and as the Chair of IEEE LEOS Chapter Taipei Section, the Board member of the 17th IEEE Taipei Section, and the Council member of the 10th Optical Engineering Society of ROC and Taiwan Photonics Society.

*Plenary Session (III)*

**Plenary Speaker**

**Faa-Jeng Lin**

Chair Professor, Department of Electrical Engineering, National Central University  
Committee Chair, National Energy Plan (NEP-II) Smart Grid Focus Center  
Ministry of Science and Technology, R.O.C. (Taiwan)

(中央大學電機工程學系兼科技部第二期能源國家型科技計畫智慧電網主軸計畫召集人林法正講座教授)

**ABSTRACT**

The National Energy Program – Phase II (NEP-II) includes development of energy policy guidelines, a planning and implementation program for smart grids, action plans for energy savings and greenhouse gas reduction, a low-carbon environment, development of a renewable energy industry and accompanying measures (e.g. Carbon Reduction Action Project, Penghu low-carbon island program, Green Energy, Renewable Energy Development Ordinance, Sustainable Energy Sources Policy Program, etc.). In response to the major changes both domestically and internationally, Taiwan's energy policies now follow three major objectives: (1) Security - to ensure stability of energy supply, finding a balance between energy use & normal systems operations, and taking into account risk management; (2) Efficiency - to strengthen energy utilization management, promoting energy conversion, transmission and utilization efficiency, as well as increase value-add for energy; (3) Cleanliness - to move towards low-carbon energy and utilize low-carbon technology whenever possible for every project. The goals, framework and some research contents of NEP-II are given in this talk.

**BIOGRAPHY**



Faa-Jeng Lin received his B.S. and M.S. degrees in electrical engineering from National Cheng Kung University in Tainan, Taiwan, and his Ph.D. degree in electrical engineering from National Tsing Hua University in Hsinchu, Taiwan, in 1983, 1985, and 1993 respectively. Currently, he is Chair Professor at the Department of Electrical Engineering, National Central University, Taiwan, and the President, Taiwan Smart Grid Industry Association. He was the Chair of the Power Engineering Division at the National Science Council in Taiwan and the Chair of the IEEE IE/PELS Taipei Chapter from 2007 to 2009. He is also now a member of the FS Technical Committee of CIS, IEEE, and the Chair of the IEEE CIS Taipei Chapter. His research interests include fuzzy and neural network control theories, nonlinear control theories, AC and ultrasonic motor drives, DSP-based computer control systems, power electronics, microgrid and smart grid. He has received the Outstanding Research Award from the National Science Council, Taiwan, in 2004, 2010 and 2013; the Outstanding Professor of Electrical Engineering Award in 2005 from the Chinese Electrical Engineering Association, Taiwan. Moreover, he is a Fellow of the Institution of Engineering and Technology (IET).

*Technical Session D1-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

### **Session Chair**

### **Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering and  
Chief Executive Officer of Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系兼工學院產學聯盟執行長劉承賢教授)

### **BIOGRAPHY**



Cheng-Hsien Liu (劉承賢) received the B.S. degree in power mechanical engineering from the National Tsing-Hua University, Taiwan, in 1987, the M.S. degree in mechanical engineering from the Lehigh University, Bethlehem, P.A., in 1992, the M.S. degree in electrical engineering and the Ph.D. degree in mechanical engineering from Stanford University, CA, in 1995 and 2000, respectively.

He presently is a professor in the Power Mechanical Engineering Department at National Tsing Hua University. He has served as the Chief Executive Officer of Industrial Liaison Program, College of Engineering, National Tsing Hua University since Aug. 2012. He had been with National Tsing Hua University, Taiwan since Autumn 2000. In 1999-2000, he worked as a senior Electrical Engineer at Halo Data Devices Inc., San Jose, where he focuses on the development of micro-drives for portable information storage applications. While at Stanford, he worked with Dr. Kenny at Stanford Micro-structures and Sensors Laboratory and focused his Ph.D. work on high-performance MEMS sensors. He currently oversees graduate students in the Micro-Systems and Control Laboratory, whose research activities cover a variety of areas in MicroElectroMechanical Systems, Lan on Chip, system dynamics/modeling/control and Nanotechnology. Some recent highlighted research includes biomimetic array chip for bio-object manipulation targeting for tissue engineering/drug screening applications, Liver on Lab Chip, Lung on Lab Chip, Biomedical Instruments, microphotonics, and advanced tunable MEMS grating.

Dr. Liu received A. Kobayashi Young Investigator Award in Experimental Science from International Conference on Computational and Experimental Engineering and Sciences (2010), the award of Outstanding Chemical Engineering Article of the Year 2010, the Academic Excellent Award from National Tsing Hua University (ranking top 4% in 2010 and 2013), Outstanding Research Program Award from National Science and Technology Program in Biomedical field (2012), Outstanding Research Award from National Science Council (NSC) in 2012 (100 年度國科會傑出研究獎).



*Technical Session D1-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

**Da-Jeng Yao**

Director, The Institute of NanoEngineering and MicroSystems  
National Tsing Hua University  
(清華大學奈米工程兼微系統研究所所長饒達仁教授)

ABSTRACT

BIOGRAPHY





## **Blood flow improvement by stents with biocompatible material**

**Aichi Chien**

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### ABSTRACT

Various designs of stent devices have been used for treating vascular diseases. Typically, medical procedures are performed by endovascular therapy to implant stents and achieve the goal of increasing lumen diameter or reconstructing the blood flow path. First generation bare-metal stents almost eliminated the risk of the arterial collapse, but they only modestly reduced the risk of restenosis. About 25% of all coronary arteries treated with bare-metal stents would close up again, usually within 6 months. As a result, for years, generations of stents were proposed to improve the treatment and minimize drawbacks. Drug eluting stents, biodegradable stents, and bioresorbable stents all showed great promise to improve treatment outcome. They dramatically reduced the rate of restenosis to less than 10%. However, these stents were associated with a serious complication: late stent thrombosis, in which a blood clot forms inside the stent after it is implanted. Combining these advances with structural design, recent improvements to strut overlap, strut thickness and changing the pulsatility showed that altering hemodynamic characteristics also can improve treatment outcome. In this talk, a discussion of the usage of stent material and design will be presented as well as the latest development of the newly approved Pipeline stent.

### BIOGRAPHY



Aichi Chien, Ph.D. is an Assistant Professor in the Department of Radiological Sciences and the Biomedical Physics IDP Graduate Program in the UCLA Medical School since 2009; a faculty member of Medical School Short Term Training Program (SSTP) and Cross-disciplinary Scholars in Science and Technology (CSST) program since 2010, and faculty in the UCLA Center for Domain Specific Computing (CDSC) since 2011.

Dr. Chien received her Bachelor's Degree from National Taiwan University, Dept. of Agricultural Machinery Engineering in 1999, Taipei, Taiwan. She then completed her Master's Degree on the subject of Micro/Nano Resonators in the Dept. of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY; and her PhD Degree in Biomedical Engineering at the University of California, Los Angeles, CA on the topic of MEMS/NEMS implantable devices for cardiovascular disease. She went on to complete Postdoctoral Fellowship training in endovascular treatment in the Division of Interventional Neuroradiology in the UCLA David Geffen School of Medicine.

Dr. Chien's research interests encompass cardiovascular and stroke disease analysis with the integration of science and engineering to assist clinical decision making for individualized medicine. She has published more than 50 peer-review journal publications of original research, including 17 first author papers in high impact factor medical journals such as Stroke, Neurosurgery, Journal of Neurosurgery, and American Journal of Neuroradiology. She has received several awards, including the American Heart Association Outreach Award (2004), Heart Failure Society of America (2004), American Society for Laser Medicine and Surgery (2006), and Young Investigator Award from Cardiovascular System Dynamics Society (2006). She is the lead inventor on multiple US Patents and International Patents; Principle Investigator in a Philips Healthcare research grant and Radiology Exploratory grant. She is currently a Co-Investigator on two NIH R01 projects and one NSF (CCF) multi-disciplinary program. She has regularly given lectures in universities/ medical centers around the world and in US and international scientific meetings.

*Technical Session D1-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

## **Using Patterned Physical Confinement to Develop Lipid Bilayer Platforms Insensitive to Air Bubbles**

**Ling Chao**

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### ABSTRACT

Two-dimensional fluidity and ability to maintain membrane species native orientation have made supported lipid bilayers (SLBs) as ideal platforms for various bioassays and biosensor applications. However, SLBs can easily delaminate by air bubbles during the assay reagent transport and exchange. The air-water interface in contact with SLBs can provide an interfacial force to peel the bilayers from the support. Here, we developed a novel method to use patterned obstacle grating to trap water above the bilayers to prevent the air-water interface from directly contacting and peeling the bilayers. We showed that our platform with certain geometry criteria can provide promising protection to SLBs from air bubbles. The interaction assay result from streptavidin and biotinylated lipid in the confined SLBs also suggested that the interaction ability can remain after air-bubble treatment. This platform integrated with a microchannel device for reagent transport has great potential to be applied with surface analytical tools to create robust cell-membrane-related assays.

### BIOGRAPHY



Dr. Ling Chao received her Bachelor degree from the Department of Chemical Engineering at National Taiwan University, Taipei, Taiwan in 2003, and her Ph.D. degree from the Department of Chemical Engineering at Massachusetts Institute of Technology, Cambridge, MA, USA in 2009.

She was a postdoctoral research associate in the Department of Chemical and Biomolecular Engineering at Cornell University, Ithaca, NY, USA from 2009-2011 after receiving her Ph.D. degree. She is currently an assistant professor in the Department of Chemical Engineering at National Taiwan University, Taipei, Taiwan.

Dr. Chao's research interest includes developing cell membrane mimic platforms as high throughput biosensors and understanding the underlying mechanisms of membrane related cellular processes for novel therapeutic applications. She has been the first author and corresponding author of the publications in several prestigious journals in her field including JACS, ACS Applied Materials and Interfaces, Lab on a Chip, Langmuir, and Biomicrofluidics. Her recent publication is also selected to feature on the front cover of issue 1 of Lab on a Chip 2015. She is a member of Chemical Engineering Society in Taiwan, AIChE and ACS.

## **Control Gaseous Microenvironments in vitro: Microfluidic Cell Culture**

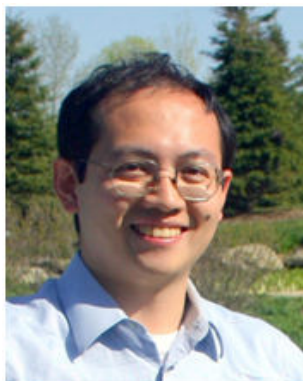
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### ABSTRACT

Cells are the basic functional units of most living organisms. They sense and respond to changes in their environment and communicate with neighboring cells by releasing chemicals or generating electrical signals. Basic in vitro cell culture techniques have changed little for almost a century. The dominant format for cell culture is the petri dish or similar platforms. However, this approach becomes increasingly expensive, complicated to scale up, and has difficulties to reconstitute complex cellular microenvironments as in vivo. Furthermore, the concentration of various gases plays an essential role for mammalian cell culturing. Due to the high diffusivity of gases in an aqueous solution, controlling gaseous microenvironments has been a challenging task for biologists. Studies of cellular responses to gases in cellular microenvironments would benefit from a reliable platform that is capable of robustly controlling the gaseous concentration in both spatial and temporal domains. Microfluidic technology offers the attractive ability to precisely control or mimic the rich biochemical and biophysical complexity of the cellular microenvironments. In this talk, I will discuss control of gaseous microenvironments using microfluidic devices. Specifically, I will talk about control of oxygen, oxygen and soluble factors, and nitric oxide for cell culture.

### BIOGRAPHY



Yi-Chung Tung was born in Keelung, Taiwan on December 2, 1974. He received his Ph.D. degree in Mechanical Engineering from the University of Michigan, Ann Arbor in 2005, and his B.S. and M.S. degrees in Mechanical Engineering from National Taiwan University, Taipei, Taiwan in 1996 and 1998, respectively.

He is currently an Associate Research Fellow in the Research Center for Applied Sciences (RCAS) at Academia Sinica, Taipei, Taiwan. Before joining Academia Sinica, he was a Postdoctoral Research Fellow in the Department of Biomedical Engineering at the University of Michigan, Ann Arbor from 2006 to 2009. He received his Ph.D. degree in Mechanical Engineering from the University of Michigan, Ann Arbor in 2005, and his B.S. and M.S. degrees in Mechanical Engineering from National Taiwan University, Taipei, Taiwan in 1996 and 1998, respectively. His research interests include developing microfluidic devices to mimic physiological microenvironments for in vitro cell culture, microelectromechanical systems (MEMS), and micro/nano fabrication techniques.

**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
**National Cheng Kung University, Tainan, Republic of China (Taiwan)**

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Dr. Tung is a member of IEEE, and he receives Ta-Yu Wu Memorial Award from Taiwan Ministry of Science and Technology (MOST) in 2014. He has published more than 100 international journal and conference papers.

**Session Chair**

**Fang-Chung Chen**

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(交通大學光電工程學系陳方中教授)

**BIOGRAPHY**



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

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA, from Oct. to Dec. in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include polymer solar cells, organic photodetectors, organic memories, organic light-emitting diodes, and organic thin-film transistors.

Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 80 Journals papers, three book chapter, 90 conference papers and owned 14 patents. He is currently on the Editorial Boards of Active and Passive Electronic Components. He frequently serves as a referee for many high-quality Journals, such as JACS, Adv. Mat., Adv. Funct. Mat., ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..

## **Tunable graphene based optics, electronics and photonics**

**Chun-Wei Chen**

Distinguished Professor, Department of Materials Science and Engineering  
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(臺灣大學材料科學與工程學系陳俊維特聘教授)

### ABSTRACT



Graphene, which consists of a single atom-thick plane of carbon atoms arranged in a honeycomb lattice, exhibits unique both “bulk” and “surface” properties of materials due to its tunable electronic structure. In this talk, I would like to present the tunable platform of graphene-based materials including graphene and graphene oxide in optical, electronic and photonic applications by manipulating their corresponding atomic and interfacial structures. By controlling the sp<sup>2</sup>/sp<sup>3</sup> ratio of graphene oxide (GO), interesting PL emission of GO and r-GO can be tuned from blue to red color with a wide spectrum [1,2]. Through tuning the atomic structures, several interesting applications of GO in optoelectronic or photovoltaic devices will be also presented as a result of tunable electrical conductivity from a thin tunneling layer of GO to a transparent electrode of graphene[3,4]. The tunable workfunction of graphene makes it an ideal candidate as an “active” electrode.

In addition, we would like to demonstrate an interesting tunable doping mechanism in graphene using so-called self-encapsulated doping or organic/inorganic hybrid doping platform,[5,6] which allows us to fabricate air-stable n- and p-type graphene based transistors with excellent tunability by using chemical or optical ways. I would like to demonstrate the wavelength-selective p- and n-typed carrier transport behaviors of a graphene transistor based on the organic/inorganic hybrid doping platform, which enables us to control the dual carrier-typed transport behaviors of a graphene transistor by wavelength-selective illumination.[7]

### **Reference:**

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- [7] **Advanced Materials**, 2014 (in press)



## **Carbon Nanotubes as Penetrating Electrodes for Promoting the Efficiency of Organic Solar Cells**

**Pen-Cheng Wang**

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(清華大學工程與系統科學系王本誠教授)

### ABSTRACT

In this study, we fabricated and characterized organic photovoltaic (OPV) devices with hybrid composite anodes containing single-walled carbon nanotube (SWCNT) networks sandwiched between ITO and PEDOT:PSS. We also integrated H<sub>2</sub>SO<sub>4</sub>/HNO<sub>3</sub>-treated and N<sub>2</sub>H<sub>4</sub>-treated SWCNT networks into OPV devices to investigate the effect of chemically-treated SWCNTs on OPV devices' performance. We found that integration of N<sub>2</sub>H<sub>4</sub>-treated SWCNTs into the hybrid composite anode could enhance J<sub>sc</sub> in P3HT:PCBM OPV devices. The improved performance in devices integrated with N<sub>2</sub>H<sub>4</sub>-treated SWCNTs can be attributed to (i) better crystallinity of the P3HT polymer, and (ii) increased hole-transport efficiency of the hybrid composite anode, both induced by the penetration/digitation of SWCNTs into the P3HT polymer layer. The chemical structures of N<sub>2</sub>H<sub>4</sub>-treated SWCNT were also probed by synchrotron photoelectron spectroscopy. We found the improved quality of SWCNT was related to the transient bonding and chemical scavenging of certain highly reactive nitrogenous radicals, such as amidogen and nitrene, thermally decomposed from N<sub>2</sub>H<sub>4</sub>.

### BIOGRAPHY



nanotechnology.

Pen-Cheng Wang is an associate professor with Department of Engineering and System Science, National Tsing Hua University, Hsinchu, Taiwan. He obtained his BS degree in chemistry from National Taiwan University and Ph.D. degree in materials chemistry from University of Pennsylvania. Before joining National Tsing Hua University as an assistant professor in 2008, he served as a faculty research assistant at University of Maryland, a research associate and a research scientist at University of Pennsylvania. His research interests mainly focus on the science and engineering of soft materials, polymeric materials, nanomaterials and their applications in displays, organic electronics, miniaturized bio-analytical systems, renewable energy and



## **Controlled Growth of Strained Si in Silicide/Silicon Nanoheterostructures from Point Contact Reactions**

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### ABSTRACT

In very-large-scale-integration technology, metal silicides have been used as circuit elements in microelectronic devices for ohmic contacts, Schottky barriers, gate electrodes, and interconnection among transistors. Additionally, nanoscale metal silicides have attracted more interest and attention as the trend of device-miniaturization continues. Therefore, more and more studies have been conducted on silicide nanodots and silicide nanowires; the latter especially stirs widespread investigations, demonstrated to play an important role in nanodevices as shown in lots of literature.

In this talk, I will discuss our efforts in generating silicide/Si nanowire heterostructures with solid state reactions and the focus will be on point contact reactions, where single crystalline silicide/Si/silicide nanowire heterostructures have been fabricated, in which giant strain was found in the middle Si layer, the dimension of which can be controlled down to sub-5 nm with atomically sharp interfaces between Si/silicides, overcoming the limit of conventional patterning process. Also, efficient and unique methods to form multiple nanoheterostructures of silicide/Si without lithography will be discussed. Moreover, it has been found that surface oxide affects the growth of these nanostructures significantly.

### BIOGRAPHY



Born and raised in Taipei, Dr. Kuo-Chang Lu received his B.S. degree in Department of Materials Science of Engineering at National Chiao Tung University, Hsinchu, Taiwan; both his M.S. and Ph.D. degrees were obtained in Department of Materials Science of Engineering at University of California, Los Angeles, USA. He is currently an assistant professor in Department of Materials Science of Engineering at National Cheng Kung University, Tainan, Taiwan. Prior to the faculty position, he was a Process Engineer in Silicon Systems Group at Applied Materials, Inc., Santa Clara, California, USA.

Dr. Lu has authored multiple publications in journals, such as Nano Letters, ACS Nano and Applied Physics Letters. His research interests include fundamental studies regarding kinetics, characterization and materials reliability.

Dr. Lu is a two-time recipient of National Science Council Award for Outstanding Young Investigator (2011, 2013). He also received Rising Star Research Award from College of Engineering, NCKU in 2011, High-Ranking Journal Paper Award from NCKU, Excellent Young Inventor Award from Taiwan Comprehensive University

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System in 2012, nomination for Ta-Yu Wu Memorial Award in 2013, and three NCKU Distinguished Faculty Awards.

## **Plasmonic Nanostructures for Light Trapping in Organic Photovoltaic Devices**

**Fang-Chung Chen**

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### ABSTRACT

Over the past decade, we have witnessed rapid advances in the development of organic photovoltaic devices (OPVs). At present, the highest level of efficiency has surpassed 10%, suggesting that OPVs have great potential to become competitive with other thin-film solar technologies. While the internal quantum efficiency of OPVs can approach 100%, efficient light harvesting in OPVs remains one of the major limitations toward realizing high PCEs. In this talk, I will present the plasmonic effects induced by metallic nanostructures on the device performance of OPVs. We constructed various Au nanostructures, such as nanoparticles and nanorods, and integrated with OPVs to trigger localized surface plasmon resonance (LSPR) for enhancing the absorption efficiencies. Further, metal nanoparticle/graphene oxide (AuNP/GO) nanocomposites are synthesized and used as anodic buffer layers in OPVs. The application of thiol-terminated polyethylene glycol as a capping agent prevents the aggregation of the AuNPs on the GO surface and further improves the solubility and stability of these nanomaterials in solution. When AuNP/GO nanomaterials served as the buffer layers, they also introduce LSPR in the OPVs, leading to noticeable enhancements in the photocurrent and the efficiencies of the OPVs. The details of the device characterization will be given. The mechanism of the plasmonic-enhanced OPVs will be also discussed. Finally, we provide a brief outlook into the future use of SPs in highly efficient OPVs.

### BIOGRAPHY



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

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA, from Oct. to Dec. in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include polymer solar cells, organic photodetectors, organic memories, organic light-emitting diodes, and organic thin-film transistors.

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Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 80 Journals papers, three book chapter, 90 conference papers and owned 14 patents. He is currently on the Editorial Boards of Active and Passive Electronic Components. He frequently serves as a referee for many high-quality Journals, such as JACS, Adv. Mat., Adv. Funct. Mat., ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..

**Session Chair**

**Ching-Fuh Lin**

Distinguished Professor, Department of Electrical Engineering and  
Director, Innovative Photonics Research Center  
National Taiwan University

(台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

BIOGRAPHY



Prof. Ching-Fuh Lin obtained the B.S. degree from National Taiwan University in 1983, and the M.S. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1989 and 1993, respectively, all in electrical engineering.

He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University. His major research area is in photonics, including organic-inorganic composites for light-emission devices and solar cells, single-crystal Si thin-film solar cells, Si-based photonics, and physics in broadband semiconductor lasers and optical amplifiers.

He is a Fellow of IEEE, a Fellow of SPIE, Member of Asia-Pacific Academy of Materials, and a member of OSA. He has published over 160 journal papers and 450 conference papers and holds more than 50 patents. He is also the sole author of two books, "Optical Components for Communications: Principles and Applications", published by Kluwer Academic Publishers (USA 2004), and "Optics and Photonics: Fundamentals and Applications" (in Chinese, 2012), and co-authors a book, "Organic, Inorganic and Hybrid Solar Cells –Principles and Practice", published by John Wiley & Sons, Inc. and IEEE Press, 2012. He had obtained the Distinguished Research Award and several Class A Research Awards from National Science Council of Taiwan, ROC, and the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering. He and his students had also been granted the 18th Acer Research Golden Award, 18th Acer Research Excellent Award, 14th Acer Research Excellent Award, 6th Y. Z. Hsu Technology Invention Award, Outstanding R&D Innovation Award of NTU 2014, Collins Thesis Awards for years of 1998, 2001, 2002, 2004, 2007, 2009, 2010, and 2012.

Prof. Lin has served in the International Scientific Committee of 27th, 28th & 29th European Photovoltaic Solar Energy Conference and Exhibition and as the Chair of IEEE LEOS Chapter Taipei Section, the Board member of the 17th IEEE Taipei Section, and the Council member of the 10th Optical Engineering Society of ROC and Taiwan Photonics Society.

## **ZnO-based Nanostructures for Sensing Devices**

### **Bohr-Ran Huang**

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### ABSTRACT

Zinc oxide (ZnO) is a versatile metal oxide semiconductor and has attracted considerable attention over the past few decades due to its wide direct band gap (3.37 eV), large exciton binding energy (60 meV at room temperature), high mechanical, chemical, thermal stabilities, piezoelectric characteristics, and biocompatibility. Optoelectronic and sensing properties of ZnO is dominated by surface morphology and nanoscale dimension, which can be affected dramatically by its morphology.

The simple and cost-effective techniques have been developed for fabricating ZnO-based nanostructures. The nanostructures provide a number of combined properties including a large surface area, improved crystallinity, work function, electrical properties, effective surface passivation, and antireflection layer. The ZnO-based nanostructures propose an effective way to enhance the efficiency of ZnO-based optoelectronic and sensing devices and will be useful for the development of next-generation devices.

### BIOGRAPHY



Bohr-Ran Huang (黃柏仁) was born in Nantou in August, 1961. He got his bachelor degree in department of Electrophysics from National Chiao-Tung University, Hsin-chu, Taiwan, in 1983. He served as the second lieutenant during his military service between 1983 and 1985. Then he received the M.S. and Ph.D degree in Electrical Engineering from Michigan State University, East Lansing, U.S.A, 1986 and 1992, respectively.

In 1992, he joined the National Yunlin University of Science and Technology (NYUST) as Associate Professor of Electronic Engineering and became a Full Professor in 2000. He served as Chairperson of Electronic Engineering and Director of Optoelectronic Institute in National Yunlin University of Science and Technology between 2002 and 2007. Then he was recruited to the graduate Institute of Electro-optical engineering and department of Electronic Engineering in National Taiwan University of Science and Technology(NTUST) since August, 2007. Currently, he is a Distinguished Professor in

NTUST(Taiwan Technology). He also serves as the Vice-Dean for College of Electrical Engineering and Computer Science since Aug., 2011.

Professor Huang's multidisciplinary research areas are synthesis of nanomaterials (including carbon nano tubes, silicon nanowires, ZnO, WO<sub>3</sub>, and Nanodiamond), silicon based solar cells and nano-optoelectronic sensing devices. Currently, he has published more than 130 papers in referred journal publications and over 200 conference proceedings. Professor Huang is a senior member of Electronic Device Society of IEEE. He received the

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Outstanding Electrical Engineering Award from Chinese Institute of Electrical Engineering at 2013. Currently, Professor Huang is a Fellow of Institution of Engineering and Technology (IET).

## **Organic/Inorganic Thermoelectric Chips: from Quantum Mechanics to System Dynamics**

**Che-Wun Hong**

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### ABSTRACT

This paper presents the multi-scale technique to integrate the thermoelectric chips based air conditioning system design from materials to system control. Thermoelectric chips offer the advantages of being solid state; no moving parts, no refrigerants, modular structure and easily switched between the two modes of either cooling or heat pumps. Nanowire concept is adopted to increase the electric conductivity, and to reduce the thermal conductivity of the thermoelectric materials. Electron and phonon transport phenomena are simulated via computational quantum mechanics techniques (CASTEP code based on density functional theory); while system dynamics simulations are carried out based on the Euler-Lagrange framework with passivity control models. Various organic/inorganic nanowire structure design ideas, including Si-Ge super-lattice, Beta phase Si, Magnetic Si, and organic conducting polymer nanowires, have been studied and their electron conductivity, electron thermal conductivity, phonon thermal conductivity, Seebeck coefficient, power factor, and figure of merit (ZT) are predicted. In addition, a feasibility study has been performed in order to determine scenarios where the solid-state air conditioner may be used and will include guidelines for its success. A MATLAB/Simulink platform will predict the coefficient of performance (COP) and transient performance of the air conditioner in the cabin of an electric vehicle.

**Keywords:** multi-scale simulation; thermoelectricity; quantum mechanics; system dynamics

### BIOGRAPHY



Che-Wun Hong (ASME Fellow) received his Ph.D in Mechanical Engineering from Imperial College, London, U.K. in 1987. He is currently in charge of the Green Energy/Quantum Engineering Lab, and Intelligent Green Vehicle Lab in the Power Mechanical Engineering Department, National Tsing Hua University in Taiwan. His research area includes molecular engineering, fuel cell engineering, solar cell/LED, combustion engines, automotive engineering, and bio-photonics which are all based on academic fundamentals of Quantum Mechanics, Molecular Dynamics, Boltzmann Modeling, Computational Fluid Dynamics, and System Dynamics.



Apart from academic researches, he has been actively conducting researches with motor companies and various research institutes. He was the general chairman of the International Symposium on Advanced Vehicle Control, 2006 (AVEC '06) and organizers/co-organizers of various international conferences. Currently, he serves as a scientific committee member and editors for many organizations and academic journals. He has published over 65 achieved journal papers and 130 conference papers. Until now, he has graduated 12 Ph.D and 77 MSc students in his 27-year academic career.

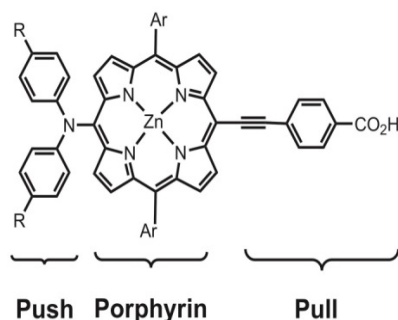
## Rational Molecular Design of Efficient Porphyrins for Dye-Sensitized Solar Cells

Chen-Yu Yeh

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### ABSTRACT

Four systems of porphyrin and diporphyrin dyes with a push-pull framework have been prepared and used in dye-sensitized solar cells (DSSC). Their spectral, electrochemical and photovoltaic properties were investigated. The absorption bands of these porphyrin dyes are broadened and red-shifted upon introduction of electron-donating groups (push unit) to the meso-positions and/or of p-extended linkers (pull unit). The photovoltaic measurements show that **YD2-o-C8** achieves a record power conversion efficiency ~12% using Co(II)/Co(III) as the electrolyte. When YD2-o-C8 is co-sensitized with an organic dye **Y123**, the device gives a power conversion efficiency of 12.3% under standard AM 1.5 sunlight, and 13.1% under AM 1.5 solar light of 500 W m<sup>-2</sup> intensity. In **YD2-o-C8**, The hydrophobic alkoxy chains at the *ortho*-positions of the meso-phenyls suppress molecular aggregation and successfully block the approach of the electrolyte to the surface of TiO<sub>2</sub> to reduce charge recombination, giving an improved Voc and the power conversion efficiency. Based on the structure of **YD2-o-C8**, a new porphyrin **GY50** with more red-shifted absorption has been synthesized. The device of GY50 gives a power conversion efficiency of 12.75% under standard AM 1.5 sunlight. We found that introduction of push and pull units to *meso*-positions is demonstrated to be achievable. Furthermore, bulky donors are compatible with cobalt-based electrolytes and yield high VOC, long alkyl chains at meso-phenyls successfully reduce dye aggregation and decrease charge recombination rate, and the benzoic acid acceptor is superior to the cyanoacrylic acid counterpart. These push-pull porphyrin dyes are promising candidates for highly efficient DSSC.



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BIOGRAPHY



Chen-Yu Yeh was born in 1968. He received his BS in chemistry from National Chung Hsing University in 1990, his MS from National Taiwan University in 1992, and his PhD from Michigan State University in 1999 under the guidance of professor Chi-Kwong Chang. After postdoctoral studies at MIT with Professor Daniel G. Nocera and at National Taiwan University with Professor Shie-Ming Peng, he joined the Department of Chemistry at National Chung Hsing University in 2002. His current research covers synthesis of porphyrins and porphyrin arrays for use in solar cells.

Professor Yeh received the following awards:

1. 2013 奈米科技傑出學術研究獎
2. 2013 Asian Rising Star (The 15th Asian Chemical Congress, Singapore, August, 2013)
3. 2013 水木傑出青年學者獎
4. 2012 The Bau Family Award (鮑氏獎) in Inorganic Chemistry
5. 2011 the tenth Y.Z Hsu Scientific Paper Award (100 年度第十屆有庠科技論文獎)
6. 2011 Academia Sinica of Award for Junior Research Investigators
7. 2011 National Chung Hsing University Brilliance Award
8. 2011 Academic Research Excellence Award
9. 2010 Academic Research Excellence Award

## **High-Efficiency Hybrid Organic/Silicon Nanowire Heterojunction Solar cells**

**Peichen Yu**

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### ABSTRACT



Hybrid organic–silicon heterojunction solar cells based on based on silicon nanowires (SiNWs) and conjugate polymer, poly(3,4-ethylenedioxy-thiophene): poly(styrenesulfonate) (PEDOT:PSS) has potential for high-efficiency low-cost photovoltaics. However, the performance is currently hindered by carrier recombination at the organic silicon interface. In this talk, we describe two approaches for interface engineering, which lead to a power conversion efficiency of over 13%. First, a small-molecule 1,1-bis[(di-4-tolylamino)phenyl]cyclohexane (TAPC) layer was introduced into the PEDOT:PSS/Si interface in order to the modified the organic morphology. The insertion of TAPC also suppressed saturation current because of an energy offset at the heterojunction interface. X-ray photoemission spectroscopy reveals that TAPC can effectively block the strong oxidation reaction occurring between PEDOT:PSS and silicon and hence improves the device characteristics. Secondly, we investigate various wide-bandgap organic materials doped with tetrafluorotetracyanoquinodimethane (F4-TCNQ), which function as an intermediate recombination layer for hybrid cells. Among all, highly fluorescent polymers such as polys9,9-dioctylfluorenyl-2,7-diyl (PFO) and Green B display best transport properties and device performance. Furthermore, the vertical doping profile in p-PFO is investigated via ultraviolet/x-ray photoelectron spectroscopy (UPS/XPS). It is realized that spatially graded doping is achieved due to unintentional vertical phase separation of F4TCNQ and PFO. The resulting reduction of band bending at the heterojunction interface can facilitate hole transport and boost the open-circuit voltage and fill factor. These learnings point toward future directions for versatile interface engineering techniques for the attainment of highly efficient hybrid photovoltaics.

### BIOGRAPHY

Dr. Peichen Yu received her PhD (2004) in electrical engineering from the University of Michigan, Ann Arbor. From 2004 to 2006, she was a design engineer for the Advanced Design group of Intel Corporation at Hillsboro, Oregon. In 2006, she joined the Department of Photonics at National Chiao-Tung University at the rank of Assistant Professor and was promoted to Associate Professor in August 2009, and Professor in August 2013. Her research mainly focuses on various nano-patterning techniques and transparent conductive nano-materials for novel solar cell and light emitting diode structures. She was also actively engaged

in the development of OPC and DFM solutions for CMOS 32nm microlithography and beyond. She has published over 50 refereed technical papers in the above research areas. Her work has been selected for Virtual Journal of Nanoscale Science & Technology and highlighted by SPIE newsroom, NPG Nature Asia-Material, etc.. Dr. Yu has received several research and teaching awards in Taiwan and is currently a member of IEEE Photonics Society and SPIE.

## **Session Chair**

### **Pei-Wen Li**

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Associate Dean of Academic Affairs  
National Central University

(中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

#### BIOGRAPHY



Pei-Wen Li was born in Taiwan in 1967 and received the Bachelor degree in electrophysics from National Chiao-Tung University, Taiwan in 1989, and the Master and Ph.D. degree in electrical engineering from Columbia University in New York city in 1991 and 1994, respectively.

Her Ph.D. dissertation was focused on the study of low temperature oxidation of SiGe alloys and she has successfully demonstrated the first pure SiGe-channel pMOSFETs. In 1995, she joined Vanguard International Semiconductor Corporation working on the process integration of 64M DRAM. Then, she joined I-Shou University as a faculty in the department of Electronic Engineering in 1996. She joined the department of Electrical Engineering, National Central University as an associate professor in 2000, was promoted to be a professor since August 2005, and served as the department chair during 2007-2010. Currently she is the associate dean of Academic Affairs and the director of the Center for Nanoscience and Technology, National Central University.

Dr. Li's main research theme focuses on experimental silicon-germanium nanostructures and devices. Her present research encompasses germanium quantum dot single-electron transistors, photodetectors, nonvolatile memory, and energy saving (photovoltaic and thermoelectric) devices, making use of self-assembly nanostructures in silicon integration technology. Her research group has successfully developed a novel CMOS-compatible, self-organized approach for the generation of germanium quantum dots on Si-containing layers through thermal oxidation of silicon-germanium-on-insulator structures. Of particular, the successful demonstration of precise placement and size control of the self-assembled germanium quantum dots shed light on the practical creation of new nano-electronic, nano-photonics, and electromechanical devices. She has published more than 70 journal papers and holds 5 patents in Si device processing.

## **Strategies on Development of Offshore Wind Technology**

### **Jing-Tang Yang**

Distinguished Professor, Department of Mechanical Engineering  
National Taiwan University

(台灣大學機械工程學系楊鏡堂特聘教授)

#### **Jing-Tang Yang,<sup>a\*</sup> Yu-Ching Tsai,<sup>a, b</sup> and Yu-Fen Huang<sup>c</sup>**

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### ABSTRACT

We explored the offshore wind technology development through the evaluation of patents granted by the United States Patent and Trademark Office and the European Patent Office. By the establishment of the offshore wind patents' landscape, the key trends of technology development were found from the leading countries. Technologies related to engineering vessels, floating foundations, turbine installations, integration of multiple technologies, tower, and mooring system have been identified as the top priorities for development, and the costs reduction, improvement of equipment transportation, improvement of installation process are the most common targets to be achieved. Based on the observation from the patents' portfolio from the leading countries and the current development status of Far East countries, the proposed strategies include the establishment of engineering fleets with innovative concepts, the design of the fixed foundation capable of withstanding typhoons, more eco-friendly construction methodology for fixed foundations, floating foundations with multiple purposes, combination of wind power and fishery sectors, the development of harbor which can support aforementioned concepts, and etc.

### BIOGRAPHY



Professor Jing-Tang Yang received his Ph.D. degree in 1983 from the Energy Division of the Mechanical Engineering Department of the University of Wisconsin at Madison and is serving as a distinguished professor in the Department of Mechanical Engineering at National Taiwan University. He had been the faculty of the Department of Power Mechanical Engineering at National Tsing Hua University during 1983-2008.

He has been the chairman of PME Department (1997-2000) at NTHU, the general director of Tzi-Chiang Science Research Center at NTHU, the member in the board of directors of Automobile Research and Testing Center (2000-2006), the general director of nanotechnology human resource development program office, the general coordinator of the reviewing

committee of annual energy projects of the Energy Bureau of the Economy Ministry, the director of the Office for Energy Strategy Development of the Steering Committee for Energy Policy and Technological Development of Executive Yuan. Currently, he serves as the convener of the Programs of Thermal Sciences and Aerospace Engineering (MOST), the executive secretary of the oversight committee of National Energy Program-II, member of the evaluation committee of the annual energy projects granted by Bureau of Energy (MOEA), the consultant of the National Space Organization (NARL), the committee of the National Council for Sustainable Development (Executive Yuan).

The current research topics of Prof. Yang's multidisciplinary research team contain energy and environmental engineering & strategy, microfluidics & lab-on-a-chip, biomimetic engineering, jet propulsion, and laser diagnostics. Prof. Yang has received the National Award of Invention and Creation, the National Innovation Award (on biotechnology), the award of the outstanding engineering professor of the Society of Chinese Engineers, the outstanding research awards of the National Science Council, six awards of Hiwin Tech outstanding master thesis, two Silver Medals of 2014 & 2011 TECO Green Tech Contests, and the award of the Chair Professor of Cho-Chang Thung Education Foundation.



*Technical Session D1-W4-T1: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings*

**Tsai-Fu Wu**

Professor and Director of Elegant Power Electronics Applied Research  
Laboratory (EPEARL)  
Department of Electrical Engineering  
National Tsing Hua University

(清華大學電機工程學系精緻電力電子應用研究室主持人吳財福教授)

ABSTRACT

BIOGRAPHY



## **The Self-Adaptation MPPT Method for a PV System**

**Yie-Tone Chen**

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### ABSTRACT

The maximum power point tracking (MPPT) methods for a PV system are to be discussed. The fixed step size MPPT method has a dilemma. The variable step size method can further improve the performance of the PV system. The varying trend of the functions existing in the solar cells can be used as the step size of the MPPT. The new method eliminates the problems existing in the fixed step size and the conventional variable step size methods. It also takes the simple flowchart to make performance well. The digital signal processor is used to accomplish the maximum power point algorithm.

### BIOGRAPHY



Yie-Tone Chen received the B.S., M.S. and Ph.D. degrees all in electrical engineering from National Taiwan University, Taipei Taiwan, R.O.C.. Since 1993, he has been with the group of power electronics in the faculty of the Department of Electrical Engineering, National Yunlin University of Science & Technology, where he is now a Professor.

His research interests include the MPPT method of the solar cell, driving design of the BLDC fan motor, modeling and control of converters, circuit design of power electronics, power factor correction topics, soft-switching converters, lighting systems and the analyses of parallel modules.

## **Power Quality and Development of Smart Grid**

### **Cheng-I Chen**

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#### ABSTRACT

Power quality at the grid interface is one of important parts in power purchase contracts between utilities and distributed generations. With the widespread use of rectifier/inverter for power conversion and related power electronic devices for operation control, many power-quality problems are present. Since the modern equipments are sensitive to these power-quality disturbances, power utilities and their consumers start to pay much attention to the improvement of power quality in recent years. As a result, the accurate and efficient assessment of power quality becomes one of the important tasks.

Recently, the concept of smart grid has been proposed to meet these new requirements through integrated communications, advanced components, advanced control methods, sensing and measurement, and improved interfaces and decision support. Since the technology of advanced metering infrastructure is the fundamental early step to grid modernization, the accurate and efficient monitoring of power quality and system states becomes a crucial task. The wide-area measurement is then the conceptual extension of remote monitoring through the numerous integrated communication technologies.

In this talk, the commonly seen power-quality disturbances would be introduced. The sensing, analysis, remedial and control methods applied in the smart grid to maintain the power quality of power system would also be summarized.

#### BIOGRAPHY



Cheng-I Chen received his Ph.D. degree from National Chung Cheng University at Chia-Yi, Taiwan, in 2009.

Currently, he is an Assistant Professor in the Department of Electrical Engineering at National Central University, Taiwan. His areas of research interests include energy information and communication technology, instrumentation and measurement, digital signal processing, power electronics, and power system.

Prof. Chen is a member of IEEE Industrial Electronics Society Technical Committee on Smart Grids and the membership development and services coordinator of IET Taiwan Local Network. He has ever got two annual awards of power engineering program of National Science Council for junior researchers. Recently, he has got the 103rd Annual Ta-You Wu Memorial Award of Ministry of Science and

Technology from the Ministry of Science and Technology.

*Technical Session D1-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

**Session Chair**

**Da-Jeng Yao**

Director, The Institute of NanoEngineering and MicroSystems  
National Tsing Hua University

(清華大學奈米工程兼微系統研究所所長饒達仁教授)

ABSTRACT

BIOGRAPHY



## **Biomimetic surface treatment and some novel applications**

### **Yi-Chang Chung**

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(高雄大學化學工程及材料工程學系鍾宜璋教授)

### ABSTRACT

Through an evolution of 3.8 billion years, creatures have been learning how to cooperate with each other and develop their own specialties. “Biomimetics” reveals a concept to learn from Nature, especially from some creatures showing their amazing structures on contact interfaces with the external world. We imitated some physical structures and/or chemical compositions on their skin surfaces in order to develop interfacial adhering or anti-sticky techniques. Cell membranes, constituted with mainly phospholipids and their derivatives, are thought to be completely compatible to each other and can be imitated as a biocompatible coating to produce biomedical surfaces and nanoparticles. We also imitated gecko-feet to develop gecko tape and further develop “octopus-inspired nanosuckers from the concept of octopus tentacles, producing a dry adhesive having 600 million nanosuckers per cm<sup>2</sup> without using photolithographic processing and sticky adhesives to show very high shear force and pull-off force. We can easily peel it off and reuse without any adhesive residue. Another interesting concept, deriving from mussels’ secrets to adhere to any surface no matter in water or in the air, has been used to produce dopamine-related coatings to accessibly modify material surfaces. Based on the techniques, we have developed some prototypes of products, such as gecko-inspired dry adhesives, octopus-inspired nanosuckers, platelet extraction devices, mussel-inspired universal coatings, anti-bacterial coatings, and so on. To fuse “biomimetics” into engineering skills might be a mainstream in the near future to produce some new materials in a way of high effectiveness, minimum energy-consumed and even lower cost.

### BIOGRAPHY



Yi-Chang Chung, born in Kaohsiung city on 1/3/1969, obtained his bachelor (1991) and doctoral (1996) degrees from the Department of Chemical Engineering, National Cheng-Kung University (NCKU). His thesis was about biomedical polymer membranes as biosensors and biomaterials. He worked as a post-doctoral fellow in NCKU for 1 year, and then served in the mandatory military for 2 years. From 1999-2003, he was teaching in the I-Shou University as an assistant professor. In 2000, he was a short-term visiting scholar at the Institute of Chemistry, Academia Sinica. He has been the initiative faculty of the Department of Chemical and Materials Engineering in the National University of Kaohsiung (NUK) since 2003 and been a full professor since 2014. He is hosting the NanoBiomaterials lab to conduct some research on biomedical nanoparticles, nano/micropatterning techniques, biomimetic surface

treatment, biocompatible coatings, optical biosensors, and so forth.

Prof. Chung has been joining in some professional societies, such as Biomaterials & Controlled Release Society, Chemical Society Located in Taipei, the Polymer Society, and Taiwan Institute of Chemical Engineer, and attending their routine activities. He also assisted in hosting 2010 Annual Polymer Conferences. He has been rewarded by the “MOST Special Outstanding Talent Award” from the Minister of Science and Technology of Taiwan since 2011 to now, and obtained the 2013 “Outstanding Faculty Teaching Award” of NUK.

## **Manipulation of Hydrogel Bio-Materials on an Electromicrofluidic Platform**

**Shih-Kang Fan**

Associate Professor, Department of Mechanical Engineering  
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(台灣大學機械工程學系范士岡教授)

### ABSTRACT

Synthesis and assembly of multi-functional, heterogeneous, and encoded microcomponents, or building blocks, of hydrogel bio-materials are essential to engineering hierarchical, complex, and three-dimensional structures. The elaborately organized architectures devise artificial tissues that reappear physiological functions by imitating natural and biological arrangements. Here we demonstrate synthesis and assembly of microcomponents by electrowetting and dielectrophoresis on a robotic electromicrofluidic platform. The platform is capable of (1) driving different droplets of hydrogel prepolymers before cross-linking, (2) arranging particles or cells in the droplets, and (3) forming microcomponents by cross-linking droplets in different shapes. In the presentation, we will demonstrate the synthesis and assembly of different hydrogel microcomponents containing different dyes and particles. The heterogeneous structures with cell adhesive GelMA (gelatin methacrylate) and non-adhesive PEG-DA (Poly(ethylene glycol) diacrylate) surfaces are prepared for cell culture. The culture of fibroblasts NIH/3T3, neonatal mouse cardiomyocyte, and endothelia HUVEC on the engineered structures synthesized and assembled on the robotic electromicrofluidic platform will be reported.

### BIOGRAPHY



focuses on electromicrofluidics.

Shih-Kang Fan received his B.S. degree from National Central University, Taiwan, in 1996, and his M.S. and Ph.D. degrees from UCLA in 2001 and 2003, respectively. Between 2004 and 2012, he was with the Institute of Nanotechnology and Department of Material Sciences and Engineering at National Chiao Tung University, Taiwan. He is now Associate Professor of Mechanical Engineering at National Taiwan University, Taiwan. Dr. Fan is the recipient of several young investigator awards in Taiwan, including Ta-You Wu Memorial Award from National Science Council, Research Award for Junior Research Investigators from Academia Sinica, and Young Scholar's Creativity Award from Foundation for the Advancement of Outstanding Scholarship. His research interest



*Technical Session D1-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

## **Novel Bio-Inspired Zwitterion Dopamine Molecule for Anti-Biofouling and Photocleavable Properties**

**Chun-Jen Huang<sup>1,2,\*</sup>**

Assistant Professor, Graduate Institute of Biomedical Engineering

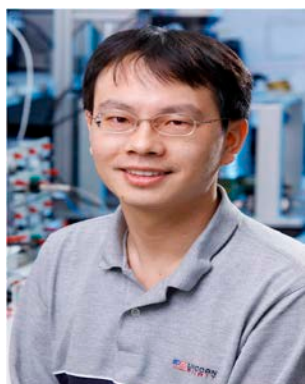
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### ABSTRACT



Use of synthetic biomaterials as blood-contacting devices typically accompanies considerable nonspecific adsorption of proteins, cells and bacteria. These may eventually induce adverse pathogenic problems in clinic practices, such as thrombosis and biomaterials-associated infection. An effective surface coating for medical devices has been pursued to repel nonspecific adsorption from surfaces. In this study, bio-inspired adhesive dopamine conjugated with zwitterionic sulfobetaine moieties (SB-DA) was developed for anti-biofouling properties. The molecules can anchor onto various substrates via catechol groups to form a stable thin film. The results indicated that the formation of self-assembled monolayers (SAMs) was strongly dependent on the pH values in preparation, which correlates to the oxidization and reduction (redox) of catechol groups in

dopamine molecules. The other mussel-inspired catecholic zwitterionic nitro-sulfobetaine moieties (SB-nDA) assembly possesses antifouling and photocleavable characters for spatiotemporal tailoring of interfacial properties and controlling bio-adsorption. X-ray photoelectron spectroscopy (XPS) was used to analyze the bonding mechanism, accounting for distinct wetting and fouling levels from contact angle and quartz crystal microbalance with dissipation (QCM-D) measurements. The thickness simulation from XPS and ellipsometry showed about 1.1 nm for intact SB-DA films and 1.03 nm for intact SB-nDA. In addition, the bacterial test indicated the excellent resistance of films against *P. aeruginosa*. This work provides not only new surface chemistry but the new route for surface modification.

### BIOGRAPHY

Dr. Chun-Jen Huang is the Assistant Professor in the Graduate Institute of Biomedical Engineering at the National Central University, Taiwan. He is also a joint appointment faculty member in the Department of Chemical and Materials Engineering. Prof. Huang received his Ph.D. degree in Molecular Biophysics at Johannes Gutenberg Universität Mainz, Germany, under supervision of Prof. Wolfgang Knoll. In 2011, he started his post-doctoral training in Prof. Shaoyi Jiang's lab at University of Washington, Seattle, WA. Since 2012, he has become a principle investigator of the Healthcare Materials Lab and focused on biomaterials, functional

**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
**National Cheng Kung University, Tainan, Republic of China (Taiwan)**

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biointerfaces, antifouling materials and nanomedicine. Prof. Huang has published 20 papers, 4 book chapters, and more than 30 abstracts.

## **CMOS-CHIP BASED PARTICLE DEPOSITION FOR SYNTHESIS OF HIGH-DENSITY PEPTIDE ARRAYS**

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### ABSTRACT

This work presents a CMOS-chip based “printing machine” that deposits solid amino-acid particles onto a glass slide for synthesis of high-density peptide arrays. The machine enables us to deposit amino-acid particles from the chip onto glass slides, which are chemically modified for Merrifield synthesis. The chip prints onto each glass slide in two locations, doubling the total particle deposition area on the slide. Eventually, this will yield at least 32,000 peptides on a single glass slide. The lithographic method and localized electrolysis can synthesize only one kind of amino acid per synthesis cycle, while we can activate 20 kinds of amino acids at the same time to synthesize a monomer layer. The yield rate is similar to standard Merrifield synthesis.

### BIOGRAPHY



Dr. Yun-Chien Cheng received his B.S. (2004) and M.S. (2006) in Electrical Engineering from the National Taiwan University. From 2008 on, he worked jointly in German Cancer Research Center, Darmstadt University of Technology, and Karlsruhe Institute of Technology, Germany, and received Dr. Ing. in 2012. Currently he is an Assistant Professor of Mechanical Engineering Department and Institute of Biomedical Engineering, National Chiao Tung University. Dr. Cheng's research interests include high-density peptide array manufacture and medical application of low-temperature atmospheric-pressure plasma.

Technical Session D1-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials

**Session Chair**

**Chun-Wei Chen**

Distinguished Professor, Department of Materials Science and Engineering  
National Taiwan University

(臺灣大學材料科學與工程學系陳俊維特聘教授)

ABSTRACT

BIOGRAPHY



## **Control of Morphology and Charge Recombination Kinetics for Perovskite Solar Cells**

**Eric Wei-Guang Diao**

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(交通大學應用化學系刁維光教授)

### ABSTRACT

The development of all solid-state thin-film solar cells has reached a new milestone when the devices made of organometallic lead halide perovskite materials were reported with power conversion efficiency (PCE) exceeding 19 %. The key issue to make a device with a great photovoltaic performance for perovskite solar cells is to control the film morphology of perovskite under different experimental conditions. Diverse processing techniques were reported according to either a one-step or a sequential method to synthesize the required perovskite layer on top of the contact electrode with either a mesoscopic or a planar interface. In this talk, I will demonstrate how the film morphology of perovskite can be controlled via varied synthetic approaches. For example, the perovskite layer can be produced under the condition of fast crystallization deposition using either toluene or chlorobenzene as an anti-solvent to induce a fast crystallization. The other approach is to use a proper additive such as hydroiodic acid (HI) to produce homogeneous precursor solutions prior to the following spin-coating step. Without adding the HI additive, one-dimensional dendroid microcrystals were produced with a poor surface coverage. When the HI additive was added in the perovskite stock solution, uniform and pinhole-free perovskite nanocrystals with full surface coverage were observed. For a p-type planar device ITO/PEDOT:PSS/CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>/PCBM/Ag fabricated using such a synthetic approach to generate the CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> layer, the power conversion efficiency attained 8 % with the short-circuit current density over 18 mA cm<sup>-2</sup>. Photo-induced absorption (PIA) spectra and nanosecond transient absorption (ns-TAS) kinetics were also performed to understand the electron-hole recombination rates responsible for the corresponding device performances.

### BIOGRAPHY



Eric Wei-Guang Diao was born in 1962 in Tainan, Taiwan. He received his B.S. in Chemistry in 1985 and Ph.D. in Physical Chemistry in 1991, both from National Tsing Hua University, Taiwan. Before joining at Department of Applied Chemistry, National Chiao Tung University, Hsinchu, Taiwan, as a faculty member since 2001, he worked as a postdoctoral fellow at Emory University (1993-1995), University of Queensland (1995-1996) and California Institute of Technology (1997-2001). He is currently professor at Department of Applied Chemistry and Science of Molecular Science, National Chiao Tung University (<http://diao08.ac.nctu.edu.tw/>).

He has established a strong research program on development and characterization of new functional materials for dye-sensitized solar cells (DSSC) and perovskite solar cells (PSC), in particular focusing on synthesis of novel photosensitizers, electrochemical and/or hydrothermal formation of electrode materials, device fabrication and characterization, and understanding of the fundamental processes using time-resolved and frequency-domain spectral techniques.

Prof. Diau has received “Outstanding Research Award” from 2014 MRS spring meeting organizers of Symposium B: Organic and Inorganic Materials for Dye-sensitized Solar Cells. He has also received “2014 Article Award in Natural Science” from Sun Yat Sen Academic and Cultural Foundation, Taiwan, with the representative article “Porphyrin-sensitized Solar Cells”. He has published over 140 peer-reviewed papers with H-index 43.

## **Rational Design of Interfacial Materials for Solid-State Dye-Sensitized Solar Cells**

**Lee-Yih Wang**

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Center for Condensed Matter Sciences, National Taiwan University  
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### ABSTRACT

The heterojunction of poly(3-hexylthiophene) (P3HT) and TiO<sub>2</sub> in hybrid solar cells is systematically engineered with four cyanoacrylic acid-containing conjugated molecules with various lowest unoccupied molecular orbital (LUMO) levels, WL-1 to WL-4. The thiophene end-groups in the interface modifiers (IMs) apparently improve the mutual compatibility of P3HT and TiO<sub>2</sub>. Incorporating a strongly electron-withdrawing -CN moiety adjacent to the -COOH anchoring group in the molecular structure of the IMs induces a molecular dipole directing away from the titania surface, and enhances the electron affinity of the molecules, simultaneously increasing the short-circuit current density (JSC) and open-circuit voltage (VOC) of the device. The increment in VOC is consistent with the order of the dipole moment along the molecular backbone of the IM. External quantum efficiency (EQE) spectra clearly indicate that excitons that are generated in both IMs and P3HT make contribution to JSC. All IMs herein considerably increase the EQE at 570 nm, which is attributed to the light-harvesting of P3HT, although WL-1 has a LUMO that is slightly higher than that of P3HT, suggesting the IMs greatly improve the P3HT/TiO<sub>2</sub> interface, promoting the dissociation of P3HT excitons. Furthermore, the LUMO of IMs plays an important role in determining the efficiency of the injection of electrons from P3HT to TiO<sub>2</sub>. The order of EQE at 570 nm (WL-4 > WL-3 > WL-2), which represents the degree of contribution of P3HT, coincides perfectly with the order of the LUMO offset of IMs and P3HT, revealing that an energy-offset of greater than ~0.3 eV between the LUMOs of P3HT and the IM promotes the smooth electron injection from P3HT through IM to TiO<sub>2</sub>. This findings provide valuable guidelines for further designing novel IMs for use in the development of high-efficiency polymer/inorganic hybrid solar cells and solid-state dye-sensitized solar cells.

In addition, diblock copolymers have emerged as an interesting and important class of functional materials because they can self-organize into a variety of highly ordered structures with characteristic lengths ranging from nanometers to micrometers. To improve the regeneration efficiency of dye molecules, a novel poly(2,5-dihexyloxy-p-phenylene)-b-poly(3-hexylthiophene) (PPP-b-P3HT) was synthesized and applied as a hole transport material (HTM) for the fabrication of solid-state dye-sensitized solar cells (ss-DSCs). This copolymer is characterized by an enhanced crystallinity, enabling its P3HT component to self-organize into interpenetrated and long-range ordered crystalline fibrils upon spin-drying and ultimately endowing itself to have a faster hole mobility than that of the parent P3HT homopolymer. Transient photovoltage measurements indicate that the photovoltaic cell based on PPP-b-P3HT as the HTM has a longer electron lifetime than that of the reference device based on P3HT

homopolymer. Moreover, comparing the two ss-DSCs in terms of the electrochemical impedance spectra reveals that the electron density in the TiO<sub>2</sub> conduction band is substantially higher in the PPP-b-P3HT device than in the P3HT cell. Above observations suggest that the PPP block facilitates an intimate contact between the copolymer and dye molecules absorbed on the nanoporous TiO<sub>2</sub> layer, which significantly enhances the performance of the resulting device. Consequently, the PPP-b-P3HT ss-DSC exhibits a promising power conversion efficiency of 4.65%. This observation demonstrates that conjugated block copolymers can function as superior HTMs of highly efficient ss-DSCs.

## BIOGRAPHY



Dr. Leeyih Wang received his B.S. degree in chemistry from National Chung-Hsing University, Taichung, Taiwan in 1982 and PhD degree in chemistry from University of Minnesota, Minneapolis, Minnesota, USA under the supervision of Prof. Wilmer Miller in 1993.

He joined the Center for Condensed Matter Sciences (CCMS), National Taiwan University (NTU) as an assistant research fellow in 1993, and was promoted to an associate research fellow in 1998 and a full research fellow in 2008 and serves as deputy director of CCMS now. He has held a joint appointment in the Institute of Polymer Science and Engineering, NTU since 2002. His research interests include design and synthesis of conjugated molecules, fullerene derivatives and low

bandgap polymers and their optoelectronic applications.

Dr. Wang Dr. Wang has been awarded for the Best Paper of the Year in 1997 & 2008, ROC Polymer Society and 4 times of the National Science Council Research Awards. He has published more than 100 papers in renowned international journals and own 20 international patents.



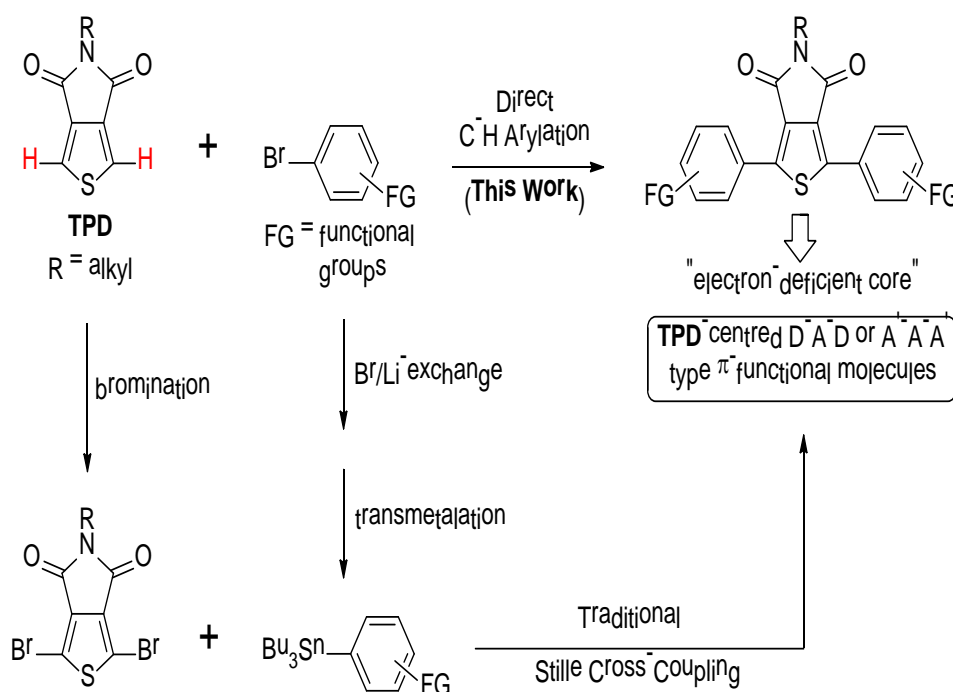
**Pd-Catalyzed Direct C-H Arylation of Thieno[3,4-c]pyrrole-4,6-dione (TPD):  
A Step-Economical Synthetic Alternative to Access TPD-Centred p-  
Functional Materials**

**Ching-Yuan Liu**

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Email: cyliu0312@ncu.edu.tw  
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ABSTRACT

We demonstrate a step-economical and viable synthetic alternative to access a series of thieno[3,4-c]pyrrole-4,6-dione (TPD)-based  $\pi$ -conjugated molecules through Pd-catalyzed direct C-H arylations. A comprehensive synthetic study including the screening of various kinds of palladium catalysts, ligands, and bases is reported. Under the optimum reaction conditions, TPD and its derivatives underwent efficient and mild direct C-H arylations with a variety of functionalized bromoarenes. Functional groups such as ester, nitrile, ketone, aldehyde, and halide were well-tolerated, which substantially extended the reaction scope. We wish present methodology would provide material scientists a greener synthetic route to efficiently prepare the TPD-containing small-molecule materials.



## BIOGRAPHY



Ching-Yuan Liu received his B.S. (2000) from National Tsing-Hua University and M.S. (2002) in Chemistry from National Taiwan University. He received his Ph.D. (2007) in Chemistry from the University of Munich, Germany. He was a postdoctoral researcher (2007-2012) of RIKEN (Wako headquarter), Japan. Currently he is an assistant professor of National Central University (2012~). Dr. Liu's research interests focus on the development of new synthetic methodologies targeted toward the efficient and green synthesis of p-functional materials, including OPVCs, DSSCs, and OFETs.

## **Exploration of piezophotocatalyst of ZnSnO<sub>3</sub> nanowires using two-step hydrothermal synthesis**

**Kao-Shuo Chang**

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(成功大學材料科學及工程學系張高碩教授)

### ABSTRACT



A novel application of single crystalline ZnSnO<sub>3</sub> nanowires is reported for the first time in the field of piezophotocatalysis, which is achieved coupling through the piezophototronic effect. Vertically aligned lead-free noncentrosymmetric ZnSnO<sub>3</sub> nanowires (LiNbO<sub>3</sub>-type, R3c) were fabricated using a two-step hydrothermal reaction. The essential feature of this research is to couple the multifunctions of semiconductors, piezoelectricity, photonics, and photocatalysis to achieve synergistic piezophotocatalysis through the modulation of the piezopotentials between the interfaces of the ZnSnO<sub>3</sub> nanowires and methylene blue solutions to reduce recombination of photogenerated electron-hole pairs. The piezophototronic effect was demonstrated to substantially enhance the photocatalytic efficiency (approximately 27%). The improvement was attributed to the enhanced mobility of the photogenerated carriers in a distorted energy band under stresses.

### BIOGRAPHY

#### **Education**

- 1998-2004 **Univ. of Maryland, College Park, MD.**  
Ph. D., Materials Science and Engineering.  
Thesis topic: Combinatorial pulsed laser deposition of functional metal oxide thin films.  
Graduate Research Associate.  
Advisor: Prof. I. Takeuchi.
- 1993-1995 **National Chiao Tung Univ., Hsinchu, Taiwan.**  
M. S., Applied Chemistry.  
Thesis topic: DNA mapping by capillary electrophoresis.  
Graduate Research Associate.  
Advisor: Prof. You-Zung Hsieh and Dr. Konan Peck.
- 1989-1993 **National Sun Yat-Sen Univ., Kaohsiung, Taiwan.**  
B. S., Chemistry.

### **Professional Experience**

- 2010-now Department of Materials Science and Engineering, National Cheng Kung University, Tainan.  
Assistant Professor
- 2005-2010 Materials Science & Engineering Laboratory, National Institute of Standards and Technology (NIST), Gaithersburg, MD. USA  
Researcher
- 2004-2005 Dept. Materials Science and Engineering, Univ. of Maryland, College Park, MD. USA.  
Post-doctorate

### **Researches**

Combinatorial methodology, Physical vapor deposition (PVD), Solution-based process, Advanced gate

stacks, Functional nano-structured thin films, Photocatalysis.

### **Recent Publications**

1. Z.-A. Lin, W.-C. Lu, C.-Y. Wu and K.-S. Chang, "Facile fabrication and tuning of a TiO<sub>2</sub> nanoarchitected morphology using magnetron sputtering and its application to photocatalysis," *Ceramics International* 40, 15523 (2014).
2. K.-S. Chang, W.-C. Lu, C.-Y. Wu, and H.-C. Feng, "High-throughput identification of higher-k dielectrics from an amorphous N<sub>2</sub>-doped HfO<sub>2</sub>-TiO<sub>2</sub> library," *J. Alloys and Compounds* 615, 386 (2014).
3. K.-S. Chang, H.-C. Feng, C.-L. Chen, and W.-C. Lu, "Substantial Enhancement of Dielectric Properties of Amorphous Y<sub>2</sub>O<sub>3</sub>-TiO<sub>2</sub> Composition Spreads Through N<sub>2</sub> Doping by Using Combinatorial Sputtering," *IEEE Trans. on Electron Devices* 61, 2125 (2014).
4. W.-C. Lu, H.-D. Nguyen, C.-Y. Wu, K.-S. Chang, and M. Yoshimura "Modulation of Physical And Photocatalytic Properties of (Cr,N) Codoped TiO<sub>2</sub> Nanorods Using Soft Solution Processing," *J. of Applied Physics* 115, 144305 (2014).

Technical Session D1-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

### **Session Chair**

#### **Bohr-Ran Huang**

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#### BIOGRAPHY



Bohr-Ran Huang (黃柏仁) was born in Nantou in August, 1961. He got his bachelor degree in department of Electrophysics from National Chiao-Tung University, Hsin-chu, Taiwan, in 1983. He served as the second lieutenant during his military service between 1983 and 1985. Then he received the M.S. and Ph.D degree in Electrical Engineering from Michigan State University, East Lansing, U.S.A, 1986 and 1992, respectively.

In 1992, he joined the National Yunlin University of Science and Technology (NYUST) as Associate Professor of Electronic Engineering and became a Full Professor in 2000. He served as Chairperson of Electronic Engineering and Director of Optoelectronic Institute in National Yunlin University of Science and Technology between 2002 and 2007. Then he was recruited to the graduate Institute of Electro-optical engineering and department of Electronic Engineering in National Taiwan University of Science and Technology(NTUST) since August, 2007. Currently, he is a Distinguished Professor in

NTUST(Taiwan Technology). He also serves as the Vice-Dean for College of Electrical Engineering and Computer Science since Aug., 2011.

Professor Huang's multidisciplinary research areas are synthesis of nanomaterials (including carbon nano tubes, silicon nanowires, ZnO, WO<sub>3</sub>, and Nanodiamond), silicon based solar cells and nano-optoelectronic sensing devices. Currently, he has published more than 130 papers in referred journal publications and over 200 conference proceedings. Professor Huang is a senior member of Electronic Device Society of IEEE. He received the Outstanding Electrical Engineering Award from Chinese Institute of Electrical Engineering at 2013. Currently, Professor Huang is a Fellow of Institution of Engineering and Technology (IET).

## **Application of DFT methods to design highly efficient organic sensitizers for Dye-Sensitized Solar Cells**

**Jyh-Chiang Jiang**

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### ABSTRACT

Dye-sensitized solar cell (DSSC) devices have attracted broad attention in the search for environmentally friendly alternatives for energy production. In order to increase the efficiency of DSSCs, it is important to search suitable dyes, which not only attach on the semiconductor surface, but also have reasonable optical properties to enhance light-harvesting efficiency of the cells. We designed highly efficient dyes based on the metal free organic sensitizers and investigated their optical performances using density functional theory (DFT) and time dependent density functional theory (TD-DFT) methods. The effects of repeating  $\pi$ -linker, donor/acceptor moieties and the substitution of additional donor/acceptor moieties in the organic sensitizers on the optoelectronic properties have been investigated. The limitations of organic dyes are reduced in molar absorption coefficient and increased dye aggregation. Especially, dye aggregation suppresses electron transport from the excited dye molecule to TiO<sub>2</sub> semiconductor surface resulting in lower DSSCs performance. Therefore, keeping in mind the requirement of efficient sensitizer and reduced tendency towards dye aggregation, we designed dyes with four different anchoring groups and studied their optical properties. This theoretical study explores the new configurations and design strategies of organic dyes for developing efficient light harvesting devices working in whole visible and near IR regions.

### BIOGRAPHY



Jyh-Chiang Jiang graduated from National Taiwan University in 1986 with a B.S. in Chemistry and received his PhD in Chemistry in 1994 from the National Taiwan University. After working as a postdoctoral fellow at IAMS, Dr. Jiang joined the faculty of National Taiwan University of Science and Technology (NTUST) in 2001 as an Assistant Professor. In 2010 he was full Professor in Chemical Engineering Department.

He focuses on the theoretical and computational chemistry study of the heterogeneous catalysis, optoelectronic materials and Li ion batteries. He has worked extensively in the development of combined electronic structure and kinetics methods for simulating processes that involve the reaction mechanisms of H<sub>2</sub> production, Hydrogen storage, NH<sub>3</sub> oxidation on metal oxide surface. Dr. Jiang is also involved in High throughput screening of many new materials for Li ion batteries based on quantum mechanics calculation. In addition, he has been active for many years in design of the optoelectronic materials for DSSCs using quantum mechanics simulation.

Dr. Jiang is Executive Supervisor of the Taiwan Theoretical and Computational Science

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Association from 9/2014. He was the coordinator of NSC- computational chemistry group during 11/2009~1/2013. Dr. Jiang was also the Panel Member in Division of Chemistry, National Science Council during 1/2010~12/2012.

## **Fabrication of Colloidal Crystals and Their Inverse Opals for Engineering Applications**

**Pu-Wei Wu**

Professor, Department of Materials Science and Engineering  
National Chiao-Tung University  
Hsin-Chu, Taiwan, R.O.C. 300  
e-mail: ppwu@mail.nctu.edu.tw  
(交通大學材料科學與工程學系吳樸偉教授)

### ABSTRACT

In this talk, I will present our progress of fabricating large-area colloidal crystals and their inverse opals using electrophoresis and electrodeposition. The samples we prepare demonstrate interesting physical and mechanical properties and they are explored for many engineering applications.

### BIOGRAPHY



### Personal Information

Born: 1970; Kaohsiung, Taiwan, R.O.C.

### Education

1992 B.S. National Tsing Hua University (Materials Science and Engineering)  
1999 Ph.D. University of California, Los Angeles (Materials Science and Engineering)  
Advisor: Professor Bruce Dunn (Fellow of Materials Research Society, American Ceramic Society, World Academy of Ceramics)

### Professional Experience

2011 – Present *Professor*, National Chiao Tung University  
Department of Materials Science and Engineering  
2014 – Present *Vice Chairman*, Department of Materials Science and Engineering  
National Chiao Tung University  
2008 – 2011 *Associate Professor*, National Chiao Tung University



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2005 – 2008

Department of Materials Science and Engineering  
*Assistant Professor*, National Chiao Tung University  
Department of Materials Science and Engineering

**Research Strengths**

Self-Assembly for Artificially Structured Materials  
Nanostructured Materials for Fuel Cell Electrocatalysts  
Materials Electrochemistry (Electroless & Electroplating)

**Distinctions, Honors and Awards**

2008 – Present	Guest Editor for Electronic Monthly
2010	Poster Award in MRS-T Annual Conference
2011	Poster Award in MRS-T Annual Conference
2008	Excellence in Student Counseling Service from NCTU (undergraduate)
2012	Excellence in Teaching from NCTU (graduate course)
2013	Excellence in Teaching from NCTU (undergraduate course)

**Graduate Student and Post Doctoral Scholar Supervision**

Committee Chair for 40 M.S. degree students since 2005  
Committee Chair for 8 Ph.D. degree students since 2005  
Supervisor for 3 Post Doctoral, Visiting Scholars, and Research Assistant since 2005  
Two MS graduate students who have been admitted to Caltech for Ph.D. program in MSE since 2010

**PROFESSIONAL ACTIVITIES**

**Oral and Poster Presentations**

Over 50 presented at national and international meetings, industrial, and national laboratories

**Patents** (USA and Taiwan) - 6 granted in total

**PUBLICATIONS**

Over 40 publications in well-respectable professional and scholarly journals (please refer to personal website for more details; <http://web.it.nctu.edu.tw/~amet/>)

Technical Session D1-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**Hsing-Yu Tuan**

Professor , Department of Chemical Engineering  
National Tsing Hua University  
(清華大學化學工程學系段興宇教授)

ABSTRACT

BIOGRAPHY



Technical Session D1-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**Cheng-Che(Jerry) Hsu**

Associate Professor, Department of Chemical Engineering  
National Taiwan University  
(臺灣大學化學工程學系徐振哲教授)

ABSTRACT

BIOGRAPHY



## **Session Chair**

### **Faa-Jeng Lin**

Chair Professor, Department of Electrical Engineering, National Central University  
Committee Chair, National Energy Plan (NEP-II) Smart Grid Focus Center  
Ministry of Science and Technology, R.O.C. (Taiwan)

(中央大學電機工程學系兼科技部第二期能源國家型科技計畫智慧電網主軸計畫召集人林法正講座教授)

## **BIOGRAPHY**



Faa-Jeng Lin received his B.S. and M.S. degrees in electrical engineering from National Cheng Kung University in Tainan, Taiwan, and his Ph.D. degree in electrical engineering from National Tsing Hua University in Hsinchu, Taiwan, in 1983, 1985, and 1993 respectively. Currently, he is Chair Professor at the Department of Electrical Engineering, National Central University, Taiwan, and the President, Taiwan Smart Grid Industry Association. He was the Chair of the Power Engineering Division at the National Science Council in Taiwan and the Chair of the IEEE IE/PELS Taipei Chapter from 2007 to 2009. He is also now a member of the FS Technical Committee of CIS, IEEE, and the Chair of the IEEE CIS Taipei Chapter. His research interests include fuzzy and neural network control theories, nonlinear control theories, AC and ultrasonic motor drives, DSP-based computer control systems, power electronics, microgrid and smart grid. He has received the Outstanding Research Award from the National Science Council, Taiwan, in 2004, 2010 and 2013; the Outstanding Professor of Electrical Engineering Award in 2005 from the Chinese Electrical Engineering Association, Taiwan. Moreover, he is a Fellow of the Institution of Engineering and Technology (IET).

## **Development and Implementation of Remote Supervisory Control System for Transmission Line Under Pollution of Weather and Salt-Fog Invasion**

**Ming-Yuan Cho**

Distinguished Professor, Department of Electrical Engineering  
Dean , College of Electrical Engineering and Computer Science  
National Kaohsiung University of Applied Sciences  
Tel: (886)-7-3814526#5530,3000  
Mobile: (886)-935076717  
Fax: (886)-7-3830491  
Email : mycho@mail.ee.kuas.edu.tw

(高雄應用科技大學電機工程系兼電資學院院長卓明遠特聘教授)

### ABSTRACT

The purpose of this paper is to establish a remote supervisory control and data acquisition (SCADA) system which integrates analog/digital data of weather, insulator leakage current, with image signal of insulator discharging image to monitor critical transmission line real time. The functions of proposed remote SCADA system are divided into two portions, the first portion of the proposed system is embedded system based data acquisition, supervisory, control and communication unit, in which data acquisition interface circuit contains circuits of analog input, digital input/output and image input interface. This unit is in charge of logging the operation status of weather parameters (temperature, humidity, rain, dew point, wind speed and wind direction), PV and wind hybrid power system (V, I, operation status and fault alarm) parameters, insulator leakage current and insulator discharging image. The second portion of this proposed system is to develop back end system located at power supply district, in which it contains windows based communication functions and web based database data management interface and man machine interface to form remote SCADA back end server. Another key point of this paper is to collect the parameters of tower weather, PV/wind hybrid power system, insulator leakage current and insulator discharging current image signal. Meanwhile, pattern recognition associated with linear regression technique is applied to analyze and establish pattern relationship between insulator leakage current and discharging image, and pattern relationship between insulator leakage current and weather parameters.

In order to demonstrate the practicality and effectiveness of the proposed remote SCADA system, this paper has finished leakage current accuracy and voltage withstand testing for proposed prototype at high voltage lab. of Taipower Research Institute and has selected two towers located at salt-fog invasive area to set up the prototype of proposed system for onsite installation and environment testing and function calibration in Cha-Nang power supply district. The implementation of proposed system will enhance the maintain efficiency as well as the availability of 69kV/161kV transmission line insulator in Taipower system.

### BIOGRAPHY

Dr. Ming-Yuan Cho, he received the M.S.E.E. and Ph.D. degrees from National Sun-Yat Sen University in 1989 and 1992 respectively. Dr. Cho is with the Department of Electrical Engineering, National Kaohsiung University of Applied Sciences (KUAS), where he is currently a



distinguished professor associated with the Dean of the College of Electrical Engineering and Computer Science since August, 2014. Dr. Cho is now also the Deputy Director of Energy Technology Research Center. Dr. Cho has ever served as the Dean of research and development office from August, 2012 to July, 2013. Besides, Dr, Cho has ever served as the chairman of Department of Electrical Engineering from August, 2000 to July, 2003. Dr. Cho has obtained the young electrical engineer award and outstanding professor award from Kaohsiung section, Chinese Institute of Electrical Engineering in 2002 and 2008 respectively. His research interests are smart grid, energy saving technologies, electricity energy management and control, and optimization technique and artificial intelligent algorithm for power system applications. Dr. Cho is the member of IEEE since 1992.

## **Current Status of Smart and Green Technology Development in Taipower**

### **Jin-Shyr Yang**

Deputy General Manager, Taiwan Power Research Institute, TPC  
198, Roosevelt Road Sec. 4, Taipei, Taiwan, R.O.C.  
Tel: +886-2-2360-1004, Fax: +886-2-2364-9611  
Email: u356461@taipower.com.tw  
(台灣電力公司綜合研究所副所長楊金石博士)

### ABSTRACT

This speech will introduce the current development of smart and green technology in Taipower.

Smart Grid extends across the entire Energy Value Chain, Taipower also set the strategies to develop smart grid. Implementation of smart grid is divided into four topics - Smart Generation & Dispatching, Smart Transmission, Smart Distribution, and Smart Customer.

Due to government's encouragement policies, the number of DERs connected to the distribution system is on a rising trend. In order to continuously satisfy the installed capacity of DERs and assure the power quality and stability supplied to end customers, Taipower develop standards for smart inverters and communication protocols. The study of requirements for DER management system is presented.

At TPRI Shulin office, we construct advanced distribution automation system, AMI and microgrid as an experiment site to study smart grid. Green campus and smart house demo system also applied for distributed energy resources (DERs), energy storage system, and demand response integration study.

For smart customer, About 24 thousand high voltage AMI system has been installed, and Taipower provided a incentive platform for those customers to reduce the peak load.

### BIOGRAPHY



Jin-Shyr Yang was born in Tainan, Taiwan. He received his Bachelor's degree, Master degree and Ph. D. in Electrical Engineering from National Taiwan University of Science and Technology in 1980, 1982, and 1989 respectively. His research interests include power system stability, smart grid and power equipment testing.

Dr. Yang works as a Deputy General Manager at Taiwan Power Research Institute (TPRI), Taiwan Power Company (TPC). Before taking up his current position, He was an Electrical Engineer of Taipei North District Office (1974-1981), System Plan Department (1982-1983), Takuan Power Plant (1984-1988) and TPRI (1989-2003). From 2004 to 2012, He was the Director of Research Lab.

Dr. Yang is a member of IEEE (since 1987) and officer of IEEE Taipei Section. He is a Director

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of Taiwan Smart Grid Industry Association, a Director of The Illumination Engineering Society of Taiwan. He got the distinguish electrical engineer award from The Chinese Institute of Electrical Engineering in 2010.



Technical Session D1-W4-T2: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings

**Shyh-Jier Huang**

Distinguished Professor, Department of Electrical Engineering  
National Cheng Kung University  
(成功大學電機工程學系黃世杰特聘教授)

ABSTRACT

BIOGRAPHY



## **Electromagnetic Interference (EMI) Noise Reduction Techniques in Switching Power Circuits for Renewable Energy Applications**

**Hung-I Hsieh**

Assistant Professor, Department of Electrical Engineering, National Chiayi University  
No.300 Syuefu Rd., Chiayi City 60004, Taiwan  
Tel: +886-5-2717981, Fax: +886-5-2717558  
Email: hihsieh@mail.ncyu.edu.tw  
(嘉義大學電機系謝宏毅教授)

### ABSTRACT

Electromagnetic interference (EMI) noise mitigation is an important issue that should be highlighted when designing modern power electronics technologies for renewable energy systems. In recent years, it has become more and more important because electromagnetic pollution of switched-mode power supply (SMPS) systems by switching circuit harmonics is a growing problem due to their fast switching speed at relatively high voltage and current conditions to obtain improved efficiency. To limit interference with other devices, EMI filters are in general used to meet international regulations limiting emissions. Even though EMI filters are the most popular and are intended for power processing industries, large EMI filters normally occupy 15% to 20% of the total size and weight of a power supply system, thus substantial savings in component spaces and costs cannot be achieved. In order to obtain low cost, light weight and high power density in SMPS applications, efforts should be made to reduce filter size by reducing the EMI noise emission propagating on switching power circuits, especially in small (i.e., more components placed in close proximity to each other on devices) and portable electronic apparatus.

The main focus of this presentation will be focused on the newly discovered mix-mode (MM) EMI noise coupling mechanism even further and use the new understanding to improve practical EMI filter designs. Specifically, three areas are discussed. One is to look at the new role in one differential-mode capacitor (X capacitor) and two-serial common-mode capacitors (Y capacitors) play in filtering mechanisms. Besides the conventional impedance mismatching concept, a novel “noise current balancing” concept is introduced. Second area of discussion is about a common-mode capacitor (Z capacitor) connection in a two-wire system which is common in many hand-held device applications. The effectiveness of such common-mode capacitor is not clear before. An explanation with the mix-mode phenomenon is given in this presentation. From this proposed theory, several practical common-mode Z capacitor connecting means are recommended. The third area of discussion is to incorporate the mix-mode considerations into a practical EMI filter design. It is concluded that with this new approach, smaller EMI filter can be achieved, and the resulting improvement in system cost and efficiency can be significant.

### BIOGRAPHY

Hung-I Hsieh received the Ph. D. degree in Electrical Engineering from National Taiwan University in 2007. From 2008 to 2009, he was with Industrial Technology Research Institute (ITRI), Hsinchu, Taiwan, where he was a Research Scientist and was responsible for the design



of power conditioning systems for renewable energy applications. Since February 2009, he has been a Research Assistant Professor with the Department of Electrical Engineering, National Chiayi University, Chiayi, Taiwan. In the summer of 2011, he was a Visiting Scholar in the Department of Electrical Engineering and Computer Science, University of California, Irvine, CA, United States. He has authored or co-authored more than 20 papers published in international conference proceedings and professional journals. He has three U.S. patents pending. His current research interests include power electronics, electromagnetic interference (EMI) in switched-mode power supplies (SMPS), control techniques for SMPS, integrated-circuit (IC) design for power management applications, and power electronics for renewable energy systems.

1. **Name:** Hung-I Hsieh

2. **Place and Date of Birth:** Hualien Taiwan, January 20, 1978

3. **Education:** Ph.D. degree received in 2007, Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan

4. **Current Position and Department:** Assistant Professor, Department of Electrical Engineering, National Chiayi University, Chiayi, Taiwan

5. **Major Fields of Study:** Power Electronics and Electromagnetic Interference (EMI)

6. **Employment and Experience:**

- (1) **2011:** Visiting Scholar, Department of Electrical Engineering and Computer Science, University of California, Irvine, CA, United States
- (2) **2009 to Present:** Assistant Professor, Department of Electrical Engineering, National Chiayi University, Chiayi, Taiwan
- (3) **2008 to 2009:** Research Scientist, Industrial Technology Research Institute (ITRI) of Taiwan, Hsinchu, Taiwan

7. **Research Areas and Interests:**

- (1) Power Electronics
- (2) Electromagnetic Interference (EMI) in Switching Power Circuits
- (3) Power Management and Electronics Design in Renewable Energy Systems

**Day 2 (November 23, 2014)**

*Plenary Session (IV): Panel Discussions: Academia and Industry Collaboration*

**Topic:**

Research, Innovation and Commercialization: Bridging the Valley of Death - From Lab Space to Marketplace

**Description:**

The “valley of death” is a common term in the start-up world, referring to the difficulty of covering the negative cash flow in the early stages of a start-up, before their new product or service is bringing in revenue from real customers.

Many breakthrough technologies originate in R&D and academic laboratories, but many perish there as well. As scientists and entrepreneurs try to move nascent technologies from the research phase to large scale commercialization, they face high capital costs, intense competition from deeply entrenched incumbents, and a dizzying array of contractual and financing hurdles. This panel will explore key scale-up challenges and discuss possible solutions and resources for scientists, founders, and investors.

## **Moderator and Panelist**

### **Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering and  
Chief Executive Officer of Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系兼工學院產學聯盟執行長劉承賢教授)

#### BIOGRAPHY



Cheng-Hsien Liu (劉承賢) received the B.S. degree in power mechanical engineering from the National Tsing-Hua University, Taiwan, in 1987, the M.S. degree in mechanical engineering from the Lehigh University, Bethlehem, P.A., in 1992, the M.S. degree in electrical engineering and the Ph.D. degree in mechanical engineering from Stanford University, CA, in 1995 and 2000, respectively.

He presently is a professor in the Power Mechanical Engineering Department at National Tsing Hua University. He has served as the Chief Executive Officer of Industrial Liaison Program, College of Engineering, National Tsing Hua University since Aug. 2012. He had been with National Tsing Hua University, Taiwan since Autumn 2000. In 1999-2000, he worked as a senior Electrical Engineer at Halo Data Devices Inc., San Jose, where he focuses on the development of micro-drives for portable information storage applications. While at Stanford, he worked with Dr. Kenny at Stanford Micro-structures and Sensors Laboratory and focused his Ph.D. work on high-performance MEMS sensors. He currently oversees graduate students in the Micro-Systems and Control Laboratory, whose research activities cover a variety of areas in MicroElectroMechanical Systems, Lan on Chip, system dynamics/modeling/control and Nanotechnology. Some recent highlighted research includes biomimetic array chip for bio-object manipulation targeting for tissue engineering/ drug screening applications, Liver on Lab Chip, Lung on Lab Chip, Biomedical Instruments, microphotonics, and advanced tunable MEMS grating.

Dr. Liu received A. Kobayashi Young Investigator Award in Experimental Science from International Conference on Computational and Experimental Engineering and Sciences (2010), the award of Outstanding Chemical Engineering Article of the Year 2010, the Academic Excellent Award from National Tsing Hua University (ranking top 4% in 2010 and 2013), Outstanding Research Program Award from National Science and Technology Program in Biomedical field (2012), Outstanding Research Award from National Science Council (NSC) in 2012 (100 年度國科會傑出研究獎).

*Plenary Session (IV): Panel Discussions: Academia and Industry Collaboration*

**Panelist**

**Ching-Yao (Hank) Huang**

Professor, Department of Electronics Engineering  
Associate Dean, College of Electrical and Computer Engineering  
Director, Center of Industry Accelerator and Patent Strategy  
National Chiao Tung University  
Chairman, Chinese Business Incubation Association  
(交通大學電子工程學系兼電機學院副院長兼產業加速器暨專利開發策略中心主任及  
中華創業育成協會理事長黃經堯教授)

BIOGRAPHY



*Plenary Session (IV): Panel Discussions: Academia and Industry Collaboration*

**Panelist**

**Sheng-Jye Hwang**

Professor and Associate Head of Department  
Department of Mechanical Engineering  
National Cheng-Kung University  
(成功大學機械工程學系兼副系主任黃聖杰教授)

BIOGRAPHY



*Technical Session D2-W1-T1: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

### **Session Chair**

### **Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering and  
Chief Executive Officer of Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系兼工學院產學聯盟執行長劉承賢教授)

### BIOGRAPHY



Cheng-Hsien Liu (劉承賢) received the B.S. degree in power mechanical engineering from the National Tsing-Hua University, Taiwan, in 1987, the M.S. degree in mechanical engineering from the Lehigh University, Bethlehem, P.A., in 1992, the M.S. degree in electrical engineering and the Ph.D. degree in mechanical engineering from Stanford University, CA, in 1995 and 2000, respectively.

He presently is a professor in the Power Mechanical Engineering Department at National Tsing Hua University. He has served as the Chief Executive Officer of Industrial Liaison Program, College of Engineering, National Tsing Hua University since Aug. 2012. He had been with National Tsing Hua University, Taiwan since Autumn 2000. In 1999-2000, he worked as a senior Electrical Engineer at Halo Data Devices Inc., San Jose, where he focuses on the development of micro-drives for portable information storage applications. While at Stanford, he worked with Dr. Kenny at Stanford Micro-structures and Sensors Laboratory and focused his Ph.D. work on high-performance MEMS sensors. He currently oversees graduate students in the Micro-Systems and Control Laboratory, whose research activities cover a variety of areas in MicroElectroMechanical Systems, Lan on Chip, system dynamics/modeling/control and Nanotechnology. Some recent highlighted research includes biomimetic array chip for bio-object manipulation targeting for tissue engineering/drug screening applications, Liver on Lab Chip, Lung on Lab Chip, Biomedical Instruments, microphotonics, and advanced tunable MEMS grating.

Dr. Liu received A. Kobayashi Young Investigator Award in Experimental Science from International Conference on Computational and Experimental Engineering and Sciences (2010), the award of Outstanding Chemical Engineering Article of the Year 2010, the Academic Excellent Award from National Tsing Hua University (ranking top 4% in 2010 and 2013), Outstanding Research Program Award from National Science and Technology Program in Biomedical field (2012), Outstanding Research Award from National Science Council (NSC) in 2012 (100 年度國科會傑出研究獎).



## **Screening of microalgae with different lipid contents by using dielectrophoretic microfluidic device**

**Yi-Je Juang**

Associate Professor, Department of Chemical Engineering, National Cheng Kung University  
No.1 University Road, Tainan, Taiwan  
Tel: +886-6-2757575 ext 62653, Fax: +886-6-2344496  
Email: yjjuang@mail.ncku.edu.tw  
(成功大學化學工程學系莊怡哲教授)

### ABSTRACT

Clean and permanent substitute for petroleum fuel has become a widely discussed subject matter in the territory of energy owing to various concerned issues such as climate change and global warming, potentially increased oil price due to the dwindling reserves of the fossil fuel, need for energy security, etc. As a result, research efforts for development of the alternative energies such as sunlight, wind, hydropower, biofuel, geothermal heat, and tidal energy have been devoted substantially in recent years. Among them, biofuel which is extracted from plant and microalgae has been considered as a promising energy source in the future because of the compatibility between now-used vehicle engines and relatively simple acquisition route. Compared to the acquisition route of plant, cultivating microalgae to extract lipid offers several advantages like no need to tap into the global food supply chain, higher energy density, absorbing carbon dioxide to mitigate global warming and producing valued compounds. In order to produce biofuel more efficiently and economically, selection of lipid-rich microalgae for cultivation is one of the crucial steps in biofuel production. In this study, the behavior of the microalgae with different lipid contents under AC electric field was investigated. The frequency sweep was conducted for algae solutions with different solution conductivity. It is found that the microalgae with different lipid contents possessed different crossover frequency, which would experience different dielectrophoretic (DEP) forces at the applied operating frequency. Based on this information, continuous sorting and analysis of the microalgae with different lipid contents by using the DEP microfluidic chip were conducted. The results showed that the he microalgae with higher lipid content can be separated from those with lower lipid content.

### BIOGRAPHY



Dr. Juang received a B.S. degree in chemical engineering from National Taiwan University (Taipei, Taiwan) in 1993 and a Ph.D. degree in chemical engineering from The Ohio State University (Columbus, Ohio, USA) in 2001.

Currently, he is the associate professor of Department of Chemical Engineering at National Cheng Kung University in Taiwan. Before joining National Cheng Kung University in 2005, he worked as a process engineer at ACLARA BioSciences Company (California, USA), a product development manager at Bioprocessing Innovative Company (Ohio, USA) and a

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postdoctoral researcher at The Ohio State University (Ohio, USA). His research interest includes micro/nanofabrication, micro/nanofluidics, BioMEMS, and polymer microfabrication.

Dr. Juang is a member of Society of Plastics Engineers-Taiwan Section.

**Paper-based immunoaffinity devices for accessible isolation and characterization of extracellular vesicles**

**Chihchen Chen**

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National Tsing Hua University  
Hsinchu 300, Taiwan

Tel: +886-3-516-2403, Fax: +886-3-574-5454

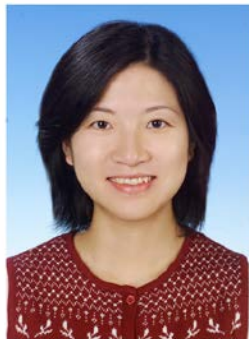
Email: [chihchen@mx.nthu.edu.tw](mailto:chihchen@mx.nthu.edu.tw)

(清華大學奈米工程與微系統研究所陳致真教授)

**ABSTRACT**

We present a paper-based immunoaffinity platform for separating subsets of extracellular vesicles (EVs). This method is inexpensive, robust, easy-to-use (easy-to-prepare), and compatible with downstream analyses, such as scanning electron microscopy (SEM), enzyme-link immunosorbent assays (ELISA), and transcriptome analysis. EVs are small membranous vesicles shed from both healthy and diseased cells and contain nucleic acid and protein cargo. EVs have been increasingly recognized as a means of cell-cell communication and hold a great potential for clinical applications. However, current protocols for isolation of EVs are often lengthy, cumbersome and require expensive equipment. Here, we have isolated EVs from small volumes of both human serum and aqueous humor samples using paper-based immunoaffinity devices. Captured EVs were analyzed morphologically using scanning electron microscopy (SEM) and appeared statistically different in size ( $p$ -value  $< 2.4 \times 10^{-22}$ ) and circularity ( $p$ -value  $< 3.6 \times 10^{-9}$ ) between subsets of EVs bearing different surface markers. Assessing the amount of EVs captured using paper-based ELISA using antibodies conjugated to horseradish peroxidase (HRP) to produce a colorimetric readout was accomplished within 10 minutes. RNAs contained in EVs can be extracted to provide information for disease management. These paper-based immunoaffinity devices, we believe, open opportunities for a wide range of applications in both basic biology and clinical medicine.

**BIOGRAPHY**



Chihchen Chen received her B.S. (1995) and M.S. (1997) in Electrical Engineering from the National Taiwan University. She received her Ph.D. (2006) from the University of Washington at Seattle, WA, with dual degrees in Bioengineering and Nanotechnology. She was a postdoctoral associate at the Massachusetts General Hospital between 2006 and 2009. Currently she is an Assistant Professor of the Institute of NanoEngineering and MicroSystems at the National Tsing Hua University, Hsinchu, Taiwan. Dr. Chen's areas of expertise and research interests are micro- and nano-fluidic technologies for applications in biology and medicine, with a focus on the isolation and characterization of the cellular and sub-cellular components. She is a member of the International Society for Extracellular Vesicles.

## **Microelectrode Array Biosensors for the Near Real-Time Monitoring of Glutamate in Vitro and in Vivo**

**Tina T.-C. Tseng**

Assistant Professor, Department of Chemical Engineering  
National Taiwan University of Science and Technology  
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Email: tinatctseng@mail.ntust.edu.tw  
(台灣科技大學化學工程學系曾婷芝教授)

### ABSTRACT

The study of behaviorally induced, pharmacologically manipulated, and electrically stimulated glutamate changes in the central nervous system requires reliable analytical techniques to investigate fundamentals of neurochemical interactions. Several limitations of conventional sampling and sensing techniques, such as inability to achieve real-time monitoring, infliction of tissue damage and loss of spatial resolution due to large sampling probe size, and disturbance of physiological states around the probe, should be overcome. The small dimension of our lithographically defined microprobes provides high spatial resolution and reduces tissue damage. The silicon-based microprobes have good mechanical strength which is suitable for implantation. Microelectrode array sites at the probe tip allow flexible surface modification for simultaneous detection of various neurotransmitters and other biomarkers. Selective detection of the analyte (e.g. glutamate) against interferents (e.g. ascorbic acid and dopamine) has been achieved by the optimized surface modification of microelectrodes. Amperometric microelectrode array sensors have high temporal resolution which allows near real-time monitoring of neurotransmitters. The microelectrode array glutamate sensor has been implanted in the rat brain for monitoring the stress-induced transient glutamate release in the hypothalamus of freely moving rats and to detect glutamate levels in the thalamus when noxious stimuli was applied to hind-limbs of rats (i.e. evoked glutamate from the afferent sensory input of hindlimbs through the spinothalamic tract).

### BIOGRAPHY



Tina Tseng earned her Ph.D. degree in chemical and biomolecular engineering from University of California, Los Angeles, USA (2011) and her B.S. degree in chemical engineering from National Taiwan University, Taiwan (2006). She is currently an assistant professor in chemical engineering at National Taiwan University of Science and Technology, Taiwan (since 2011). Her research interests include (1) the fabrication of micromachined microelectrode array sensor probes, (2) the development of miniaturized implantable biosensors for neurotransmitters and small molecules and their applications in vitro and in vivo, and (3) the development of electrochemical enzyme immunoassays. Her recent selected publications include T. T.-C. Tseng et al., "Fabrication of implantable, enzyme-immobilized glutamate sensors for the monitoring of glutamate concentration changes in vitro and in vivo", *Molecules*, 19, 2014, p. 7341-7355, T.

T.-C. Tseng et al., "Selective enzyme immobilization on arrayed microelectrodes for the application of sensing neurotransmitters", *Biochemical Engineering Journal*, 78, 2013, p. 146-153, and T. T.-C. Tseng et al., "Implantable microprobe with arrayed microsensors for combined amperometric monitoring of the neurotransmitters, glutamate and dopamine", *Journal of Electroanalytical Chemistry*, 682, 2012, p. 141-146.

**Session Chair**

**Fang-Chung Chen**

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**BIOGRAPHY**



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

He was a teaching assistant in Department of Chemistry, National Taiwan University in 1998. He was a postdoctoral research associate in Department of Materials Science and Engineering, UCLA, from Oct. to Dec. in 2003. He joined Department of Photonics and Display Institute at National Chiao Tung University (NCTU) since Feb. 2004 as an assistant professor. He was also the chairman of Degree Program of Flat Panel Display Technology in NCTU. His research interests include polymer solar cells, organic photodetectors, organic memories, organic light-emitting diodes, and organic thin-film transistors.

Prof. Chen is the recipient of Award for Junior Research Investigators of Academia Sinica 2008, which is one of the most important awards for junior research investigators in all research fields in Taiwan. He has published more than 80 Journals papers, three book chapter, 90 conference papers and owned 14 patents. He is currently on the Editorial Boards of Active and Passive Electronic Components. He frequently serves as a referee for many high-quality Journals, such as JACS, Adv. Mat., Adv. Funct. Mat., ACS Nano, Energy Environ. Sci., J. Mat. Chem., APL etc..

**Nickel oxide p-type electrode interlayer in CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite/fullerene planar-heterojunction hybrid solar cells**

**Tzung-Fang Guo**

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**ABSTRACT**



Our recent work had successfully presented the application of nickel oxide as the p-contact to fabricate the decent perovskite-based photovoltaics. The p-type nickel oxide exhibits several optical, electrical, and chemical advantages being the potential electrode-interlayer. A respectful solar to electrical PCE of 7.8% with a VOC = 0.92 V, a JSC = 12.43 mA/cm<sup>2</sup>, and a FF = 0.68 has been achieved with the device configuration of the glass/ITO/NiO<sub>x</sub>/CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite/PCBM/BCP/Al structure under standard 1 sun AM 1.5G simulated solar irradiation. In addition, the device composed of the mesoscopic nanocrystalline NiO/perovskite/PCBM configuration exhibits a VOC = 1.04 V, a JSC = 13.24 mA/cm<sup>2</sup>, and a FF = 0.69, corresponding to a higher magnitude of PCE to 9.51%. To the best of our knowledge, this is the highest magnitude of PCE for perovskite-based solar cells applying p-contact metal oxide electrode interlayer.

NiO electrode interlayer is a p-type semiconductor of high work function of 5.4 eV, which is close to the valence band edge level of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite (5.4 eV). The alignment of energy level minimizes the interfacial energy losses for the hole transfer and optimizes the photovoltage output of device. Additionally, the higher magnitude of JSC and PCE also results from the better surface coverage (93%) of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite film on the glass/ITO/NiO<sub>x</sub> substrate. The efficient hole transfer at perovskite/NiO heterojunction was verified by photo-induced absorption spectroscopy, showing a broad spectral feature above 800 nm, the long-lived charge-separation state of NiO<sup>+</sup>/P<sup>-</sup>. The success of this new style device configuration of p-type metal oxide material has the advantages of providing robust perovskite-based thin film solar cells in future. Our findings reveal the design principle for enhancing the photovoltaic performance of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite/PCBM hybrid PHJ solar cells through the judicious selection of the metal oxide electrode interlayer.

**BIOGRAPHY**

Professor Tzung-Fang Guo received the B.S. degree in Chemistry from Soochow University, Taiwan in 1993, and Master degree in Chemistry from National Chung Cheng University, Taiwan in 1995. He obtained the Ph.D. degrees in Materials Science and Engineering from University of California Los Angeles in 2002. Prof. Guo became the faculty at Department of

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Photonics, National Cheng Kung University, Taiwan since 2003. He is serving the department chairman currently. His research focuses on high-performance O/PLEDs, polymer PVs, n-type pentacene OTFTs, and the magneto conductance responses of organic electronic devices.



## **Passivation of Cu(In, Ga)Se<sub>2</sub> solar cell with Trioctylphosphine Sulfide**

**Jiun-Haw Lee**

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### ABSTRACT

In this talk, we demonstrated the passivation effects of Cu(In,Ga)Se<sub>2</sub> (CIGS) thin film solar cell by trioctylphosphine sulfide (TOP:S) treatment. X-ray photoelectron spectroscopy results showed: (1) the formation of In<sub>2</sub>S<sub>3</sub> on the surface of the CIGS thin film, (2) residue of TOP monolayer, and (3) increase of Na density on the surface which effectively passivated the CIGS thin film, confirmed by the increase of photoluminescence intensity. Short circuit current, shunt resistance, and hence the power conversion efficiency increased by applying such TOP:S passivation to the CIGS solar cell. Besides, the reverse saturation current decreased which demonstrated the effective passivation effect.

### BIOGRAPHY



Jiun-Haw Lee received the B.S.E.E., M.S.E.E., and Ph.D. degrees in electrical engineering in 1994, 1995, and 2000, respectively, all from National Taiwan University, Taipei, Taiwan. From 2000 to 2003, he was with the RiTdisplay Corporation as the director. Since 2003, he joined the faculty of National Taiwan University in the Graduate Institute of Photonics and Optoelectronics and the Department of Electrical Engineering, where he is currently an professor. His research interests include organic optoelectronic devices, display technologies, and solar cells.

## **Stretched Contact Printing of One-Dimensional Nanostructures for Nano and Organic Transistors**

**Chien-Wen Hsieh**

Assistant Professor, Institute of Lighting and Energy Photonics  
National Chiao Tung University  
(交通大學照明與能源光電所謝建文教授)

### ABSTRACT

Recent reports on one-dimensional nanostructure alignment have showed a broad range of proof-of-concept self assembly approaches, such as wet solution-based microfluidic alignment, Langmuir-Blodgett films, as well as dry assembly methods by shear-sliding contact printing and roll printing. However, achieving spatially specific, highly ordered 1-D nanostructure arrays from wet and dry sources still continues to be a significant challenge.

Here this study demonstrate a stretched contact printing technique to assemble one-dimensional nanostructures with controlled density and orientation from either dry or wet sources. The random, chaotically arranged nanostructures can gradually transform to a highly aligned configuration. Our results show that up to 90% of the printed nanowires are aligned within  $\pm 15^\circ$  of the primary stretching direction. It is easily applicable to a variety of substrates and materials, including inorganic nanowires, carbon nanotubes and organic nanowires, and uniquely compatible to both solution-based dispersions and as-grown nanostructures supported on substrates. The various fabricated device structures, ranging from single- and multi-nanowire field effect transistors to organic-based transistors, demonstrate the potency and feasibility of this technique for different electronic applications.

### BIOGRAPHY



Chien-Wen Hsieh has been an Assistant Professor in the Institute of Lighting and Energy Photonics at the National Chiao Tung University in Taiwan since 2011. He holds a BSc degree in Chemistry and a MSc degree in Chemical Engineering, both from the National Tsing Hua University, Taiwan. From 2002-2006, he was an R&D engineer in the Industrial Technology and Research Institute (ITRI), Taiwan, working on the emerging areas of MEMS, NEMS, and flexible electronics. In 2006 he went on to read for a PhD degree in the Electronic Devices and Materials Group at the Engineering Department, University of Cambridge, UK, under the supervision of Prof. Bill Milne, and he was awarded his Ph.D. in 2011. He was also a member of St John's College and a recipient of the Overseas Research Studentship, Cambridge Overseas Trust Award and Taiwan Merit Scholarship. In 2010, he was elected as a Junior Research Fellow at Homerton College, Cambridge. Chien-Wen has authored over 15 publications in leading peer reviewed journals and is the co-inventor of 8 issued US, TW, and CN patents. His research interests include organic electronics, one-dimensional nanomaterials and nanodevices, large area assembly techniques, and materials and fabrication for MEMS/NEMS.

## **GeSn waveguide light-detectors and emitters for Si micron- and nano-photonics**

**Guo-En Chang**

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### ABSTRACT

Si and Ge are the building materials for Si electronics for decades. Recently, they are considered as photonic materials for the development of electron-photonic integrated circuits on a Si platform for next-generation telecommunication and chip-scale optical interconnection. However, the indirectness of energy band leads to inefficient direct optical transitions and limits the performance of SiGe photonic devices. Recently, Sn-another group-IV element, has been employed in the growth of IV-IV compounds. By incorporating Sn into Ge, GeSn alloys can be transferred to a true direct bandgap material for developing high-performance Si-based photonic devices.

Here we report the fabrication and characterization of GeSn waveguide structures integrated on Si substrates. The Sn incorporation into Ge is realized by low-temperature molecular beam epitaxy to suppressed Sn segregation. The optical properties are characterized by different experiment techniques. For photodetectors, a significant increase in optical response of GeSn waveguide structures in comparison to the pure Ge devices as revealed by the photocurrent experiments. Photoluminescence experiments were carried at room temperature, showing a redshifted emission wavelength for the GeSn waveguides compared to the Ge reference due to the bandgap shrinkage by Sn-alloying. Besides, we observe rippling structures in the photoluminescence spectrum, which are attributed to the waveguide modes. Those results suggest that GeSn waveguide structures are promising for high-performance Si-based photonics integrable with Si electronics.

### BIOGRAPHY



Guo-En Chang was born in Taipei, Taiwan in 1981. He received the B.S. degree from the Department of Mechanical Engineering, National Cheng Kung University, Tainan, Taiwan, and the Ph.D. degree from the Institute of Applied Mechanics, National Taiwan University, Taipei, Taiwan, in 2003 and 2010, respectively.

He was a Visiting Scholar with the University of Illinois at Urbana-Champaign, Urbana, from 2007 to 2009, and postdoctoral fellow in National Taiwan University from 2010 to 2011. In 2011, he joined the Department of Mechanical Engineering, National Chung Cheng University, Chia-Yi County, Taiwan, where he is currently an Associate Professor. His current research interests include Si-based photonics, bio-photonics, sensors and actuators, and precision optical measurements. He has published more than 20 referred international journal

and conference papers.

Dr. Chang is a member of the Optical Society of America (OSA), and the Institute of Electrical and Electronics Engineers (IEEE). He is a recipient of the Graduate Student Study Abroad Program Award 2007 from National Science Council of Taiwan. He is also a recipient of the 2014 Young Scholar Award from the Taiwan Comprehensive University System (TCUS).

**Session Chair**

**Ching-Fuh Lin**

Distinguished Professor, Department of Electrical Engineering and  
Director, Innovative Photonics Research Center  
National Taiwan University

(台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

**BIOGRAPHY**



Prof. Ching-Fuh Lin obtained the B.S. degree from National Taiwan University in 1983, and the M.S. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1989 and 1993, respectively, all in electrical engineering.

He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University. His major research area is in photonics, including organic-inorganic composites for light-emission devices and solar cells, single-crystal Si thin-film solar cells, Si-based photonics, and physics in broadband semiconductor lasers and optical amplifiers.

He is a Fellow of IEEE, a Fellow of SPIE, Member of Asia-Pacific Academy of Materials, and a member of OSA. He has published over 160 journal papers and 450 conference papers and holds more than 50 patents. He is also the sole author of two books, “Optical Components for Communications: Principles and Applications”, published by Kluwer Academic Publishers (USA 2004), and “Optics and Photonics: Fundamentals and Applications” (in Chinese, 2012), and co-authors a book, “Organic, Inorganic and Hybrid Solar Cells –Principles and Practice”, published by John Wiley & Sons, Inc. and IEEE Press, 2012. He had obtained the Distinguished Research Award and several Class A Research Awards from National Science Council of Taiwan, ROC, and the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering. He and his students had also been granted the 18th Acer Research Golden Award, 18th Acer Research Excellent Award, 14th Acer Research Excellent Award, 6th Y. Z. Hsu Technology Invention Award, Outstanding R&D Innovation Award of NTU 2014, Collins Thesis Awards for years of 1998, 2001, 2002, 2004, 2007, 2009, 2010, and 2012.

Prof. Lin has served in the International Scientific Committee of 27th, 28th & 29th European Photovoltaic Solar Energy Conference and Exhibition and as the Chair of IEEE LEOS Chapter Taipei Section, the Board member of the 17th IEEE Taipei Section, and the Council member of the 10th Optical Engineering Society of ROC and Taiwan Photonics Society.

Technical Session D2-W3-T1: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**Chih-Huang Lai**

Distinguished Professor and Chair  
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ABSTRACT

BIOGRAPHY



## **Photocatalysis and Photoluminescence of Graphene Oxide Quantum Dots**

### **Hsi-Sheng Teng**

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#### **ABSTRACT**

Graphene oxide (GO) is a p-type semiconductor with tunable electronic properties. Introducing nitrogen into GO quantum dots has resulted in the coexistence of p- and n-type conductivities in the nitrogen-doped GO quantum dots (NGOQDs). Under irradiation the photogenerated electron-hole pairs in NGOQDs undergo recombination for photoluminescence or separation for photocatalysis. The function of NGOQDs, as a phosphor or photocatalyst, depends on the defect-state density on the NGOQD surface.

Surface-passivated NGOQDs suspended in water or other solvents exhibit strong emission at  $\lambda = 530$  nm, irrespective of the excitation wavelength. Excitation at 470 nm yields a maximum photoluminescence quantum yield. Electron relaxation from the graphene anti-bonding p orbital to the non-bonding oxygen state may be responsible for this emission.

Surface defects on NGOQDs tend to serve as the active sites for interaction between photogenerated charges and surrounding species. NGOQDs populated with intrinsic defects can catalyze overall water-splitting into H<sub>2</sub> and O<sub>2</sub> under visible light irradiation. The ability in overall water-splitting might be associated with the formation of p-n type photochemical diodes in the QDs. Replacing the intrinsic surface defects with deposited Pt states makes the NGOQDs highly active in catalyzing H<sub>2</sub> evolution from an aqueous triethanolamine solution.

#### **BIOGRAPHY**



Professor Hsi-Sheng Teng was born in Taipei, Taiwan in 1962. He received his BS degree in Chemical Engineering from National Cheng Kung University (NCKU), Taiwan, in 1984, and PhD in Engineering from Brown University, USA, in 1992. His major fields of study include photocatalysis, electricity storage devices, and solar cells.

He was an associate scientist in China Steel Corporation and associate professor at Chung Yuan Christian University before joining NCKU. He is now a University Chair at NCKU. He published more than 140 journal papers, with an h-index of 43.



## **Heterostructure & strain-enhanced performance of ZnO-based photodetectors**

**Ruey-Chi Wang**

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### ABSTRACT

In the work, we take ZnO as an example to demonstrate the employment of heterostructure and strain to improve the performance of nanorod (NR)/nanowire (NW) photodetectors. In the first part, amorphous carbon nanoshells were deposited on surface of ZnO NRs synthesized by chemical bath deposition via thermal decomposition of acetone in a CVD system. The photodetector made by depositing Au electrodes on ZnO/C NRs demonstrates enhanced photoresponsivity from 0.16 to 0.38 AW<sup>-1</sup>, decreased response time from 292 to 0.2 sec, and improved resistance to humidity interference compared with a controlled ZnO NR photodetector. The enhanced photoresponsivity are attributed to the increased photocurrent contributed by carbon. The improved velocity and resistance to humidity are ascribed to the blocking of oxygen and water molecules from ZnO by carbon shell. In the second part, photodetectors were fabricated by directly growing large-area horizontal single-crystalline Al-doped ZnO NW arrays across Au micro-electrodes patterned on a flexible SiO<sub>2</sub>/steel substrate to enhance the transportation of carriers and the junction between NWs and electrodes. The device shows excellent photosensing properties with a high ultraviolet/visible rejection ratio of 41450, as well as extremely high maximum photoresponsivity and sensitivity (3.8 AW<sup>-1</sup> and 1.2×10<sup>6</sup>, respectively) at a low bias of 0.1~2 V. Increasing the tensile strain from 0 to 5.6% linearly enhances the photoresponsivity from 1.7 to 3.8 AW<sup>-1</sup> at a bias of 1 V, which is attributed to a decrease in the Schottky barrier height resulting from a piezo-photonic effect.

### BIOGRAPHY



Dr. Ruey-Chi Wang was born in Taoyuan, Taiwan in 1971. She obtained her Ph.D. degree in materials science and engineering from National Cheng Kung University (NCKU), Taiwan, R. O. C. in 2006.

She is currently a professor in the department of chemical and materials engineering at National University of Kaohsiung (NUK), Taiwan, R. O. C. Before starting to do her Ph.D. degree in 2003, she was working as a senior engineer in an electronic company.

Prof. Wang received the Young Investigator Award (Ta-You Wu Memorial Award) from the



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National Science Council (NSC), Taiwan, in 2010. Her current research interests are focused on nanomaterials and nanodevices.

## Microstructured Cobalt Sulphide in Photoelectrochemical Water Splitting

Chia-Yu Lin

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### ABSTRACT

In this talk, we report on the synthesis of cobalt sulfide (CoS) thin film and microtube array and their application as the cathode in photoelectrochemical water splitting system. CoS thin film (FTO | CoS, Fig. 1a), prepared using a simple and scalable chemical bath deposition (CBD) method, shows excellent electrocatalytic activity and stability toward the hydrogen evolution reaction (HER) in both neutral and basic electrolytes. At an overpotential of 390 mV for 72 h, turnover numbers of approximately 2,600 and 3,400 H<sub>2</sub> (mol Co)<sup>-1</sup> can be achieved in neutral and basic electrolyte, respectively. The geometric HER rate can be further enhanced by employing a CoS microtube array (FTO | microCoS, see Fig. 1b-c), which is prepared by sulphurisation of a cobalt hydroxide carbonate nanorods array template using CBD. When coupled with hematite nanorod photoanode (FTO | nanoFe<sub>2</sub>O<sub>3</sub>), the resultant PEC device shows comparable performance to that with Pt foil as cathode (Fig. 1d).

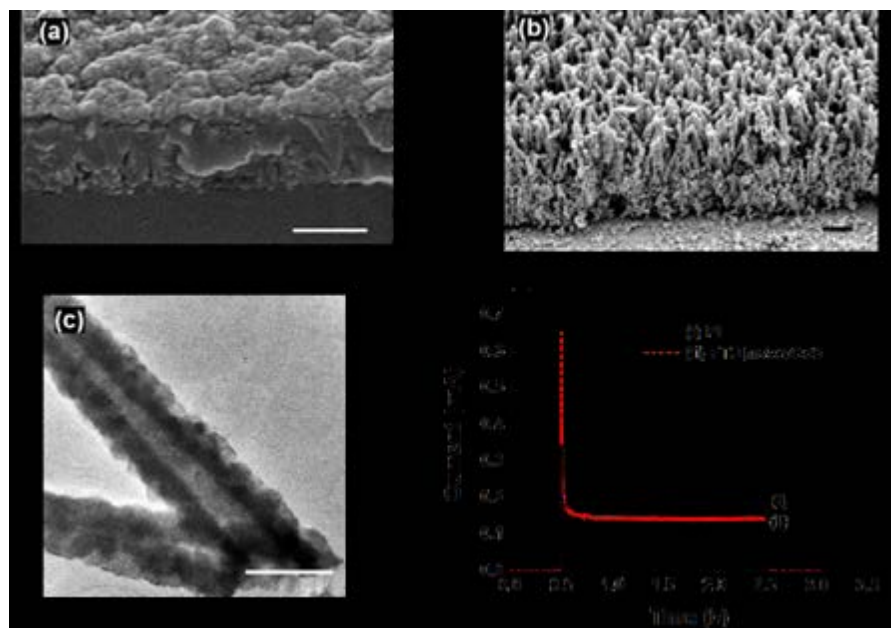


Fig. 1 Tilted (45°) SEM images of (a) the FTO | CoS and (b) the FTO | microCoS electrode with scale bar of 2  $\mu\text{m}$ . (c) TEM image of the microCoS with scale bar of 0.5  $\mu\text{m}$ . (d) Photocurrent transients of a two-electrode PEC cell with Pt or FTO | microCoS combined with

FTO | nanoFe<sub>2</sub>O<sub>3</sub> at 1.23 V bias under irradiation in electrolyte (pH 13) containing KOH (0.1 M) and Na<sub>2</sub>SO<sub>4</sub> (0.1 M).

### BIOGRAPHY



Chia-Yu Lin received his B.S (2003) degree in chemical engineering from National Cheng Kung University, Taiwan. He received his M.S. (2005) and Ph.D. (2010) degrees both in chemical engineering from National Taiwan University, Taiwan.

After a short compulsory military service (between 2010 and 2011), he joined Christian Doppler Laboratory for Sustainable SynGas Chemistry, Department of Chemistry, University of Cambridge, United Kingdom, as a POSTDOCTORAL RESEARCH from 2011 to 2013. Currently, he is an ASSISTANT PROFESSOR in Department of Chemical Engineering, National Cheng Kung University, Taiwan. His researches mainly focused on chemical sensors and photoelectrochemical devices for

energy conversion.

## **Session Chair**

### **Pei-Wen Li**

Professor, Department of Electrical Engineering  
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Associate Dean of Academic Affairs  
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## **BIOGRAPHY**



Pei-Wen Li was born in Taiwan in 1967 and received the Bachelor degree in electrophysics from National Chiao-Tung University, Taiwan in 1989, and the Master and Ph.D. degree in electrical engineering from Columbia University in New York city in 1991 and 1994, respectively.

Her Ph.D. dissertation was focused on the study of low temperature oxidation of SiGe alloys and she has successfully demonstrated the first pure SiGe-channel pMOSFETs. In 1995, she joined Vanguard International Semiconductor Corporation working on the process integration of 64M DRAM. Then, she joined I-Shou University as a faculty in the department of Electronic Engineering in 1996. She joined the department of Electrical Engineering, National Central University as an associate professor in 2000, was promoted to be a professor since August 2005, and served as the department chair during 2007-2010. Currently she is the associate dean of Academic Affairs and the director of the Center for Nanoscience and Technology, National Central University.

Dr. Li's main research theme focuses on experimental silicon-germanium nanostructures and devices. Her present research encompasses germanium quantum dot single-electron transistors, photodetectors, nonvolatile memory, and energy saving (photovoltaic and thermoelectric) devices, making use of self-assembly nanostructures in silicon integration technology. Her research group has successfully developed a novel CMOS-compatible, self-organized approach for the generation of germanium quantum dots on Si-containing layers through thermal oxidation of silicon-germanium-on-insulator structures. Of particular, the successful demonstration of precise placement and size control of the self-assembled germanium quantum dots shed light on the practical creation of new nano-electronic, nano-photonics, and electromechanical devices. She has published more than 70 journal papers and holds 5 patents in Si device processing.

## **Characterization and Activity of S,Zn Co-doped TiO<sub>2</sub> with Visible Light**

**Hsin Chu**

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### ABSTRACT

Dimethyl-disulfide (DMDS) is one of sulfur-containing volatile organic compounds (VOCs) with toxicity, irritation and strong corrosion. Photocatalytic oxidation has been widely reported as a good method to decompose organic environmental pollutants because of its non-toxicity, fast oxidation rate, and chemical stability. The sulfur and transition metal co-doped TiO<sub>2</sub> photocatalysts were prepared by a sol-gel method in this study. The physical and chemical properties of these photocatalysts were characterized by X-ray diffraction, X-ray photoelectron spectroscopy, and Fourier transform-infrared spectroscopy. Compared to sole TiO<sub>2</sub> and S/TiO<sub>2</sub>, sulfur and Zn co-doped TiO<sub>2</sub> photocatalysts can reduce lattice parameter and all photocatalysts are anatase structures. The XPS spectra confirm that Zn<sup>2+</sup> is adsorbed on the surface of TiO<sub>2</sub>. S<sub>0.05</sub>Zn<sub>0.001</sub>/TiO<sub>2</sub> shows the best photocatalytic activity and S-VOCs tolerance for the degradation of DMDS under visible irradiation. The possible mechanism has been developed for S,Zn co-doped TiO<sub>2</sub> under visible-light in this study.

### BIOGRAPHY



Prof. Hsin Chu received his B.S. (1978) in civil engineering and M.S. (1982) in environmental engineering from National Taiwan University. After two-year services in Taiwan Army, he went to the US to continue his study. He received his Ph.D. (1988) in environmental health engineering from Northwestern University. He started his professional career in Energy & Resources Laboratories, Industrial Technology Research Institute (ITRI) back in Taiwan in March 1988. He did various researches in the fields of coal, oil, and gas combustion, low NO<sub>x</sub> burners, flue gas desulfurization, coal gasification, and electrostatic precipitation during the three and half

years in ITRI.

He accepted a faculty position in the Department of Environmental Engineering, National Cheng Kung University (NCKU) in 1991. He has been promoted from an associate professor, through professor, to distinguished professor since. He also served as the director of the Division of Academic Services, NCKU, and the chair of his department in the recent years.

Prof. Chu has broadened his research interests to NO<sub>x</sub>/SO<sub>x</sub> removal from conventional flue gas, H<sub>2</sub>S/COS/HCl removal from gasified coal gas, catalytic and photocatalytic conversion of

VOCs, resource reuse, chemical looping combustion, CO<sub>2</sub> mitigation, and microalgae cultivation and bio-fuels production. He has published more than 70 refereed journal papers and has been awarded many times in the class teaching and research work. He has been granted six patents and one of the patents has been technically transferred to seven engineering corporations. He loves being a bridge between the academic and industries.

## **Design of a SOFC/GT hybrid power generation system by consuming greenhouse gases**

**Wei Wu**

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### ABSTRACT

A new SOFC/GT power generation system is developed to ensure very low carbon emissions. The fuel processing unit which produces the CO-rich syngas is directly connected to the SOFC stack by consuming greenhouse gases. Through the modeling, simulation and efficiency evaluation, the high efficiency of a 1 MW hybrid power generation system can achieve up to 86.5% where a CO<sub>2</sub> reformer is verified to reduce CO<sub>2</sub> emissions and enhance the operating temperature. The heat exchanger network design is employed to improve the heat recovery such that the annual operating can reduce by 28.4%.

### BIOGRAPHY



Wei Wu received the B.S. degree from the Department of Chemical Engineering, Feng Chia University, Taichung, Taiwan, in 1988 and the M.S., Ph.D. degree from the Chemical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan, in 1990, 1995 respectively.

After working as a postdoctoral fellow at National Taiwan University of Science and Technology (Jan. 1996~July 1996), He joined the faculty of National Yunlin University of Science and Technology (NYUST) in 2000 as an Associate Professor. In 2002 he was full Professor in Chemical Engineering Department. Also, He was a Visiting Scholar with the Department of Chemical Engineering, University of California, Los Angeles, USA from June. 2004 to Oct. 2004 and with the Department of Chemical Engineering, University of Delaware, USA from Sep. 2009 to Feb. 2010. In 2011, he has joined the faculty of the Department of Chemical Engineering of National Cheng Kung University as a Professor until now.

His research interests include (1) stand-alone PV/FC/Battery hybrid power systems; (2) combined heat and power economic dispatch problem; (3) optimal hybrid power management; (4) stand-alone syngas production systems using biomass.

**Using microfluidic and optical technologies to aid the optimization and integration of bioenergy production processes**

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**ABSTRACT**

Bioenergy production is more challenging in optimization and integration compared with other green energy processes because it often applies living organisms as catalysts, which makes the quality of product unpredictable and variant. However, conventional methods for quantifying desired products in bioenergy production involve time-consuming and instrument-demanding processes. Therefore, optimization and integration of bioprocesses are currently dependent on great amounts of experiments. To expedite the development of bioenergy industry, obtaining information related to the production process in a timely manner is essential. Microfluidic and optical techniques are ideal for rapid detection and quantification of bio-products for several reasons. Microfluidic assays have high throughput compared with lab-scale tests and they require extremely small amount of reagents and cells. Optical methods can be non-invasive and multiple cellular components can be detected simultaneously.

This presentation includes two examples of how microfluidic and optical techniques can be used to optimize bioenergy production or to assess feasibility of integrating multiple processes. The first example is the real-time quantification of lipids and pigments in microalgae cell to determine the cultivation condition and harvest timing. Near infrared Raman spectrometry is applied to determining the intensity of emission lights with specific wavelength, which is subsequently translated into lipid or pigment abundance, from microalgae powder, paste, or suspension. The second example is the rapid screening of carbon sources for electricity generation by native microorganisms of Taiwan. The electrochemical activity of microorganisms is determined by a membraneless microfluidic microbial fuel cell ( $\mu$ MFC). The  $\mu$ MFC can test the efficiency of one carbon source in generating electricity in 1 hour and parallel tests can be conducted to test several carbon sources simultaneously. Suitable carbon sources for a mixed-culture microorganisms and *Proteus hauseri* Strain ZMd44 to generate electricity are obtained and the results are validated with lab-scale MFCs. The  $\mu$ MFC is also applied to seek possibilities in integrating biohydrogen production with microbial fuel cell in series. Preliminary data show that it is promising to use the metabolic products during biohydrogen production as carbon sources for electricity generation in microbial fuel cell.

**BIOGRAPHY**

Professor Hsiang-Yu (Angie) Wang is devoted to the integration of bioenergy, microfluidics, and engineering. She graduated with a Ph.D. from Purdue University, USA in 2007 and after joining National Cheng Kung University in 2009, she has been working with several top researchers in the areas of biofuel and microbial fuel cells to develop





rapid and high-throughput analysis platforms for selecting energy-generating microbes/cultivation strategies and for monitoring cellular metabolic products. She has been awarded the “Rising Star Research Award” in National Cheng Kung University in 2013 for her excellence in academic research. She is now the associate professor in the Department of Engineering and System Science in National Tsing Hua University in Taiwan.

### **Si-Yu Li**

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#### **ABSTRACT**

Carbon dioxide is a ubiquitous molecule produced by most industrial activities. With the evident CO<sub>2</sub> accumulation in the atmospheric layer over the past few decades, more and more research attentions have been paid to reduce the CO<sub>2</sub> emission or to recover emitted CO<sub>2</sub>. Fermentation process is highly associated with the CO<sub>2</sub> emission. For example, 1 mole of bioethanol being produced is equivalent to 1 mole-CO<sub>2</sub> emitted, considering the microbial fermentation process as a whole. Meanwhile, 1 mole of biobutanol is roughly 4-mole CO<sub>2</sub> equivalent using *Clostridium acetobutylicum*. Although the concept of biofuels is to reach carbon neutral by using biomass as the feedstock, it is desirable to take one step further to reduce the CO<sub>2</sub> emission during fermentation. One potential way is to metabolically turn industrial bacteria from heterotrophs to mixotrophs, where mixotrophs can use both carbohydrates and CO<sub>2</sub> as carbon sources. In this manner, the CO<sub>2</sub> emission can be recycled by bacteria itself while those recycled CO<sub>2</sub> can be used to make more fermentation products. In this study, the feasibility of mixotrophic *Escherichia coli* will be discussed. The mixotrophic *Escherichia coli* is constructed based on the Calvin cycle, where two key genes encoding ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco) and phosphoribulokinase (PrkA) was cloned and overexpressed in *E. coli*. By further appropriate metabolic engineering on the central metabolism, Rubisco-based engineered *E. coli* can recycle CO<sub>2</sub> during the metabolism of not only pentoses but also hexoses.

#### **BIOGRAPHY**



Dr. Si-Yu Li was born in Taoyuan, Taiwan in 1981. He received his BS degree and MS degree from the Department of Chemical Engineering at National Chung Hsing University, Taiwan, in 2003 and 2005, respectively. He received his PhD degree from the Department of Chemical Engineering at the University of Connecticut, USA in 2010. He is currently an assistant professor of the Department of Chemical Engineering at National Chung Hsing University, Taiwan. He has authored 12 SCI peer-reviewed journal articles and several patent applications. His research interests are Rubisco-based engineered *E. coli*, butanol fermentation, biodegradable plastics production, and bio-separation. Dr. Li is the editorial board member of *Smart Science*. In 2014, he received Outstanding Advisor Award from the College of Engineering, National Chung Hsing University.

*Technical Session D2-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

### **Session Chair**

#### **Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering and  
Chief Executive Officer of Industrial Liaison Program, College of Engineering  
National Tsing Hua University

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#### BIOGRAPHY



Cheng-Hsien Liu (劉承賢) received the B.S. degree in power mechanical engineering from the National Tsing-Hua University, Taiwan, in 1987, the M.S. degree in mechanical engineering from the Lehigh University, Bethlehem, P.A., in 1992, the M.S. degree in electrical engineering and the Ph.D. degree in mechanical engineering from Stanford University, CA, in 1995 and 2000, respectively.

He presently is a professor in the Power Mechanical Engineering Department at National Tsing Hua University. He has served as the Chief Executive Officer of Industrial Liaison Program, College of Engineering, National Tsing Hua University since Aug. 2012. He had been with National Tsing Hua University, Taiwan since Autumn 2000. In 1999-2000, he worked as a senior Electrical Engineer at Halo Data Devices Inc., San Jose, where he focuses on the development of micro-drives for portable information storage applications. While at Stanford, he worked with Dr. Kenny at Stanford Micro-structures and Sensors Laboratory and focused his Ph.D. work on high-performance MEMS sensors. He currently oversees graduate students in the Micro-Systems and Control Laboratory, whose research activities cover a variety of areas in MicroElectroMechanical Systems, Lan on Chip, system dynamics/modeling/control and Nanotechnology. Some recent highlighted research includes biomimetic array chip for bio-object manipulation targeting for tissue engineering/ drug screening applications, Liver on Lab Chip, Lung on Lab Chip, Biomedical Instruments, microphotonics, and advanced tunable MEMS grating.

Dr. Liu received A. Kobayashi Young Investigator Award in Experimental Science from International Conference on Computational and Experimental Engineering and Sciences (2010), the award of Outstanding Chemical Engineering Article of the Year 2010, the Academic Excellent Award from National Tsing Hua University (ranking top 4% in 2010 and 2013), Outstanding Research Program Award from National Science and Technology Program in Biomedical field (2012), Outstanding Research Award from National Science Council (NSC) in 2012 (100 年度國科會傑出研究獎).

**A novel micro/nano hybrid structured chitosan nerve conduit for proliferation enhancement and growth direction guidance of neuroblastoma B35**

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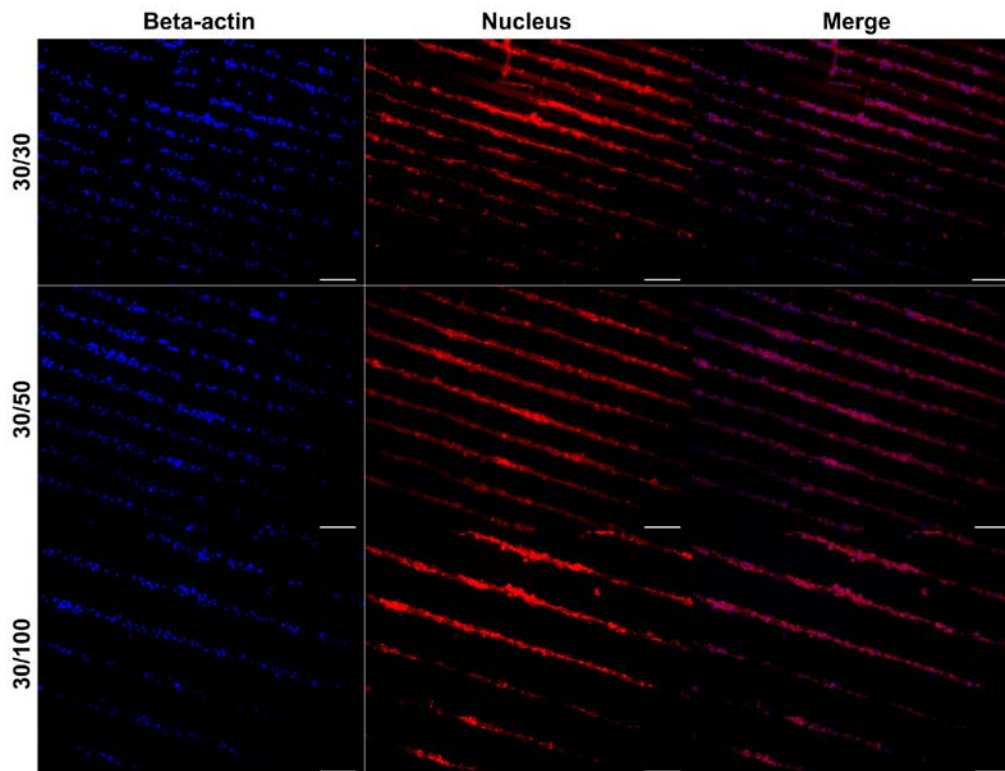
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**ABSTRACT**

Nerve injury induced limited mobility or even paralysis is an extremely clinical issue. Restore the function of the injured nerve has been one of the important themes in clinical neurology. Recent advances in tissue engineering enable the feasibility of restoring the injured nerve using tissue engineering nerve conduits. The most crucial problem of nerve repairing is the difficulty to precisely control the growth direction of the nerve cells and their axons. Hence the regenerative nerve tissue does not well connect with the target nerve tissue, degrading the recovery of the physiological function.

This study proposed a novel chitosan scaffold with micro and nano hybrid patterns. The hemispheric array of the barrier layer of an anodic aluminum oxide (AAO) film was used as the substrate. The micro electro mechanical system (MEMS) and nickel electroforming techniques were integrated for the fabrication of chitosan nerve conduits with various micro/nano hybrid patterns. Nerve cells were then cultured on the conduits. The cell morphology was observed through the Hoechst (staining nucleus) and phalloidin (staining cytoskeleton) labeling. It was observed that the pure micro groove containing conduits could only guide the nerve cells to grow approximately along the ridges of the micro groove structure, while some cells grew across the space in between two ridges of the micro groove structure to reach the neighbouring ridges. However, the proposed micro/nano hybrid structures could more effectively guide the cells to grow along the ridges and enhance the proliferation of nerve cells.



Cell morphologies of B35 cells cultured on the chitosan conduits with micro/nano hybrid patterns (nano structure on the ditch bottom). The conduits could more effectively guide cells to grow along the ridges. Scale bar: 100  $\mu\text{m}$ .

## BIOGRAPHY



Dr. Gou-Jen Wang received the B.S. degree on 1981 from National Taiwan University and the M.S. and Ph.D. degrees on 1986 and 1991 from the University of California, Los Angeles, all in Mechanical Engineering. Following graduation, he joined the Dowty Aerospace Los Angeles as a system engineer from 1991 to 1992. Dr. Wang joined the Mechanical Engineering Department at the National Chung-Hsing University, Taiwan on 1992 as an Associate Professor and has become a Professor on 1999 and a Distinguished Professor on 2009. From 2003-2006, he served as the Division Director of Curriculum of the Center of Nanoscience and Nanotechnology. From 2007 to 2011, he was the Chairman of the Graduate

Institute of Biomedical Engineering, National Chung-Hsing University, Taiwan. On 2008, he served as the Conference Chair of the Microfabrication, Integration and Packaging Conference (April/2008, Nice, France). From 2009, he is a Committee member of the Micro- and Nanosystem Division of the American Society of Mechanical Engineers. His research interests include biosensors, biomedical micro/nano devices, nano fabrication, and dye-sensitized solar cells.

## **Effect of anions on the redox reaction of hydrogen peroxide of the nanostructured gold**

**Chiun-Jye Yuan**

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### ABSTRACT

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is an important analyte in laboratories, health care and in food and cosmetic related industries. H<sub>2</sub>O<sub>2</sub>, a byproduct of bioenergetic process in living organisms, is one of the important markers for the inflammation and oxidative stress. H<sub>2</sub>O<sub>2</sub> is also an efficient liquid oxidant for the development of fuel cells. Hence, the development of a reliable and efficient electrode material for the determination or the catalysis of H<sub>2</sub>O<sub>2</sub> is practically important. Recently, a nanostructured gold (Au)-modified carbon fiber paper (CFP) has been developed in our laboratory. First of all, we found that the nanostructured Au modification greatly improve the heterogeneous electron transfer rate constant of CFP. More interestingly, this modification dramatically turned the CFP electrode from a catalytically inactive state for H<sub>2</sub>O<sub>2</sub> into a catalytic active state. Interestingly, when the oxidation of H<sub>2</sub>O<sub>2</sub> was performed in different electrolytes, such as phosphate, sulfate, nitrate, acetate, chloride and hydroxide ions, a differential electrochemical response was observed. In phosphate buffer H<sub>2</sub>O<sub>2</sub> exhibited a Au-catalyzed oxidative response. However, this Au-dependent electro-oxidation of H<sub>2</sub>O<sub>2</sub> was greatly abolished in solutions containing some of these anions. These results suggest that the catalytic activity of nanostructured Au to H<sub>2</sub>O<sub>2</sub> can be greatly affected by the anionic electrolytes used in the measuring. The mechanism underlying these phenomena was also studied in this study. We found that the surface area of nanostructured Au exposed to hydroxide or other reactants was greatly affected by the presence of different anions in the reaction solutions.

### BIOGRAPHY



Dr. Chiun-Jye Yuan was born in Kaoshiung city in January, 23rd, 1958.

#### **Education:**

Ph.D. in Biochemistry and Biophysics, Department of Biochemistry and Biophysics, Iowa State University, Ames, IA, USA, 1993

M.S. in Biochemistry and Biophysics, Department of Biochemistry and Biophysics, Iowa State University, Ames,

IA, USA, 1989

B.S. in Chemistry, Department of Chemistry, National Cheng Kung University, Tainan, Taiwan, ROC, 1981

**Experiences:**

- |                |  |
|----------------|--|
| 2014/2-present | Joint appointment at Institute of Molecular Medicine and Bioengineering, National Chiao Tung University, Hsinchu, Taiwan, ROC                                      |
| 2010/8-present | Professor at the Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan, ROC   |
| 2006/8-2007/7  | Chairmen of the Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan, ROC  |
| 2004/8-2010/7  | Associate Professor at the Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan, ROC                                   |
| 1997/8-2004/7  | Assistant Professor at the Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan, ROC                                   |
| 1994/4-1997/7  | Visiting fellow in Dr. A. B. Mukherjee's laboratory at National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, USA. |
| 1994/1-1994/3  | Postdoctoral research fellow in Dr. Donald J. Graves's laboratory at Iowa State University, Ames, IA, USA.   |

Professor Yuan is the member of the American Society of Molecular Biology and Biochemistry and the American Chemical Society. He received the Excellence in Undergraduate Mentor of the Department of Biological Science of Technology, NCTU in 1999, the Excellence in Teaching Award of NCTU in 2009, and the NSC fellowship for 3 months advanced research abroad in 2010.



*Technical Session D2-W1-T2: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

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ABSTRACT

BIOGRAPHY





**Mass spectrometry sensitivity and selectivity enhancement on nanostructured silicon surface**

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ABSTRACT

Mass spectrometry (MS) is a widely used analytical technique providing quantified mass to charge ( $m/z$ ) ratio of atoms and molecules. Matrix assisted laser desorption/ionization (MALDI) is one of the most widely used soft ionization technique in MS analysis. However, this technique requires chemical matrix mix with the sample solution which creates signal noise. Nanostructured silicon (nSi) surfaces can be served as matrix-free MS analysis target substrate without organic matrix interference at low  $m/z$  range as high sensitivity matrix-free MS analysis method.

In addition to the matrix-free and high MS detection sensitivity advantages, the nSi surface can tailored into various surface functionalities to further enhance MS detection selectivity and sensitivity through nanostructured silicon surface engineering. Various nSi surface engineering techniques by surface modification, on-chip catalyst reaction and magnetic nanoparticle to enhance nSi MS detection sensitivity and selectivity will be presented in this presentation.

BIOGRAPHY



Prof. Chia-Wen Tsao was born in Taipei, Taiwan, in 1976. He received bachelor degree in mechanical engineering from Yuan-Ze University, Taiwan in 1998. He received M.S degree in mechanical engineering, from University of Colorado, Boulder, USA in 2004 and Ph.D. degree from mechanical engineering in University of Maryland, College Park, USA, in 2008. He join Department of Mechanical Engineering, National Central University, Taiwan in 2008 where he is currently an Associate Professor.

His research interests include Microfluidics, Mass Spectrometry, MEMS, Micro & Nano/ Technology, Polymer Microfabrication and Heat exchanger design.

Technical Session D2-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials

### **Session Chair**

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(成功大學光電科學與工程學系兼系主任郭宗枋特聘教授)

### BIOGRAPHY



Professor Tzung-Fang Guo received the B.S. degree in Chemistry from Soochow University, Taiwan in 1993, and Master degree in Chemistry from National Chung Cheng University, Taiwan in 1995. He obtained the Ph.D. degrees in Materials Science and Engineering from University of California Los Angeles in 2002. Prof. Guo became the faculty at Department of Photonics, National Cheng Kung University, Taiwan since 2003. He is serving the department chairman currently. His research focuses on high-performance O/PLEDs, polymer PVs, n-type pentacene OTFTs, and the magneto conductance responses of organic electronic devices.

## **Good light based on organic light-emitting diodes**

**Jwo-Huei Jou**

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### ABSTRACT



Light has its dark side and could be 'toxic', especially 'carcinogenic' if selected and used improperly. Starting from 2013, healthy other than high-quality and energy-saving has become one of the key factors to pursue for general lighting. By realizing the notorious effects of blue light on artworks, human eyes, and physiology, devising a good light that is free from the blue hazards has become a must and urgent. We will demonstrate in the presentation the feasibility of employing organic light-emitting diodes (OLEDs) to enable an artwork-, human-eyes-, and physiologically-friendly light source with very low color temperature ( $CT < 2,000K$ ) and very high natural light spectrum resemblance index, ( $SRI > 90$ ). Especially, the OLED-based light source can also be

made nearly blue-emission free and with a spectrum closely matching that of the dusk-hue or candle light. A prototype luminaire based on the candle light-style OLED will also be revealed, proving the possibility in replacing the hydrocarbon-burning candles that invented 5,000 years ago. At the end, an OLED-based good light that is free of mercury, ultraviolet, infrared, flickering, glare, and blue emission will be compared against the current lighting measures, including an LED, a compact fluorescent lamp, an incandescent bulb, and a candle.

### **Promising characters of candlelight-style OLED**

Figure 1 compares the candlelight-style OLED with current lighting sources in terms of power spectrum, color temperature, color rendering index (CRI), and characters regarding the presence of mercury (Hg), flickering, glare, ultraviolet (UV), and infrared (IR).<sup>[1]</sup>

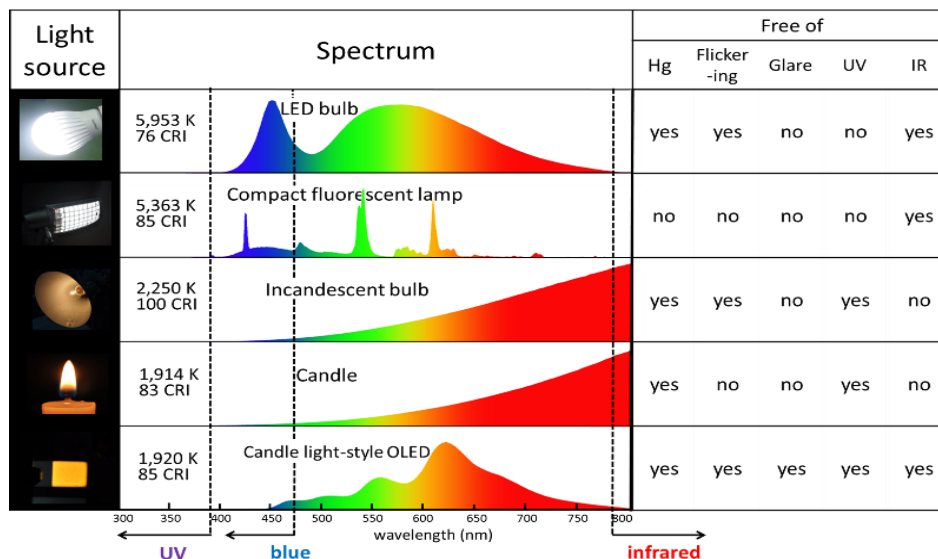


Figure 1. Comparison of the candlelight-style OLED with current lighting sources.[1]

## Reference

1. J.-H. Jou, C.-Y. Hsieh, J.-R. Tseng, S.-H. Peng, Y.-C. Jou, J. H. Hong, S.-M. Shen, M.-C. Tang, P.-C. Chen, C.-H. Lin, *Adv. Funct. Mater.*, 2013, 23, 2750.

## BIOGRAPHY

Prof. Jwo-Huei Jou of the Department of Materials Science and Engineering at the National Tsing-Hua University Taiwan, was the department chairperson from 2006 to 2009, and is serving as the president of Chinese Organic Electronics Association, the Editor of Fluorescent Materials, and an active member of Engineering Ethics Committee of the Chinese Engineers Association. His web page is: <http://www.mse.nthu.edu.tw/~jjou/>

Prof. Jou received his PhD degree in 1986 from Macromolecular Science and Engineering Program, University of Michigan (USA). In 1986 he joined as a Postdoctoral Visiting Scientist at IBM-Almaden Research Center, San Jose, CA, and then joined National Tsing-Hua University in 1988 as an Associate Professor. In 1992, he received academic title Professor.

Professor Jou's research interests include sunlight style organic light emitting diodes (OLEDs); candle light style OLEDs, high efficiency low color temperature OLEDs, ultra-deep blue OLEDs, very high color rendering index OLEDs, spectrum resemblance index to measure the quality of light, flexible OLEDs, long lifetime OLEDs, thin film stress analysis, polymers and expert system applications. He has made several breakthrough inventions, including Sunlight style color-temperature tunable OLED, Candle light style OLED, Chromaticity tunable between dusk-hue and candle-light OLED, and Solution pre-mixed method for OLEDs fabrication etc. He is the author of over 120 international peer reviewed journal papers, and has filed or been granted over 65 patents including 20 US patents. He has delivered more than 35 talks as an invited or plenary speaker in international conferences over the past five years. In the past three years, he has also delivered 24 invited talks on OLEDs and 19 invited talks on Engineering Ethics in Taiwan. He was awarded "Excellence in Industry-Academic Cooperation" Taiwan (2013); International Inventor Prize (IIP) (2012); "Award of Excellence Commercialization" Taiwan (2012); 2012 ITRI (Industrial Technology Research Institute) Laurel

**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
**National Cheng Kung University, Tainan, Republic of China (Taiwan)**

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lecturer; 2007-2011 Outstanding Academic Teaching Awards; 2009 and 2010 NTHU-Academic Summit Program: Boost Program Research Funding; “Prism award for Photonics Innovation” finalist 2009; “Outstanding Poster Paper Award” International Display Workshop (2007); “Boost Program Research Funding” 2007; “Excellence Research Program Funding” (2006); National Science Council (NSC) Outstanding Research Award-1992; “NSC Grade-A Research Award” 1989-1991, 1995-1999; “Booster Program Research Funding” (1991). Lead guest-editor of several special issues in International Journal of Photoenergy (<http://www.hindawi.com/journals/ijp/si/905140/cfp/> and <file:///C:/Users/Sudhir%20Dubey/Downloads/948689.pdf>), Journal of Nanomaterials (<http://www.hindawi.com/journals/jnm/si/369109/cfp/>), Advances in Materials Science and Engineering (<http://www.hindawi.com/journals/amse/2012/878301/>), and The Open Optics Journal (<http://benthamopen.com/tooptsj/Special-Issues.htm>). Editor of Fluorescent Materials launched recently by De Gruyter Open ([www.degruyteropen.com](http://www.degruyteropen.com)).

Professor Jou’s recent journal publications and patents can be found from the link:  
<http://www.mse.nthu.edu.tw/~jjou/page3.html#成果簡述>

Technical Session D2-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials

**Zingway Pei**

Associate Professor, Graduate Institute of Optoelectronic Engineering &  
Department of Electrical Engineering  
Director, Center for Research and Development of Engineering Technology,  
National Chung Hsing University  
(中興大學電機工程學系暨光電工程研究所裴靜偉教授)

ABSTRACT

BIOGRAPHY



## **New Alternatives of Contact Materials for Transistor**

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(中央大學電機工程學系辛正倫教授)

### ABSTRACT

In this talk, I will introduce you our recent work on the metal silicide thin films for integrated circuit industry. The feature size of the transistor keeps scaling down and following Moore's law while employing new materials and structures. With the decrease of the source/drain contact area, the series and contact resistance of metal silicides are getting more critical. However, the poor thermal stability of the nanoscaled metal silicide thin film has become a serious issue in recent years, especially for the contemporary Si<sub>0.8</sub>Ge<sub>0.2</sub> source/drain of P-channel MOSFET. In order to find out the alternatives to replace NiSi, our strategy is the silicide by alloy and ultra-thin epitaxial silicide. Thermal stability and reliability of these materials were studied, suggesting that these novel silicides could provide feasible process window for the IC fabrication with acceptable cost and superior electrical properties.

### BIOGRAPHY



Cheng-Lun Hsin received his Bachelor degree and Ph.D. degree in Dept. of Materials Science and Engineering from National Tsing-Hua University, Taiwan in 2002/06 and 2008/05, respectively.

After reporting his duty, he joined the Back-end module Department 1 of Taiwan Semiconductor Manufacturing Company as a principal engineer. Then, he joined National Chiao-Tung University in 2009/12 and University of California, Berkeley in 2011/03 as a postdoctoral researcher. Since 2012/8, he has been an Assistant Professor with the

Electrical Engineering Department, National Central University, Taiwan. His research interests include semiconductor process innovation, silicide and metal oxide materials, thermoelectric devices and microscopy techniques.

Dr. Hsin has won the Exploration Research Award of Pan Wen Yuan Foundation, Taiwan on 2013 and is a member of the Chinese Institute of Electrical Engineering.



## **An Epitaxy Approach to Explore Photoelectrochemistry of Complex Oxide Heterostructures**

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### ABSTRACT

The enhancement photoactivity mechanisms of a particular crystal facet semiconductor-based photocatalyst due to metal nanoparticles play important roles for designing highly efficient photocatalyst structures. Herein, we used Au nanoparticles (NPs) - BiVO<sub>4</sub> (BVO) heteroconjugation, in which the {001} facet of single crystal BVO was uniformly decorated by Au NPs with various sizes and densities, as a model heterostructure photocatalyst. We demonstrate, through X-ray photoemission experiments, the band alignment of Au NPs and BVO. The valence band offset value increases as the mean size of Au NPs increases at  $7 \leq d \leq 38$  nm and Au NPs density increases from 80 to 740 NPs  $\mu\text{m}^{-2}$ . As compared with bare BVO, Au NPs decorated BVO exhibited significantly enhanced both photoelectrochemical water splitting and photocatalytic degradation of Congo Red under visible-light irradiation. The dynamics of relaxation processes of Au/BVO heteroconjugation have been investigated by femto-second laser pump – probe and photoluminescence measurements. The analytic results indicated that the efficiency improvement of interfacial electron transfer from BVO to Au NPs as the result of an increase in Au size corresponding to increase the photocatalytic activity of BVO. Furthermore, 3D finite-difference time domain simulation was performed to investigate the Au NPs size dependent of electrical field amplification at the Au/BVO interface upon surface plasmon resonance excitation. A strong electrical field amplification region overlapped with the absorption band of BVO leading to an enhancement optical absorption of BVO, thus increasing generation of electron and hole pairs for photoactivity reaction. This study delivers a general approach to probe the photochemistry of complex oxide heteroconjugation.

### BIOGRAPHY



Professor Ying-Hao Chu received his PhD in the Department of Materials Science & Engineering from National Tsing-Hua University in 2004. He joined University of California, Berkeley in 2004 as a postdoc. In 2008 he joined National Chiao Tung University in the Department of Materials Science & Engineering as an assistant professor. In 2013 he started an adjunct position in institute of physics, Academia Sinica. In 2014 he hold an adjunct position in Department of Electrophysics, National Chiao Tung University. His research is highly focused on complex functional oxides and strongly correlated electron systems. He

has extensive experience in the use of advanced characterization techniques to understand and



manipulate complex functional oxide heterostructures, nanostructures, and interfaces. His current goal is try to create a pathway to use topological defects for next generation electronics. Now, he is top 3 of the most publication in BiFeO<sub>3</sub> and top 10 of the most publication in multiferroic materials. He has published more than 175 papers with more than 7000 citations (h-index=42 and i10-index=93) (Web of Science). In 2014, he has been placed in the list of Highly Cited Researchers in Materials Science (Thomson Reuters) (Researcher ID: A-4204-2008).

*Technical Session D2-W2-T2: Electronic, Photonic, and Magnetic Materials, Organic Polymer and Soft Materials*

ABSTRACT

BIOGRAPHY

Technical Session D2-W3-T2: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**Session Chair**

**Chih-Huang Lai**

Distinguished Professor and Chair  
Department of Materials Science and Engineering  
(清華大學材料科學工程系兼系主任賴志煌特聘教授)

ABSTRACT

BIOGRAPHY



## **Solar energy harvesting scheme utilizing three-dimensional hierarchical nano- and micro-structures**

**Yu-Lun Chueh**

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### ABSTRACT

In this talk, hierarchical nanostructures were used to enhance the energy harvesting based on photo-solar and thermal-solar in my group. In the first part of my talk, I will report fabrication of a large area Cu(In,Ga)Se<sub>2</sub> nanotip arrays (CIGS NTRs) by using one step Ar<sup>+</sup> milling process without template.<sup>[1]</sup> By controlling milling time and incident angles, the length of CIGS NTR<sub>s</sub> with adjustable tilting orientations can be precisely controlled. The CIGS NTRs have very low reflectance < 0.1 % at incident wavelengths between 300 nm to 1200 nm. Open circuit voltage and short circuit current of CIGS NTR<sub>s</sub> solar cell were measured to be ~390 mV and ~22.56 mA/cm<sup>2</sup>, yielding the filling factor and the efficiency of 59 % and 5.2 %, respectively. In contrast to CIGS thin film solar cell with efficiency of 3.2 %, the nanostructured CIGS NTRs can have efficiency enhancement of ~160 % due to the higher light absorption ability because of the nanostructure. In the secondary part of my talk, an enhanced heat capacity of modified HITEC molten salt by doping of metal NPs will be reported. We encapsulate the Tin alloy into Sn/SiO<sub>x</sub> core-shell NPs to prevent mixture with salt when operation temperature is higher than the melting point of Tin. The SiO<sub>x</sub> shell layer can protect the Sn NPs to be oxidized and maintains a melted status during the heat cycles, providing a stable latent heat value of 28.36 J/g. Besides, effective heat capacity of HITEC salt with Sn/SiO<sub>x</sub> core-shell NP<sub>s</sub> can be enhanced to be 30 % a mixture percentage of 5 wt%. The merits of this approach show a low-cost and easy way to enhance the thermal properties of current molten salt without complicated manufacturing.<sup>[2]</sup>

### **References:**

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### BIOGRAPHY



**Yu-Lun Chueh** received his Ph.D degree from department of materials science and engineering, National Tsing Hua University, Taiwan in 2006 and worked as postdoctor in electrical engineering and computer science, UC Berkeley from 2007-2009. He joined department of materials science and engineering, National Tsing Hua university in 2009. His research directions include (1) Syntheses of energy materials and its applications in solar energy harvesting, (2) Performance enhancement of Resistive change memory, (3) Synthesis of graphene and its application in nanodevices, and development of desalination from sea water. Details can be found at:

<http://nanoscienceandnanodevicelab.weebly.com/index.html>

**Experience:**

- **Associate Professor** in Department of Materials science and Engineering, National Tsing-Hua University, **2012/Aug ~ present**
- **Assistant Professor** in Department of Materials science and Engineering, National Tsing-Hua University, **2009/Aug ~ 2012/Aug**
- **Postdoctoral Fellow** in Laboratory for Nanomaterials & Electronics, Department of Electrical Engineering and Computer Sciences, University of California at Berkeley, USA, **2008/Apr- 2009/July (Prof. Ali Javey's Research Group)**.
- **Postdoctoral Fellow** in Nano-structures & dynamics Lab Department of Materials Science and Engineering National Tsing -Hua University, Hsinchu, Taiwan. **2007/Nov-2008/Apr**

## **First Principles Study of Band Alignment at the Rutile-Anatase TiO<sub>2</sub> Interface**

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### ABSTRACT

Mixed-phase samples of rutile and anatase TiO<sub>2</sub> have been experimentally shown to have synergic effect on the photocatalytic activity of water-splitting reactions under sunlight. This extraordinary behavior is generally believed to be mainly attributed to the electric field built-in at the interface between anatase and rutile phases of TiO<sub>2</sub>, which can effectively enhance the photo-excited charge carrier separation to increase the generated photocurrents. Nevertheless, there remain some debates regarding the band lineups between the anatase and rutile phases of TiO<sub>2</sub> in terms of different experimental viewpoints.

In this study, we have employed first-principles density function theory calculations to investigate the band alignment between the rutile and anatase phases of TiO<sub>2</sub>. At variance with the previous theoretical studies on this material system, we indeed constructed two realistic heterojunction model structures based on the experiments, anatase (112) / rutile (100) and anatase (110) / rutile (011), respectively, to deduce their theoretical band alignments. These heterojunction interface structures were generated using ab initio molecular dynamics simulated annealing method so that they are much more reliable than those previously generated using classical force field modeling. Our generated structure models reveal that the fivefold- and sixfold-coordinated Ti atoms are the most predominant bonding configurations in the interface region rather than the fourfold-coordinated Ti atoms as suggested by a recent tight-binding molecular dynamic study.

Our calculations show that the offset values of VBM/CBM are  $0.409 \pm 0.12\text{eV}$  /  $0.239 \pm 0.12\text{eV}$  for anatase (112) / rutile (100) interface, and  $0.588 \pm 0.03\text{eV}$  /  $0.418 \pm 0.07\text{eV}$  for anatase (110) / rutile (011) interface, respectively, which are consistent with the most recent experimental measurements. These results indicate the direction of the photo-excited electron transport should be majorly from the rutile side to the anatase phase of TiO<sub>2</sub>. Furthermore, we also applied other theoretical methods, such as the branch point energy lineup and vacuum level lineup, to predict the band alignments of these two phases without constructing the realistic interface structure models. As compared with those calculated using the generated heterojunction models, we obtained satisfactory results for the trend predicted using these indirect theoretical approaches though the relative magnitudes of the band offsets appear to be slightly different. Nevertheless, they can provide a much easier way to acquire useful preliminary guess for the band alignments of the relatively more complicated oxide material systems.

BIOGRAPHY



## **Investigation on the photocatalytic characteristics of Ag and B doped TiO<sub>2</sub> nanophotocatalysts**

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### ABSTRACT

Ag-doped TiO<sub>2</sub> nanoparticles are favorable to absorption of visible light. Ag nanoparticles play the role of electron receivers on TiO<sub>2</sub> surface and thereby enhance photodegradation reaction. However, deposition of excess Ag nanoparticles decreased the surface area of TiO<sub>2</sub> nanoparticles and increased the possibility of charge recombination, resulting in reduced photocatalytic activity. In this study, the impact of various Ag doping concentrations on photocatalytic activity of TiO<sub>2</sub> has been investigated. Surface treatment by various concentrations of nitric acid solution after Ag doping has been also performed to avoid excessive deposition of Ag nanoparticles. The extent of removing Ag and its impact on photocatalytic activity of TiO<sub>2</sub> could then be explored. It was found that the number of times of calcination affected photocatalytic activity of TiO<sub>2</sub> as well. The anatase TiO<sub>2</sub> accompanied with less rutile TiO<sub>2</sub> obtained by appropriate Ag doping and twice calcinations exhibited the best photocatalytic activity. B-doped TiO<sub>2</sub> nanoparticles were also fabricated. Their photocatalytic properties were compared with those of Ag-doped TiO<sub>2</sub> nanoparticles. Even though B-doped TiO<sub>2</sub> had good photodegradation efficiency, its photocatalytic activity was inferior to that of Ag-doped TiO<sub>2</sub>.

### BIOGRAPHY



Dr. Chun-Pei Cho was born in Taichung in 1975. She received her B.S. and M.S. degrees in Chemistry and Ph.D. degree in Materials Science and Engineering from National Tsing Hua University of Taiwan. She had conducted postdoctoral research in the Optoelectronics Research Interdisciplinary Center at National Tsing Hua University and the Institute of Chemistry at Academia Sinica. Afterwards, she had worked as a senior R&D engineer in the array device technology department of AU Optronics. She is currently an assistant professor of the Department of Applied Materials and Optoelectronic Engineering at National Chi Nan University.

The research interests of Dr. Chun-Pei Cho include nanostructures of small molecular semiconductive materials, nanoscale characterization techniques, photocatalytic composite materials, and organic electronic devices such as OLEDs, OPVs and OFETs. Dr. Cho is a fellow of the Chinese Institute of Electrical Engineering. She has been also



**The EITA-New Materials 2014, Saturday-Sunday, November 22-23, 2014**  
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a reviewer of some SCI journals such as Advanced Functional Materials, Journal of Materials Chemistry C, Applied Surface Science, Thin Solid Films and Physica Scripta, etc.

## Alloy phase stability under current stressing

Shih-kang Lin

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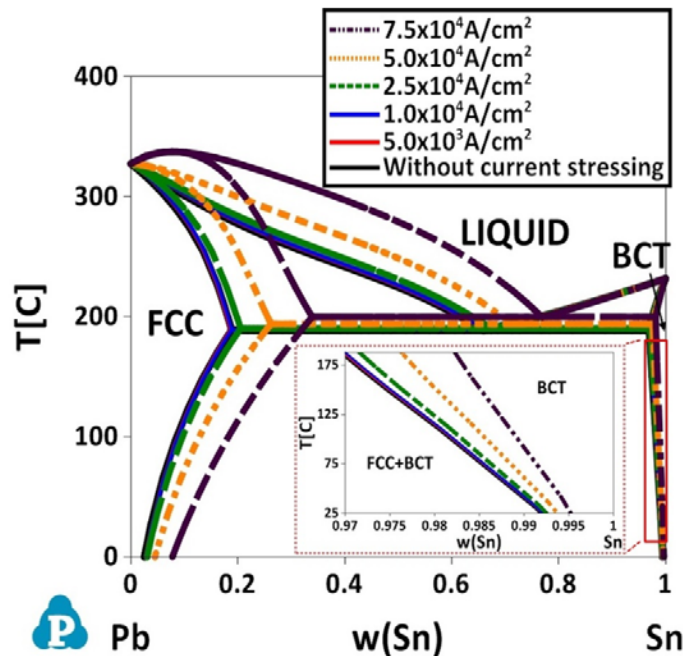
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### ABSTRACT



**Fig. 1** Phase diagram of the Pb-Sn binary system under current stressing with various current densities.

Soldering is an ancient process, having been developed 5000 years ago. It remains a crucial process with many modern applications. In electronic devices, electric currents pass through solder joints. With the developments of the advanced packaging technologies, such as the 3D IC and flip-chip packaging, the current densities applied and passed through electronic joints in modern devices have been tremendously increased. Thus, the impacts of these electric current-induced effects are more and more pronounced and crucial to the reliability of electronic products.

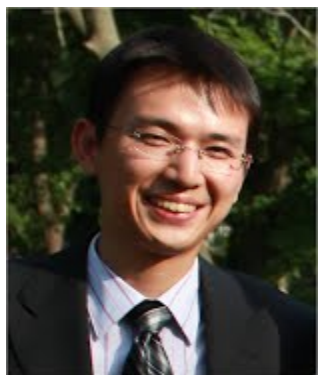
Several electric current-induced effects upon metallic materials have been discovered, including the effects related to temperature change, e.g. Joule heating and thermoelectric effects in 1822-1851, and the isothermal electric current-induced effects that are not related to temperature change, e.g. electromigration effect in 1961, the polarity and non-polarity effects of electromigration upon interfacial reactions in 1998-2000, and more recent alloy supersaturation effect in 2011-2012. The “momentum transfer” mechanism proposed by Huntington and Grone in 1961 well explained the electromigration effect and the polarity effect of electromigration upon interfacial reactions. However, it failed to describe the mechanisms for the supersaturation and non-polarity effects.

In this presentation, a brief review of electric current-induced effects upon materials will be given. Particularly, new experimental findings of the polarity and non-polarity effects of electromigration effect upon interfacial reactions and the supersaturation phenomenon in the

past two decades will be summarized and presented. The newest physical phenomenon – the supersaturation of solders under high electric currents – will be explained based on the changes in the phase stability of solders under current stressing. As shown in Fig. 1, ab initio-aided CALPHAD modeling is utilized to convert the electric current-induced stress into the excess Gibbs free energies of the phases. Hence, the phase equilibrium can be shifted by current stressing. Moreover, this “current stressing-induced phase stability change” model has been applied to explain the peculiar non-polarity effect of electromigration under current stressing. A big picture of electric current effects up electronic solder joints will be presented.

**Keywords:** Electromigration; ab initio; CALPHAD; solder; phase diagram

## BIOGRAPHY



Dr. Shih-kang Lin was born in Taipei, Taiwan in 1981. He obtained both his B.S. and Ph.D. in chemical engineering from National Tsing Hua University (NTHU), Taiwan in 2003 and 2008, respectively.

He is currently an assistant professor of the department of materials science and engineering in National Cheng Kung University (NCKU), Taiwan. Before joining NCKU in 2011, he has worked as a Visiting Scholar in the institute of scientific and industrial research (ISIR) in Osaka University, Japan in 2006, a Visiting Scholar in the department of materials science and engineering in the Pennsylvania State University, PA, USA in 2007-2008, and a Research Associate in department of materials science and engineering in the University of Wisconsin – Madison, WI, USA in 2009-2011. In 2008-2009, he has served as a Second Lieutenant in the ROC Army, Taiwan. He has published 27 referred journal papers, including the recent works on “Formation of alternating interfacial layers in the Au-12Ge/Ni joints” in Scientific Reports in 2014, “Atomistic structure and ab initio electrochemical properties of the Li<sub>4</sub>Ti<sub>5</sub>O<sub>12</sub> defect spinel for Li ion batteries” in Journal of the Electrochemical Society in 2014, and “Ab initio-aided CALPHAD thermodynamic modeling of the Sn-Pb binary system under current stressing” in Scientific Reports in 2013. His researches focus on phase equilibria and phase transformation for electronic packaging technologies, lithium ion batteries, and steelmaking using computational and experimental approaches.

Dr. Lin is a member of the Minerals, Metals and Materials Society (TMS), USA and the Materials Research Society of Taiwan (MRS-T), Taiwan. He has received several international and national awards, including the “2014 TMS EMPMD Young Leader Professional Development Award” from the TMS, USA, the “2014 TMS EMPMD Best Young Professional Poster Award” from the TMS, USA, the “2012 Award for encouragement of Research in Materials Science” from the Materials Research Society of Japan (MRS-J), Japan, the “2011 STT Grant” from Foundation for Applied Thermodynamics, Sweden, the “Outstanding Student Paper Award-Graduate Division, 1st place” from the TMS, USA, the “2014 Raising Star Award” from the College of Engineering, NCKU, and the “Excellence in Teaching Award” in 2012-2014 from the Department of Materials Science and Engineering, NCKU. He has been an organizer for several international symposia/conferences, including the phase stability symposium of the TMS annual meetings in 2011-2015, the CALPHAD symposium of the 2015 TMS annual meeting, the iMPACT conferences in 2012-2014, the 2014 IUMRS-ICEM, the ISMEN IV/6th PCGMR, etc.

## **Session Chair**

### **Hsin Chu**

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## **BIOGRAPHY**



years in ITRI.

Prof. Hsin Chu received his B.S. (1978) in civil engineering and M.S. (1982) in environmental engineering from National Taiwan University. After two-year services in Taiwan Army, he went to the US to continue his study. He received his Ph.D. (1988) in environmental health engineering from Northwestern University. He started his professional career in Energy & Resources Laboratories, Industrial Technology Research Institute (ITRI) back in Taiwan in March 1988. He did various researches in the fields of coal, oil, and gas combustion, low NO<sub>x</sub> burners, flue gas desulfurization, coal gasification, and electrostatic precipitation during the three and half

He accepted a faculty position in the Department of Environmental Engineering, National Cheng Kung University (NCKU) in 1991. He has been promoted from an associate professor, through professor, to distinguished professor since. He also served as the director of the Division of Academic Services, NCKU, and the chair of his department in the recent years.

Prof. Chu has broadened his research interests to NO<sub>x</sub>/SO<sub>x</sub> removal from conventional flue gas, H<sub>2</sub>S/COS/HCl removal from gasified coal gas, catalytic and photocatalytic conversion of VOCs, resource reuse, chemical looping combustion, CO<sub>2</sub> mitigation, and microalgae cultivation and bio-fuels production. He has published more than 70 refereed journal papers and has been awarded many times in the class teaching and research work. He has been granted six patents and one of the patents has been technically transferred to seven engineering corporations. He loves being a bridge between the academic and industries.

## Photocatalytic conversion of sunlight to renewable energy

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### ABSTRACT

Global warming and energy shortage raise the concern about green house gases and renewable energy. One of the best routes to convert CO<sub>2</sub> into renewable energy and simultaneously reduce the concentration of CO<sub>2</sub> in atmosphere is photosynthesis. As shown in Figure 1, in general, there are two steps in the chloroplast of green plant [1]. The first step (left-hand side) is water splitting in which proton is generated and O<sub>2</sub> is released using solar energy. The second step (right-hand side), also called Calvin cycle, is a dark reaction in which CO<sub>2</sub> taken from atmosphere is reduced to glucose. Proton is carried via NADPH and transferred to the Calvin cycle as hydrogen source and energy. One of the key steps may rely on the hydrogenation of CO<sub>2</sub> to organic compounds. This study explored the photocatalytic hydrogenation of CO<sub>2</sub> by a novel twin reactor to mimic photosynthesis process under light irradiation.

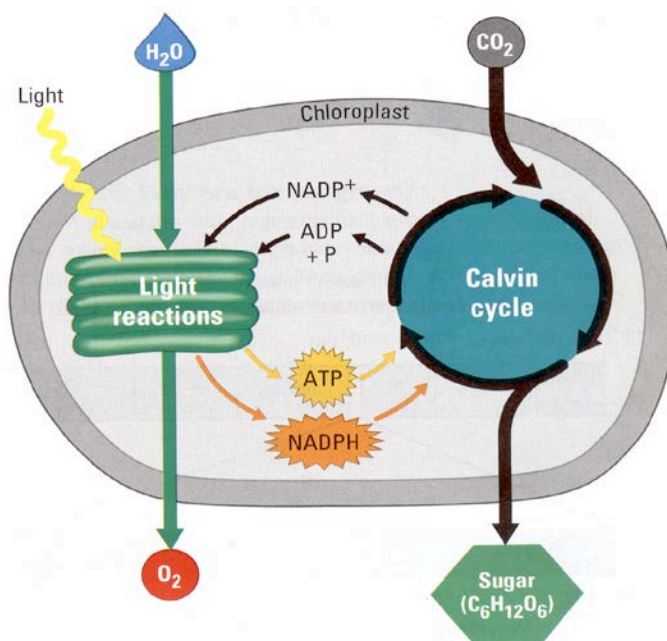


Figure 1: The schematic of photosynthesis [1]

The Z-scheme of water splitting is comprised of H<sub>2</sub>-photocatalyst and O<sub>2</sub>-photocatalyst with aid of electron transfer mediator to produce hydrogen and oxygen, respectively [2]. A twin reactor, which divided H<sub>2</sub>-photocatalyst and O<sub>2</sub>-photocatalyst in two compartments using a membrane, can separate H<sub>2</sub> and O<sub>2</sub> thus preventing backward reaction. Pt/SrTiO<sub>3</sub>:Rh and BiVO<sub>4</sub> were used as the H<sub>2</sub>-photocatalyst and the O<sub>2</sub>-photocatalyst, respectively. The diffusion of electron mediator, Fe<sup>2+</sup>/Fe<sup>3+</sup>, through Nafion membrane was investigated [3]. The transfer rate of mediator ions was remarkably larger than the photoreaction rate, indicating that membrane did not delay the water-splitting reaction in the twin reactor. Under the favorable condition, the hydrogen generation rate reached 0.65 μmole/g•hr and matched the H<sub>2</sub>/O<sub>2</sub> stoichiometric ratio of water splitting. We found the H<sub>2</sub>-generating of the twin-reactor system was the rate-limiting side. By using the twin reactor, the deactivation of Pt/SrTiO<sub>3</sub>:Rh could be minimized due to the suppression of Fe(OH)<sub>3</sub> formation on the photocatalyst surface [4].

Figure 2 shows the schematic of CO<sub>2</sub> reduction in the twin reactor. Photocatalytic water splitting is performed in the twin reactor under AM 1.5G sunlight. Oxygen is released at the left-hand side of the reactor. Simultaneously H<sup>+</sup> is diffused through the membrane to the left-hand side. CO<sub>2</sub> is purged in the left-hand side and is reduced to hydrocarbons by photocatalyst.

A series of sol-gel prepared InTaO<sub>4</sub> were loaded with different metal oxide such as NiO, RuO<sub>2</sub>, Cu(OH)<sub>2</sub> and Pt were as co-catalysts. The UV-VIS spectra of this series catalysts indicated that the photocatalysts could absorb visible light. These CO<sub>2</sub> hydrogenation catalysts were applied into the twin photoreactor. Methanol yield was 0.03 μmole/g•hr in gas phase of twin photoreactor, when photocatalyst was hung above the solution. In slurry system, which catalyst was dispersed in the solution, the maximum yields of methanol and acetaldehyde were 9.27 μmole/g•hr and 11.30 μmole/g•hr at 25°C. The twin photoreactor gave higher photoconversion yields of CO<sub>2</sub> than those in the single reactor because the backward (oxidation) reaction was inhibited by separating O<sub>2</sub> in the other side [5].

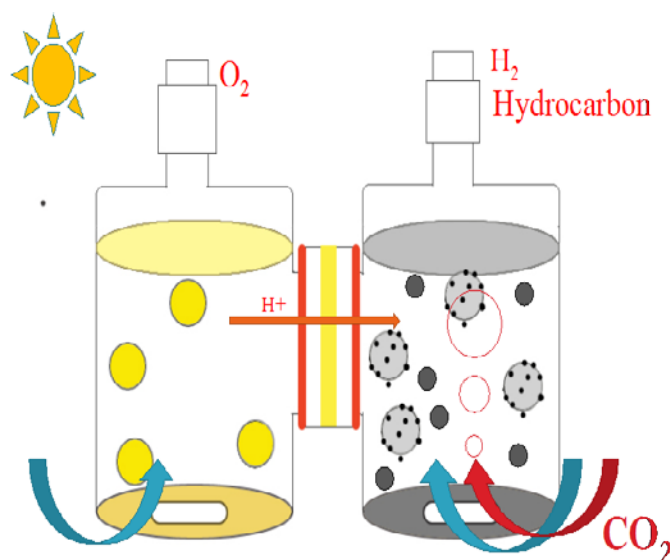


Figure 2: Schematic of twin reactor for photocatalytic CO<sub>2</sub> reduction

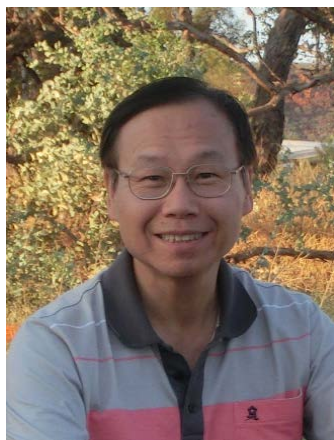
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## BIOGRAPHY



Jeffrey Chi-Sheng Wu received his PhD degree in Chemical Engineering from University of Pittsburgh, USA in 1988. He obtained MS and BS degrees in Chemical Engineering from West Virginia University and National Taiwan University, respectively. His major fields are catalysis, reaction engineering and membrane separation process.

Currently he is associate chair of the Chemical Engineering Department, National Taiwan University. He is a member of the Taiwan Institute of Chemical Engineers and Taiwan Institute of Engineers. He serves as a member of editorial boards of *Applied Catalysis A: General*, *Chemical Engineering Journal* and *Journal of CO<sub>2</sub> Utilization*. He also was the guest editor of 3 special issues in *Catalysis Today*. He has served as international committee

members of the 13th Asia Pacific Confederation of Chemical Engineering Congress, Taiwan in 2010. His current research interests are to develop improved strategies and materials for (a) the highly efficient photoreduction of CO<sub>2</sub> with H<sub>2</sub>O to fuel; (b) photocatalytic water splitting for H<sub>2</sub> production; (c) photocatalytic selective catalytic reduction of NO<sub>x</sub> air pollutant; and (d) biodiesel synthesis using solid acidic catalysts.

Professor Wu has received a number of prestigious awards including Outstanding Cross-Sector Collaboration Award, 2nd National Industrial Innovation in 2012, "Lai Tzai-Der award" of Taiwan Institute of Chemical Engineers in 2009, "Chemical Technology Award" of Taiwan Institute of Chemical Engineers in 2006, "Silver medal of National Invention", Taiwan in 2004, "Outstanding Research Achievement", National Taiwan University in 2004 and "Outstanding Scientist and Engineer, Taiwan Tai-Ching Educational Foundation in 2000.

## **Recent Studies on Vanadium Redox Flow Battery for Energy Storage Applications**

**Kan-Lin Hsueh**

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(聯合大學能源工程學系系主任薛康琳教授)

### ABSTRACT

Renewable energy, such as photovoltaic and wind turbine, becomes popular as alternative energy for fossil fuel. Due to their intermittent nature of power generation, energy storage is critical for a stable power grid and for energy management of micro-grid. Vanadium redox flow battery (VRFB) is one of the candidates for grid scale energy storage due to low cost (\$/kWh-cycle), easy maintenance, long cycle life, safe operation, etc. Several MW scale VRFB energy storage systems were installed worldwide.

Low energy density of VRFB (kWh/Liter, kWh/kg) limits its applications on stationary energy storage. Our reaction kinetic study indicated that the electrochemical reaction on the positive electrode is sluggish and it can be improved by surface modification on the positive electrode. Inter-digit flow channel design yields uniform flow pattern in the porous electrode without significant pressure drop. Interfacial resistance between the electrode and bipolar plate is one of the major voltage loss during battery operation. Significant improvement on charge/discharge efficiency can be achieved by high electrode compression. The charge/discharge curve of VRFB can be calculated by our simplified mathematic model. Based on our model, if 6% of the electricity is generated from wind turbine, the amount of land required for VRFB is much smaller than a hydro-pumped energy storage.

### BIOGRAPHY



He was graduated in 1977 from Chung Yuan University, Taiwan with a B. Sc. in Chemical Engineering. He received his M. S. and Ph. D. degree in Chemical Engineering from Clarkson University, USA, in 1980 and 1983, respectively. He joined the Department of Chemical Engineering, National Tsing Hua University, Taiwan as Associate Professor from 1984 to 1989. From 1989 to 1999, he served as the Member of Technical Staff at AMP Incorporated, a Fortune 500 Company with 10 billion USD annual incomes in the US. From 1999 to 2001, he worked as the Member of Technical Staff of NanoSciences Corporation. Since 2002, he joined Industrial Technology Research Institute (ITRI), Taiwan as a researcher and then as a Lab manager in 2006. In 2007 summer, he joined the Department of Energy Engineering, National United University, Taiwan as Associated Professor. Since then, he also served as adjunct Professor at National Chung Hsin University and at National Tsing Hua University and served as a consultant at Industrial



Technology Research Institute.

Kan-Lin Hsueh devoted his electrochemistry professional career at US industries (AMP and NanoSciences,), Taiwan academia (National United U., National Tsing Hua U. and National Chung Hsin U.), and Taiwan research organization (ITRI, Industrial Technologies Research Institute). His research is focus on fuel cells and batteries. Currently, he is working on (1) Vanadium redox flow battery for energy storage. (2) Rechargeable metal air battery for energy storage. (3) Internal reforming solid oxide fuel cell for distributed power generation.

Dr. Hsueh has published more than 50 papers on technical journal related to fuel cells and batteries, 4 US patents and 3 Taiwan patents, 2 chapters in energy related books, 23 review papers, and 109 conference presentations. He is currently a member of The Electrochemical Society (US), the Material Research Society-Taiwan (MRS-Taiwan), The Hydrogen Energy and Fuel Cell Society-Taiwan (HEFC-Taiwan), and The Taiwan energy Association.

## **Metabolic Engineering for the production of renewable fuel and chemical**

### **Claire Roa-Pu Shen**

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### ABSTRACT

Increasing atmospheric CO<sub>2</sub> concentration and the fluctuation of fossil fuel supply have led to significant efforts in the synthesis of commodity chemicals from renewable resources. Development and scale-up of biobased chemical productions have been an ongoing thrust worldwide as the global demand for bioplastics reaching 1 million tons per year by 2015, representing a \$2.9 billion USD market. In addition, certain C<sub>4</sub>-C<sub>12</sub> hydrocarbons such as short chain alcohol and alkane produced by microorganisms possess properties which can serve as advanced transportation biofuel to lower the demand for non-renewable natural gas and petroleum resources.

Parallel with the emerging global interests in renewable chemical and advanced biofuel, my research has focused on the development of biobased products from a variety of renewable feedstock such as biomass, protein waste, CO<sub>2</sub> and light energy using a combination of synthetic biology and metabolic engineering approaches. This talk will introduce the concept of strain and pathway design via two examples: 1) engineering high-titer anaerobic production of 1-butanol in *Escherichia coli* by creation of driving forces, and 2) identifying synergy as a design principle via theoretical yield calculation and experimental validation. Current efforts and advances in the biofuel and biomonomer industry of Taiwan will also be discussed from the perspective of the world.

### BIOGRAPHY



Claire Shen received her B.S. degree from the Department of Chemical and Biomolecular Engineering at University of California, Los Angeles (UCLA) with Magna Cum Laude in 2006. She then continued her study at the Department of Chemical and Biomolecular Engineering at UCLA and obtained her Ph.D. degree in 2011, specializing in metabolic engineering and renewable fuel/chemical production under the supervision of Dr. James Liao. She joined the Institute for Genomics and Proteomics at UCLA during her post-doctoral research from 2011 to 2013. Dr. Shen joined the Department of Chemical Engineering at National Tsing Hua University as an assistant professor in the December of 2013. Her current research interests include biobased chemical and fuel from renewable sources, design of synthetic pathway, assembly of novel

pathway in unique hosts, and directed evolution of production system to achieved novel functions. Dr. Shen is the co-author of ten peer-reviewed papers in academic journals and presented at various international workshops and conferences on these topics. She is also the co-inventor of several pending US patents.

## **Heterogeneous catalysis in biomass conversion to fuels and chemicals**

### **Yu-Chuan Lin**

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### ABSTRACT

Conversion of lignocellulosic biomass to fuels and chemicals is a potential way to ease our fossil fuel addiction. Catalytic fast pyrolysis, hydrodeoxygenation, and partial oxidation, the three important processes in a biorefinery, are of my interests. Catalytic fast pyrolysis is a one-pot process by which solid biomass (e.g., cellulose) can be directly converted to liquid fuels (e.g., aromatics) in an inert environment. Pyrolysis temperature, heating rate, and zeolite design are keys to manipulate product distribution. Hydrodeoxygenation extracts oxygen from biomass framework to yield hydrocarbons through hydrogenation, releasing water as the byproduct either under high or ambient H<sub>2</sub>-pressured conditions. Sulfided and phosphided nickel catalysts are effective in lignin hydrodeoxygenation, and a detailed hydrodeoxygenation mechanism was explored. Partial oxidation under an autothermal mode allows rapid conversion of biomass waste, e.g., glycerol, into syngas at millisecond contact times. Thermally stable perovskite is a promising candidate in oxidative, high-temperature environments for biomass partial oxidation to syngas. An integrated study of computational chemistry, reaction engineering, and catalyst design of aforementioned research fields is currently ongoing, and is deemed to be critical for the practice of lignocellulosic biorefinery.

### BIOGRAPHY



Yu-Chuan Lin was born in Taipei, Taiwan. He obtained his BS (2000) and MS (2002) degrees in chemical engineering from National Cheng Kung University (Taiwan), with Hung-Shan Weng as his advisor. He received his PhD in chemical engineering from Kansas State University (2006) under the supervision of Keith L. Hohn in the area of catalytic partial oxidation. In addition, he collaborated with L. T. Fan in mechanistic studies by using a newly developed graph-theoretic method (P-graphs). He did a postdoctoral stay with George W. Huber at University of Massachusetts-Amherst (2008-2009) where he focused on catalytic fast pyrolysis in converting lignocellulosic biomass. In summer 2010, he visited Dionisios G. Vlachos' group at University of Delaware, where he studied ethane oxidative dehydrogenation to ethylene.

He is an Assistant Professor of Chemical Engineering at National Cheng Kung University (Taiwan). Before joining NCKU, he has been an Associate Professor of Chemical Engineering and Material Science at Yuan Ze University (Taiwan). His research focuses on heterogeneous catalysis and reaction engineering, mostly in biomass conversion, e.g., catalytic fast pyrolysis and hydrodeoxygenation, and hydrogen production via partial oxidation. He is the

author/coauthor for more than 30 journal articles. He serves as an Editorial Board member in Catalysts.

*Technical Session D2-W1-T3: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

**Session Chair**

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**BIOGRAPHY**



Dr. Gou-Jen Wang received the B.S. degree on 1981 from National Taiwan University and the M.S. and Ph.D. degrees on 1986 and 1991 from the University of California, Los Angeles, all in Mechanical Engineering. Following graduation, he joined the Dowty Aerospace Los Angeles as a system engineer from 1991 to 1992. Dr. Wang joined the Mechanical Engineering Department at the National Chung-Hsing University, Taiwan on 1992 as an Associate Professor and has become a Professor on 1999 and a Distinguished Professor on 2009. From 2003-2006, he served as the Division Director of Curriculum of the Center of Nanoscience and Nanotechnology. From 2007 to 2011, he was the Chairman of the Graduate Institute of Biomedical Engineering, National Chung-Hsing University, Taiwan. On 2008, he served as the Conference Chair of the Microfabrication, Integration and Packaging Conference (April/2008, Nice, France). From 2009, he is a Committee member of the Micro- and Nanosystem Division of the American Society of Mechanical Engineers. His research interests include biosensors, biomedical micro/nano devices, nano fabrication, and dye-sensitized solar cells.

## **A CMOS Based Polysilicon Nanowire Biosensor Platform for Biomarkers of Heart Disease**

**Chih-Ting Lin**

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### ABSTRACT

In this work, we demonstrate a promising polysilicon nanowire (poly-Si NW) biosensor platform. Several biomarkers, such as N-terminal prohormone brain natriuretic peptide (NT-proBNP), Low-density lipoprotein (LDL), Hemoglobin (Hb), and Hemoglobin A1C (HbA1c), for heart disease and diabetes are experimentally examined by the developed platform. Based on experimental results, the sensor responses of each biomarkers are suitable for clinical diagnoses. Compared with conventional examination methods, using polysilicon nanowire biosensor not only reduce the inspection time but also economize the cost of diagnoses. Moreover, these implemented biosensor platform are made by a standard complementary metal-oxide-semiconductor (CMOS) process. Based on this technology, the developed devices can be easily integrated with different functional modules, such wireless and microfluidic systems. Therefore, this work demonstrates a good potential of CMOS based biosensor platform to accomplish the need of early diagnosis and point-of-care (POCT) system.

### BIOGRAPHY



Chih-Ting Lin received the B.S. degree in civil engineering and M.S. degree in applied mechanics from the National Taiwan University, in 1996 and 1998, respectively. He also received the M.S. and Ph.D. degree in electrical engineering and computer science from the University of Michigan, Ann Arbor, in 2003 and 2006, respectively. In 2006, he joined the Graduate Institute of Electronics Engineering and Department of Electrical Engineering, National Taiwan University, as an Assistant Professor. Since 2012, he has been an Associate Professor. His research interests include CMOS based biotechnology, biosensors, electro-chemical sensors, organic electronics, NEMS, and MEMS.

Novel Filter-like SERS Substrate for Biomedical Application

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### ABSTRACT

There is increasing interest in the detection of certain bacteria due to the essential functions of these biological systems which have negative effects on animals, humans and the environment. The accurate, highly sensitive and rapid identification assay of cells is thus extremely important in areas such as medical diagnosis, biological research, and environmental monitoring.

Surface enhanced Raman scattering (SERS) is a powerful spectroscopic technique that can be used for analysis of biological samples and molecule structures as well as detection of low concentrations of analytes or contaminants. Many SERS-active substrates made of silver, gold, copper, lithium and other metallics were expected to have a notable effect on signal enhancement. In order to obtain greater sensitivity and reproducibility, a large amount of the literature on this topic has indicated that numerous SERS-active substrates have been designed and prepared using polymerization, surface modification or immobilization, and either electrochemical deposition of metal particles (or colloids) to create nanoparticles or rough metal surfaces with various geometric forms under different matrices.

This talk will focus on the development of this field and show our recent works on producing strong SERS signals with high quality Raman signal without any need for pre-labeling.

### BIOGRAPHY



Chi-Chang Lin received his B.S. (1994), M.S. (1998) and Ph.D. (2003) in Polymer Engineering from the National Taiwan University of Science and Technology. Research interesting include: 1) development of a diagnostic method based on surface enhancement Raman spectroscopy and nanotechnology for rapid identification of clinical infectious diseases and environmental microorganism. 2) Biomaterial for tissue regeneration, artificial kidney, bioartificial liver support system. 3) Biosensor for chemical, microorganism, cell migration and proliferation measurement.

He is an Associate Professor of Chemical and Materials Engineering, a faculty membrane of Life Science Center for Biomaterials and Biosensors. He was a postdoctoral fellow at the Chang Gung Memorial Hospital-Kaohsiung Medical Center (2002-2006). He was also a postdoctoral fellow the Institute of Biomedical Engineering, National Cheng Kung University (2006-2010) and became a Research Professor between 2010 and 2012. Current and previous research interests include biomaterials and tissue engineering, biosensor



and Raman spectroscopy for biomedical applications.

Dr. Lin is member of polymer society (Taiwan), Biomedical Engineering Society and the Secretary-General of Association of Chemical Sensors in Taiwan. He contributes more than 30 times to international conference chairs/speakers and received more than 20 best paper awards. He has contributed more than 50 articles to journals, 150 conference articles, and three books. He served as peer reviewers and organizing committee of various journals, conferences and NSC council.

## **Organic Conductive Biointerfaces for Cell Engineering**

**Shyh-Chyang Luo**

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### ABSTRACT

Interfacing materials with cells through specific ligand/receptor interactions, matching mechanical properties, and matching nanostructures are very critical in biomedical technologies. Recently,  $\pi$ -conjugated polymers have emerged for various related applications, ranging from biosensing to medical bionics. Many features of conducting polymers, including simplicity for nanostructure fabrication, tailored functional groups for bioconjugation, intrinsic electrical conductivity, and softer mechanical characteristics than metals, provide advantages as materials for cell-related diagnostic and therapeutic platforms as well as controlled cell engineering. Because of the molecular advantageous features of dioxythiophenes, we are particularly interested to develop general approaches for their polymeric nanostructures with various functional groups. We created various functionalized dioxythiophene-based monomers as our molecular building blocks following biomimetic approaches. One specific area we are interested is cell engineering, particularly electrical-active cells. Herein, I would like to discuss our recent efforts on designing  $\pi$ -conjugated polymers which could specifically interact with neuron cells and provide electrical stimulation for enhanced growth and stimulated release of these cells.

**Keywords:** conducting polymer, biointerfaces, biomaterials, stimuli-responsive materials

### BIOGRAPHY



Shyh-Chyang Luo is a native Taiwanese. He received his B.S. and M.S. degree from National Taiwan University in 1996 and 1998. He then went to United States in 2001 and received his Ph.D. degree from the University of Florida in 2005. His current research interests include organic conducting systems such as biointerfaces, bioelectronics, biosensors, and stimuli-responsive materials.

He did his postdoctoral research at Institute of Bioengineering and Nanotechnology in Singapore starting from 2006 to 2009. He then joined RIKEN in Japan as a research scientist from 2009 to 2013. In August of 2013, he moved back Taiwan. He is currently on the Materials Science and Engineering faculty at the National Cheng Kung University as an assistant

professor.

## **Engineered Tissue on Lab Chip**

### **Cheng-Hsien Liu**

Professor, Department of Power Mechanical Engineering and  
Chief Executive Officer of Industrial Liaison Program, College of Engineering  
National Tsing Hua University

(清華大學動力機械工程學系兼工學院產學聯盟執行長劉承賢教授)

#### ABSTRACT

The formation, homeostasis, and regeneration of tissues are the result of intricate temporal and spatial coordination of numerous individual cell fate processes, each of which is regulated not only by cell-autonomous processes but also by extracellular microenvironmental stimuli. Hence, the ability to approach tissue-mimetic reconstruction and manipulate the cellular microenvironment to facilitate cell-cell interactions and cell- extracellular-matrix interactions is essential to maintain cell/tissue physiological functions for applications such as drug screening and regenerative medicine. In this talk, the research progress of our biomimetic tissue Lab chip, which takes advantage of the electrokinetic force to reconstruct biomimetic tissue, will be presented.

#### BIOGRAPHY



Cheng-Hsien Liu (劉承賢) received the B.S. degree in power mechanical engineering from the National Tsing-Hua University, Taiwan, in 1987, the M.S. degree in mechanical engineering from the Lehigh University, Bethlehem, P.A., in 1992, the M.S. degree in electrical engineering and the Ph.D. degree in mechanical engineering from Stanford University, CA, in 1995 and 2000, respectively.

He presently is a professor in the Power Mechanical Engineering Department at National Tsing Hua University. He has served as the Chief Executive Officer of Industrial Liaison Program, College of Engineering, National Tsing Hua University since Aug. 2012. He had been with National Tsing Hua University, Taiwan since Autumn 2000. In 1999-2000, he worked as a senior Electrical Engineer at Halo Data Devices Inc., San Jose, where he focuses on the development of micro-drives for portable information storage applications. While at Stanford, he worked with Dr. Kenny at Stanford Micro-structures and Sensors Laboratory and focused his Ph.D. work on high-performance MEMS sensors. He currently oversees graduate students in the Micro-Systems and Control Laboratory, whose research activities cover a variety of areas in MicroElectroMechanical Systems, Lan on Chip, system dynamics/modeling/control and Nanotechnology. Some recent highlighted research includes biomimetic array chip for bio-object manipulation targeting for tissue engineering/ drug screening applications, Liver on Lab Chip, Lung on Lab Chip, Biomedical Instruments, microphotonics, and advanced tunable MEMS grating.

Dr. Liu received A. Kobayashi Young Investigator Award in Experimental Science from

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**National Cheng Kung University, Tainan, Republic of China (Taiwan)**

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International Conference on Computational and Experimental Engineering and Sciences (2010), the award of Outstanding Chemical Engineering Article of the Year 2010, the Academic Excellent Award from National Tsing Hua University (ranking top 4% in 2010 and 2013), Outstanding Research Program Award from National Science and Technology Program in Biomedical field (2012), Outstanding Research Award from National Science Council (NSC) in 2012 (100 年度國科會傑出研究獎).

**Session Chair**

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**BIOGRAPHY**



Jiun-Haw Lee received the B.S.E.E., M.S.E.E., and Ph.D. degrees in electrical engineering in 1994, 1995, and 2000, respectively, all from National Taiwan University, Taipei, Taiwan. From 2000 to 2003, he was with the RiTdisplay Corporation as the director. Since 2003, he joined the faculty of National Taiwan University in the Graduate Institute of Photonics and Optoelectronics and the Department of Electrical Engineering, where he is currently an professor. His research interests include organic optoelectronic devices, display technologies, and solar cells.

## **Effects of Characteristic Photoelectrode and Mixed Dyes on Dye-Sensitized Solar Cells**

**Chien-Hsin Yang**

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### ABSTRACT

Anatase-titanium dioxide (TiO<sub>2</sub>) nanoparticles were spin-coated on fluorine-doped tin oxide (FTO) glass substrates to fabricate TiO<sub>2</sub> films through annealing at 450°C/30 min. Triphenylamine-based dyes deposited onto mesoporous TiO<sub>2</sub> films to form a composite electrode of dye/TiO<sub>2</sub>/FTO. The composite electrodes have been used to dye-sensitized solar cells (DSSC). On the other hand, a systematic analysis for mixed dyes of D131, D149, and N3 ternary components on performance of dye-sensitized solar cells (DSSCs) has been performed. Using an experimental design of mixture, empirical models are fitted and plotted as contour diagrams, which facilitate revealing the synergistic/antagonistic effects between these mixed dyes. Dye co-sensitization effects in DSSCs are proved by the photo-physic properties, efficiency of the DSSC devices, and kinetic parameters of photo-electron transfer. The performance of DSSCs is significantly affected by the composition of dyes. The optimal efficiency (ca. 9.5%) of these mixed-dye DSSCs exists at the composition of 1/2 D149–1/2 N3. This composition appears to help conveying the charge transfer from the excited dye molecules to the conduction band of TiO<sub>2</sub>, leading to a higher efficiency of the assembled devices. Supplementary study of the electrochemical impedance are in support of enhancing charge transfer of TiO<sub>2</sub>(e<sup>-</sup>) with the co-sensitized dyes.

### BIOGRAPHY



Professor Chien-Hsin Yang was born in Pitung, Taiwan in 1958. He received his BS of the chemical engineering from National Taiwan University of Science and Technology, Taipei, Taiwan in 1985 and his PhD of the chemical engineering from National Cheng Kung University on the Optoelectronic Materials, Tainan, Taiwan in 1994 under the supervision of Prof. Ten-Chin Wen. He then worked in Kun Shan University of Technology as an associate professor in the department of environmental engineering in 1994 and became a professor in 1998. Professor Yang is now working in the department of Chemical and Materials of National University of Kaohsiung, as a professor. He has been an active member of the Journal of Electrochemical Society (JES) and a member of ACS. His current research interests include the development of functional materials in the application of electrochromic devices and dye-sensitized solar cells.

## SiGe-based nanomaterials for thermoelectric applications

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(中央大學材料科學工程研究所李勝偉教授)

### ABSTRACT

We present an effective approach to grow high-quality thin film of composite quantum dots (CQDs) as a building block for thermoelectric materials, in which 3 times the usual Ge deposition can be incorporated within a 3-fold CQD. Selective chemical etching experiments reveal that a thin Si inserted layer in the CQDs modifies the growth mechanism through surface-mediated diffusion and SiGe alloying. Such thin-film-like CQD materials are demonstrated to exhibit reduced thermal conductivity  $\kappa$  with respect to the conventional QDs, perhaps as a consequence of enhanced diffusive phonon scattering from the high Si/Ge interface density and enhanced local alloying effect. Moreover, the structural parameters of CQDs, including dot size and morphology, Si/Ge interface density, and composition distribution in dots, can be manipulated by tuning the thickness of inserted Si as well as increasing the stack number of the multifold CQDs, or through a post-annealing process. The reduction of  $\kappa$  and enhanced electrical conductivity  $\sigma$  make such thin-film-like CQD materials promising candidates for future TE applications in microelectronics.

### BIOGRAPHY



Dr. Sheng-Wei Lee received the Ph.D. degree in Materials Science and Engineering from National Tsing Hua University. In 2007, Dr. Lee joined the R&D Division of Taiwan Semiconductor Manufacturing Company (TSMC) to undertake the integration and development of new source/drain (S/D) metal-silicide materials. He currently teaches at the Institute of Materials Science and Engineering of National Central University as a Professor. Dr. Lee primarily conducts research on SiGeC epitaxy and metal silicides applied for S/D contacts. He especially focuses on the design and fabrication SiGe nanostructured architectures for thermoelectric or optoelectronic applications. Dr. Lee is also currently involved in research and development of metal oxides for green energy and biomedical applications. He has successively published more than 80 international journal papers in relevant research fields. In addition, He has applied for 10 patents. Dr. Lee has been actively participating in the activities and services in scientific professional societies. In 2012, Dr. Lee received the Exploration Research Award of Pan Wen Yuan Foundation. He was a visiting scholar at the Department of Electrical Engineering of University of California, Los Angeles. In recent years, Dr. Lee has served as the principal investigator for research projects initiated by National Science Council of Taiwan, the University System of Taiwan, Institute of Nuclear Energy Research, and TSMC.

## **Design of ionic liquids-based polymers and composite materials for optoelectronic applications**

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### ABSTRACT

Ionic liquids (ILs) have some attractive features, such as 100% ionic compounds liquid at room temperature, good thermal stability, non flammability, high ionic conductivity, negligible vapor pressure, and wide electrochemical window, make them very attractive candidates as electrolytes in rechargeable lithium batteries, electrochemical capacitors, solar cells, and fuel cell. There are three topics in this presentation, (1) ionic liquids-based hybrid materials; (2) polymerizable ionic liquids: ionic liquid functional polymers (ILFPs); (3) application of ionic liquids in dye-sensitized solar cells. Ionic liquid functional polymers are organic polymers synthesized mainly by the polymerization of unsaturated ionic liquid monomers. These polymers combine the advantages of ionic liquids which have drawn great attention due to their special structures and properties. The research on ILFPs developed in recent years is summarized in this presentation. According to the kinds of ions linking with chains, the existing ILFPs are classified into three types, which are polycations, polyanions, and zwitterions. ILFPs can be used as polymer electrolytes, surfactant, catalyst, enzyme carriers, gas adsorbents, and give the possible prospects in the future.

### BIOGRAPHY



Tzi-yi Wu received his Bachelor degree at the department of chemical engineering, National Cheng Kung University in 2000. In September 2000, he joined the group of Prof. Y. Chen in National Cheng Kung University for master and PhD thesis on the synthesis and optoelectronic characterization of novel luminescent conjugated polymers, where he obtained his PhD degree in Mar 2005. In 2004 and 2005, he is a visiting PhD-student for a short period research on the donor-acceptor conjugated polymers and organic electronics in Max-Planck Institute for polymer research, Mainz, Germany. During 2006 - 2008, he was a principal engineer in Taiwan Semiconductor Manufacturing Company. From 2008, he joined the group of Prof. I. W.

Sun and held a postdoctoral position in National Cheng Kung University. Since 2010, he was an adjunct assistant professor at department of materials engineering in Kun Shan University, and since 2012 he was an assistant professor at department of chemical and materials engineering in Yunlin University of Science and Technology.

His current scientific interests include the synthesis of functional ionic liquids, novel sensitizers for solar cells, novel functional conjugated oligomers and polymers, nanostructured



functional polymer composites, and study their applications in electrochromic devices, fuel cell, lithium ion battery, and dye-sensitized solar cells. Moreover, he has published over 77 peer-reviewed scientific papers, and he obtained professor Yen-Ping Shih best paper award, which was offered by professor Yen-Ping Shih foundation and Taiwan institute of chemical engineers, 2012.

## **The Growth of GaN Nanodots on Si (111) by Droplet Epitaxy**

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### ABSTRACT

Group-III nitride based semiconductors have been successful commercialized as light emitting diodes (LED) and high electron mobility transistors (HEMT). An enormous interest in gallium nitride (GaN) nanodots can be observed due to their strong carrier confinement phenomenon. GaN quantum dots (QDs) are highly potential materials for the applications in electronics such as single electron transistors, and in optoelectronics such as QD lasers and photodetectors.

For the fabrication of self-assembled GaN nanodots, several methods were proposed so far. For example, molecular beam epitaxy (MBE) and metal organic chemical vapor deposition (MOCVD) provided nanodots growth via Stranski-Krastanov (SK) mode, which requires sufficient lattice mismatch between substrate, wetting layer and epi-layer. Droplet epitaxy technique, the method of Ga droplets formation and nitridation to grow GaN nanostructures, has been employed to fabricate GaN nanodots on any sort of substrate.

In this report, self-organized GaN nanodots have been grown on Si (111) by droplet epitaxy method, and their density can be as high as  $1.1 \times 10^{11} \text{ cm}^{-2}$  from the result of SEM. Based on the characterization of in situ RHEED, we can find the surface condition of Si has impact on the growth of GaN nanodots. Crystal GaN nanodots have been observed by HRTEM, and the surface composition of GaN nanodots have been analyzed by SPEM and XPS with a synchrotron x-ray source. Growth parameters such as substrate temperature, substrate pre-nitridation, nitridation duration, and in situ annealing have influence on the formation of GaN nanodots, and their density can be controlled via different growth parameters.

### BIOGRAPHY



Ing-Song Yu was born in Tainan of Taiwan, 17th February 1975. He received his B.S. (1997) and M.S. (1999) in Materials Science and Engineering from National Tsing Hua and Chiao Tung University, respectively. He received his co-supervisory Ph.D. in Electronics Engineering from National Taiwan University and in Physics from University of Grenoble, France between 2004 and 2010. His thesis is "magnetotransport properties of (Ge,Mn) ferromagnetic semiconductor grown on GaAs (001) for spintronics". He had work in Chung-Shan Institute of Science and Technology as Assistant Scientist for 6 years. He was a Chief Engineer of R&D department, E-Ton Solar Tech. Co. between 2010 and 2011. Currently, he is an Assistant Professor and leads MBE Laboratory at National

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Dong Hwa University. Dr Yu's research interests are molecular beam epitaxy (MBE) technology, photovoltaics and ferromagnetic semiconductors.

**Session Chair**

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BIOGRAPHY



Professor Hsisheng Teng was born in Taipei, Taiwan in 1962. He received his BS degree in Chemical Engineering from National Cheng Kung University (NCKU), Taiwan, in 1984, and PhD in Engineering from Brown University, USA, in 1992. His major fields of study include photocatalysis, electricity storage devices, and solar cells.

He was an associate scientist in China Steel Corporation and associate professor at Chung Yuan Christian University before joining NCKU. He is now a University Chair at NCKU. He published more than 140 journal papers, with an h-index of 43.

## **Gadolinia-doped Ceria Nanoparticles as Electrolytes by Atmospheric Pressure Plasma Jet**

**Yu-Lin (Joseph) Kuo**

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(國立台灣科技大學機械系(材料組)兼學生事務處副學務長郭俞麟教授)

### ABSTRACT

The study describes a strategy to use composite nitrate salt solution as precursors to synthesize CeO<sub>2</sub> and Gd<sub>2</sub>O<sub>3</sub>-doped CeO<sub>2</sub> (GDC) nanoparticles by atmospheric pressure plasma jet (APPJ). The microstructures of CeO<sub>2</sub> and GDC were found to be nanocrystallites of cubical and spherical shapes with average particle sizes of 10.5 and 6.7 nm, respectively. XRD pattern showed single phase of GDC and CeO<sub>2</sub> with a cubic-fluorite structure by APPJ. Reactive oxygen species detected by optical emission spectroscopy (OES) are believed to be the major oxidative agents for the formation of oxide materials in the APPJ process. Based on the materials characterization and OES observations, the study effectively demonstrated the feasibility of preparing well-crystallized GDC nanoparticles by the APPJ system as well as the gas-to particle mechanism. Notably, the Bader charge of CeO<sub>2</sub> and Ce<sub>0.9</sub>Gd<sub>0.1</sub>O<sub>2</sub> by density function theory (DFT) simulation and AC impedance measurement shows that Gd as doped metal helps to increase the charge on Ce<sub>0.9</sub>Gd<sub>0.1</sub>O<sub>2</sub> nanocrystals for improving the conductivity as potential electrolyte for solid oxide fuel cells. For the application of solid oxide fuel cell, GDC film sintered at 1300 °C for 2 h with a comparable conductivity could be feasibly applied as the diffusion barrier between 8YSZ electrolyte and cathode materials for the prevention of interdiffusion.

### BIOGRAPHY



Yu-Lin Kuo was born in Pingtung city of Taiwan in 1976. And he received his B.A. degree in chemical engineering from Yuan-Ze University (Taiwan) in 1998 and his Ph.D. degree in chemical engineering from National Taiwan University of Science and Technology (NTUST/Taiwan Tech., Taiwan) in 2003.

After finishing the military service in Taiwan, he joined Electronics Design Center at Case Western Reserve University (USA) as an Associate Researcher and Postdoctoral Fellow from 2005 to 2007. After he returned to Taiwan, he has become an Assistant Professor at the Department of Materials Engineering, Tatung University since 2007. After 2 years teaching at Tatung University, he transferred to Department of Mechanical Engineering at NTUST/Taiwan Tech.

(Taiwan), and then promoted as an Associate Professor in 2012. His researches are concerning

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in the materials and processing including solid oxide fuel cells (SOFC), photocatalyst, chemical looping process, atmospheric pressure plasma technology, H<sub>2</sub> production, coating technology, and integrated circuit (IC) process technology.

Professor Kuo is currently an Associate Professor and Vice Dean of Student Affairs Office at his university. So far, he is an Executive Council Member and was Secretary General for TACT. And now he is also the Guest Editor for the special issue of Surface and Coatings Technology and the Editorial Board Member of The Scientific World Journal (Materials Division). He was awarded as the Young Scientists at Taiwan Association for Coatings and Thin Films Technology (TACT) in 2013 and The Taiwan Ceramics Society in 2011. Besides, in 2012, he also honorably received the Young Research Award for 3-year funding and Excellent Researcher Award from his university.

**“Symbiotic” Semiconductors: Unusual and counter-intuitive Ge/Si interactions!**

**Tom George**

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**ABSTRACT**

We report a unique, cooperative mechanism that involves the interplay of Ge, Si, and Oxygen interstitials enabling unusual Ostwald Ripening and migration behavior for Ge nanocrystallites embedded within a SiO<sub>2</sub> matrix and subsequently within Si<sub>3</sub>N<sub>4</sub> or Si layers. Ge nanocrystallites generated by the selective oxidation of SiGe nano-pillars appear to be very sensitive to the presence of Si interstitials generated either from within the oxidized nano-pillars themselves, or from the adjacent Si<sub>3</sub>N<sub>4</sub> layers, or from the Si substrate.

With no external source of Si interstitials, very little change in the size and morphology of Ge nanocrystallites is observed during thermal annealing in an H<sub>2</sub>O ambient. When both Si and Oxygen interstitials are present in high concentrations, for instance, a high flux of Si interstitials is emitted through catalytic local oxidation of Si<sub>3</sub>N<sub>4</sub> layers in proximity to the growing Ge nanocrystallites. Ostwald Ripening occurs concurrently, propelling the Ge nanocrystallite to migrate towards the source of the Si interstitials—the adjacent Si<sub>3</sub>N<sub>4</sub> layers.

A cooperative phenomenon is observed wherein the Si interstitials aid in both the migration and coarsening of these Ge nanocrystallites into spherically-shaped Ge Quantum Dots (QDs). In turn, the Ge nanocrystallites appear to enhance the generation of Si interstitials through catalytic decomposition of the Si<sub>3</sub>N<sub>4</sub> layers. The Ge nanocrystallite movement occurs by virtue of the fact that the Si interstitials created in front of the nanocrystallites combine with O interstitials to regenerate SiO<sub>2</sub> behind the Ge nanocrystallites on their migration path.

Yet another, SiO-enabled, void formation mechanism is observed for Ge nanocrystallites migrating through SiO<sub>2</sub> layers. This type of migration also ultimately transforms the Ge nanocrystallite clusters into fully coalesced spherical QDs. Here, in the presence of Si interstitials, the Ge nanocrystallites/QDs catalytically decompose SiO<sub>2</sub>, generating volatile SiO and creating voids in front of the migrating Ge nanocrystallite cluster. Further, the SiO-enabled void formation mechanism promotes the migration of the spherical Ge QD forward, leaving behind a trail of SiO<sub>2</sub> similar to the previous case.

Finally, penetration of these Ge QDs into the underlying Si substrate however, leads to a completely different behavior! The Ge QDs “explode,” regressing back almost to their origins as individual Ge nuclei formed early in the fabrication process during the oxidation of the original nanopatterned SiGe structures.

Our extensive experimentation and characterization of the intriguing anomalous migration behavior and morphology changes of the Ge nanocrystallite clusters/QDs with Raman

Spectroscopy and High Resolution Transmission Electron Microscopy have led to our proposing mechanisms that are radically different from the accepted paradigms. On the practical side, through the exquisite control offered by the above mechanisms, we have successfully fabricated and tested previously-impossible heterostructure devices.

## BIOGRAPHY

Thomas (Tom) George was born in India in 1959 and received his B.Tech degree in metallurgy from the Indian Institute of Technology in 1982, and his Masters (1984) and Ph.D. (1989) degrees in materials science engineering from the University of California, Berkeley.

Tom has been very fortunate in his career, in that every four years or so, he finds himself doing something completely different! Tom's Ph.D. dissertation was focused on the study of GaAs on Si on a joint project between Intel Corp., Nagoya Institute of Technology (Japan) and U.C. Berkeley. Between his Masters and PhD degrees (1984-1987) Tom worked at National Semiconductor Corporation both in Santa Clara and Penang, Malaysia, developing a tape-automated bonding process for semiconductor chips. After his PhD. Tom was invited to be a Visiting Research Professor with the Umeno group at the Nagoya Institute of Technology where he set up and operated a state-of-the-art high resolution transmission electron microscopy facility conducting research on a wide variety of MOCVD-grown materials from semiconductors to superconductors. Subsequently, Tom became a Member of Technical Staff at NASA's Jet Propulsion Laboratory in Pasadena, California, performing research on Si- and III-V semiconductor materials and devices. He then switched fields to do research and make a number of inventions in Micro Electro Mechanical Systems (MEMS) ultimately becoming the manager of JPL's MEMS Technology Group. Since leaving JPL in 2005, Tom has held executive management positions, Director of Product Development at ViaLogy LLC, developing novel IP-enabled sensor networks, Vice President of Device Engineering at Zyomed Corp. developing a novel, non-invasive blood glucose sensor, and currently Vice President of Research & Development at Chromologic LLC developing a wide range of biomedical and industrial sensing technologies. During his career, Tom has proven to be a prolific inventor and author with 11 US Patents and over 100 publications. He created and has continued to chair (2006-present) a cutting-edge, Micro- and Nanotechnology Sensors, Systems, and Applications Conference.

Tom counts himself also very fortunate to be associated with Prof. Pei-Wen Li and her group at the National Central University in Taiwan. Through this very productive collaboration, Tom has obtained a "ring side" seat and the extremely valuable opportunity to observe and interpret fascinating phenomena occurring in SiGe based materials that have revolutionized the field by upsetting long-held paradigms set by distinguished laboratories such as the AT&T Bell Labs and the IBM TJ Watson Research Center. A number of trend-setting papers have resulted from this fruitful collaboration, the content of some of which will be used for the current presentation.

In conclusion, Tom has received numerous awards and honors, the most notable among which are Indian Engineer of the Year (2008) awarded by the Kerala Society, New York and SPIE Fellow (2014) in recognition for his lifetime accomplishments.



Technical Session D2-W3-T3: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**Mei-Li Hsieh**

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ABSTRACT

BIOGRAPHY



## **Thermally-Assisted-Occupation Density Functional Theory**

**Jeng-Da Chai**

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### ABSTRACT

In this talk, I will briefly describe the formulation of our recently proposed thermally-assisted-occupation density functional theory (TAO-DFT) [J.-D. Chai, J. Chem. Phys. 136, 154104 (2012)] and the density functional approximations to TAO-DFT [J.-D. Chai, J. Chem. Phys. 140, 18A521 (2014)]. In contrast to Kohn-Sham DFT, TAO-DFT is a DFT with fractional orbital occupations given by the Fermi-Dirac distribution (controlled by a fictitious temperature), for the study of large ground-state systems with strong static correlation effects. Relative to TAO-LDA (i.e., the local density approximation to TAO-DFT), TAO-GGAs (i.e., the generalized-gradient approximations to TAO-DFT) are significantly superior for a wide range of applications, such as thermochemistry, kinetics, and reaction energies. For noncovalent interactions, TAO-GGAs with empirical dispersion corrections are shown to yield excellent performance. Due to their computational efficiency for systems with strong static correlation effects, TAO-LDA and TAO-GGAs are applied to study the electronic properties of acenes with different number of linearly fused benzene rings (up to 100), which is very challenging for conventional electronic structure methods. Some interesting results will be presented in this talk.

### BIOGRAPHY



Dr. Jeng-Da Chai received his B.S. degree in Physics from National Taiwan University (June 1997), M.S. degree in Physics from The Ohio State University (June 2002), and Ph.D. degree in Chemical Physics from the University of Maryland (December 2005). After receiving his Ph.D., Dr. Chai performed postdoctoral research at the University of California, Berkeley (January 2006 ~ June 2009). Since August 2009, he has joined the faculty of the Department of Physics at National Taiwan University. His group has focused on the development of new quantum-mechanical methods suitable for the study of nanoscale systems (with 100 ~ 1,000,000 electrons), and their applications to materials for new energy (e.g., solar cells and hydrogen storage materials). Dr. Chai, who is one of the active developers of Q-Chem (a well-known quantum chemistry software), currently serves in the Editorial Boards of “Open Journal of Physical Chemistry”, “Dataset Papers in Science”, “Journal of Theoretical Chemistry”, “Orectic Journal of Physical Chemistry”, and “Progress in Chemical Engineering”. As of now, the 26 SCI papers published by Dr. Chai have been cited more than 2,000 times. Among them, one paper has been cited more than 1,200 times. Dr. Chai was elected as a “TWAS Young Affiliate” by The World

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Academy of Sciences (TWAS) - for the advancement of science in developing countries in 2013. He received “Epson Scholarship Award” from The International Society for Theoretical Chemical Physics in 2011, “Young Theorist Award” from the National Center for Theoretical Sciences of Taiwan in 2012, and “Career Development Award” from National Taiwan University in 2013.

## **Modeling Anode Gas Distribution of Proton Exchange Membrane Fuel Cells with a Dead-Ended Anode**

**Yong-Song Chen**

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### ABSTRACT

The energy efficiency of a fuel cell depends on operating condition and hydrogen utilization. In order to increase the hydrogen utilization, the anode of the fuel cell is operated in a dead end mode. When the anode outlet is blocked, the performance of the fuel cell will gradually decrease due to accumulation of nitrogen and water. The cell performance can be recovered by opening the solenoid valve at the anode outlet to purge impurity out of anode.

In this study, a mathematical model was developed to predict distributions of gases and current density along the anode channel. In addition, the local current density variation was measured by a specially designed single cell. The experimental data were used to calibrate parameters of this model.

The modeling results agree well with experimental data. The results show that nitrogen accumulation rate increases with increasing load current. The local current density will gradually decrease at the anode outlet and increase at the anode inlet during the dead-end operation. This model helps develop a gas management strategy of fuel cells.

### BIOGRAPHY



Dr. Yong-Song Chen was born in Taipei, Taiwan in 1975. He received his BS degree and MS degree from the departments of mechanical engineering and materials science and engineering at National Taiwan University, Taiwan, in 1997 and 1999, respectively. He received his PhD degree in mechanical engineering from University of Michigan, Ann Arbor, USA, in 2009.

He worked for Chung-Shang Institute of Science and Technology, Taiwan, as an Assistant Researcher from 2009 to 2011. He has been an assistant professor in the Department of Mechanical Engineering at National Chung Cheng University, Chiayi, Taiwan, since 2011. His current research interests include fuel cells, flow batteries, and energy storage systems.

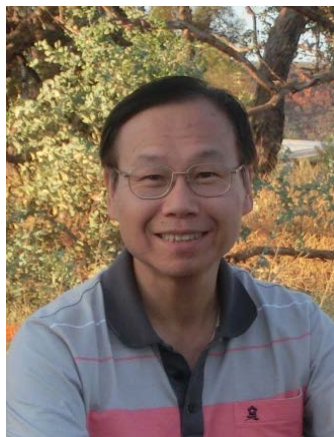
Dr. Chen is a reviewer of Internal Journal of Hydrogen Energy and Energies. His research results are mainly published in Journal of Power Sources and Applied Energy.

### **Session Chair**

#### **Jeffrey Chi-Sheng Wu**

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#### **BIOGRAPHY**



Jeffrey Chi-Sheng Wu received his PhD degree in Chemical Engineering from University of Pittsburgh, USA in 1988. He obtained MS and BS degrees in Chemical Engineering from West Virginia University and National Taiwan University, respectively. His major fields are catalysis, reaction engineering and membrane separation process.

Currently he is associate chair of the Chemical Engineering Department, National Taiwan University. He is a member of the Taiwan Institute of Chemical Engineers and Taiwan Institute of Engineers. He serves as a member of editorial boards of Applied Catalysis A: General, Chemical Engineering Journal and Journal of CO<sub>2</sub> Utilization. He also was the guest editor of 3 special issues in Catalysis Today. He has served as international committee

members of the 13th Asia Pacific Confederation of Chemical Engineering Congress, Taiwan in 2010. His current research interests are to develop improved strategies and materials for (a) the highly efficient photoreduction of CO<sub>2</sub> with H<sub>2</sub>O to fuel; (b) photocatalytic water splitting for H<sub>2</sub> production; (c) photocatalytic selective catalytic reduction of NO<sub>x</sub> air pollutant; and (d) biodiesel synthesis using solid acidic catalysts.

Professor Wu has received a number of prestigious awards including Outstanding Cross-Sector Collaboration Award, 2nd National Industrial Innovation in 2012, "Lai Tzai-Der award" of Taiwan Institute of Chemical Engineers in 2009, "Chemical Technology Award" of Taiwan Institute of Chemical Engineers in 2006, "Silver medal of National Invention", Taiwan in 2004, "Outstanding Research Achievement", National Taiwan University in 2004 and "Outstanding Scientist and Engineer, Taiwan Tai-Ching Educational Foundation in 2000.

## **The Evolution to Smart Grid of Taiwan Power System**

### **Bruce Yen-Feng Hsu**

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#### ABSTRACT

Making the power grid smarter is always an inevitable engineering project for every utility. Taiwan power company started to deploy many advanced control and operation technologies since 1980. Because of the more complicated operation environment and global warming issues, the traditional power grids need to be enhanced again. Smart Grid thus became a common direction in the future. Taiwan power company reviewed the existing grid performance and evaluated the benefits of new technologies. The higher cost effect projects will be deployed at the first stage. The objectives include higher safety, reliability and efficiency. It will be a greener grid as well.

#### BIOGRAPHY



Yen-Feng Hsu was born in Taiwan, R.O.C., 1962. He received his B.Sc. in Electrical Engineering from National Taiwan Institute, M.Sc. degree in Electrical Engineering from National Tsing Hua University, and Ph.D. degree from National Taiwan University of Science and Technology. Since 1989, he has been with the Taiwan Power Company Research Institute. His research interests include power quality and impact evaluation of renewable generations on distribution system.

## **Communication-Efficient Decentralized Demand Side Management: A Dual Consensus ADMM Approach**

**Tsung-Hui Chang**

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(台灣科技大學電子工程學系張縱輝教授)

### ABSTRACT

Demand side management (DSM) has been one of the enabling technologies for the smart grid systems. This talk considers the cooperative DSM (CoDSM) problem where a load aggregator (e.g., the utility) coordinates the energy consumption of a neighborhood with large numbers of customers, in order to achieve real-time power balance. We are interested in decentralized DSM control which is implemented in a fully distributed manner with the computation shared between the utility and customers. The utility and customers only need to exchange messages with their connecting neighbors. In particular, we propose to apply the recently proposed dual consensus alternating direction method of multipliers (DC-ADMM) distributed optimization method for the CoDSM. Simulation results show the DC-ADMM can significantly improve the power balance and outperforms the existing approaches.

### BIOGRAPHY



Tsung-Hui Chang received the B.S. degree in electrical engineering and the Ph.D. degree in communications engineering from the National Tsing Hua University (NTHU), Hsinchu, Taiwan, in 2003 and 2008, respectively. Since September 2012, he has been with the Department of Electronic and Computer Engineering, National Taiwan University of Science and Technology (NTUST), Taipei, Taiwan, as an Assistant Professor. Before joining NTUST, he held research positions with NTHU (2008-2011), and University of California at Davis, CA (2011-2012). He was also a Visiting Scholar of the University of Minnesota, Twin Cities, MN, the Chinese University of Hong Kong and Xidian University, Xian, China. His research interests are widely in signal processing and

optimization problems in data communications, smart grid and machine learning. Dr. Chang currently serves as an Associate Editor of IEEE TRANSACTIONS ON SIGNAL PROCESSING.





## **The Study and Development of Smart Grid Standards in Taiwan**

### **Shih-Che (Anthony) Hsu**

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### ABSTRACT

Taiwan government increasingly puts emphasis on smart grid industry and tries to maintain the industrial competitiveness in the long run. Standardization is a key issue for smart grid implementation and is also a major concern for industrial manufacturing.

In this study, a set of core standards are identified to point out the most important fields for smart grid development. The current status of developing smart grid standards in Taiwan and of international collaboration are introduced. Also, the direction and strategy for developing smart grid standards of Taiwan are recommended.

This approach can help domestic companies to master smart grid standards as soon as possible and to fulfill the requirements of international markets.

### BIOGRAPHY



Shih-Che Hsu received the B.S. degree in electrical engineering from National Taiwan University of Science and Technology, Taiwan, in 1990, and the M.S. and Ph.D. degrees in electrical engineering from National Tsing Hua University, Taiwan, in 1994 and 2007, respectively.

He was an electrical engineer of Taiwan Mechanical & Electrical Service Company from 1990 to 1991. At that time, his works included hydro power plant planning and distribution substation design. In 1993, he served as an application software engineer of Intergraph Corporation, Taiwan, and then was promoted to a project manager till 1997. In this period, he focused on the development of the Automatic Mapping and Facility Management System for Taiwan Power Company. During 1997 to 2000, he served as the Manager of Technical Department of Fanta Computer Corporation Ltd. to develop an Outage Management System. From 2000 to 2003, he was a Consultant of YK Engineering Corporation Ltd. for building the Distribution Automation System. Currently, he is an Assistant Professor in the Electrical Engineering Department of Chung Yung Christian University, Taiwan. His research interests include Smart Grid, Distribution Automation System and Power System Reliability.

Dr. Hsu is the member of IEEE Power & Energy Society.

## **The offshore wind resources assessment application of floating LiDAR in the Taiwan Strait**

**Chung-Yao Hsuan**

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### ABSTRACT

Wind and wave measurements of a Floating LiDAR (Light Detection And Ranging) Device (FLD) are performed on the site of Fuhai Offshore Wind Farm in the Taiwan Strait. The location of the deployment is situated 10 kilometers off-coast of Changhua County, and the anchored water depth is 25 meters. It is the very first time in Asia Pacific Region to use such state-of-the-art device for tasks of offshore wind and wave measurement. Six range gate heights were set at 55m, 71m, 90m, 110m, 150m and 200m from the FLD sensor lens. Wind speeds and wind directions were measured by a remote sensing technology. Wave heights and periods were also measured by the buoy wave sensor. NCKU WindSentinel data are planning comparisons with Fuhai's offshore fixed mast data when the meteorological mast is completed. The goal is to convince the wind energy community that FLD are a reliable and cost effective way of obtaining data for resource assessment. Until this moment, The FLD are observing and measuring the offshore wind farm's meteorological and oceanographic data. In September, a mild typhoon (Fung-Wong) passed through from east of Taiwan. NCKU WindSentinel continuously measured during typhoon period in the sea. The present preliminary measurements campaign presented the convenience and more cost effective option of the FLD, which may be a key tool for assessment of offshore wind resources in future offshore wind farm developments.

### BIOGRAPHY



Chung-Yao Hsuan was born in Tainan, Taiwan in 1970. He received his Ph. D. in Mechanical Engineering from National Cheng Kung University in 2011. His research interests include combustion theory, energy technologies and offshore wind power.

He has been working in the wind research (onshore and offshore) since 2011. He is currently an assistant researcher at the Research Center for Energy Technology and Strategy (RCETS) of the National Cheng Kung University in Taiwan. RCETS purchased a Floating LiDAR, named WindSentinel, from AXYS Technologies Inc. of Canada in May 2013. He was assigned to lead a team and take responsible for the operation and maintenance of the floating lidar. His research is currently focused on offshore wind farm's meteorological and oceanographic measurement and the offshore wind resources assessment in the Taiwan Strait.

*Technical Session D2-W1-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

**Session Chair**

**Chih-Ting Lin**

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**BIOGRAPHY**



Chih-Ting Lin received the B.S. degree in civil engineering and M.S. degree in applied mechanics from the National Taiwan University, in 1996 and 1998, respectively. He also received the M.S. and Ph.D. degree in electrical engineering and computer science from the University of Michigan, Ann Arbor, in 2003 and 2006, respectively. In 2006, he joined the Graduate Institute of Electronics Engineering and Department of Electrical Engineering, National Taiwan University, as an Assistant Professor. Since 2012, he has been an Associate Professor. His research interests include CMOS based biotechnology, biosensors, electro-chemical sensors, organic electronics, NEMS, and MEMS.

## **Biomedical Diagnosis and Detection in Resource-Limited Settings**

### **Chien-Fu (Steve) Chen**

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### ABSTRACT

Attention toward health services and medical care in developing countries has increased intensively in recent years. Researchers have been contributed extraordinary efforts to fight major diseases, enabled by the availability of cost-effective and high sensitive diagnostic systems for early discovery, timely treatment and prognosis monitoring to improve vector control. However, classic laboratory tests require costly and complex infrastructures, well-trained personnel, and a stable power source that are lacking in resource-constrained settings. In order to solve abovementioned difficulties, we address the need using a platform that is based on affordable, sensitive, specific, user-friendly, rapid and robust, equipment-free and deliverable to end-users manners using different approaches that combine nanocarbon field-effect transistors with cyclo olefin polymer based and paper-based analytical devices. In addition, different sensing mechanisms including device fabrication, surface chemistry and biomolecular recognition are also investigated to discern potential use for future applications.

### BIOGRAPHY



Chien-Fu Chen is an Assistant Professor in Graduate Institute of Biomedical Engineering at National Chung Hsing University, Taiwan. He received his PhD in Institute of Applied Mechanics from National Taiwan University in 2007, and then did his postdoctoral work with Cheng S. Lee and YuHuang Wang in the Department of Chemistry and Biochemistry, and Don L. DeVoe in the Department of Mechanical Engineering at University of Maryland, College Park from 2007 to 2011. Dr. Chen's research focuses on the miniactualized systems utilizing micro/nanomaterials for biomedical sensing applications based on affordable, sensitive, specific, user-friendly, rapid and robust, equipment-free and deliverable to end-users manners. He is author of over fifty peer reviewed publications and served as program committees and section chair of relative workshops and conferences. In 2014, he received Young Faculty Award from College of Engineering, National Chung Hsing University.

## **Multifunctional Gold Nanostructures in Biomedical Engineering**

### **Dehui Wan**

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### ABSTRACT



Gold nanostructures have proven to be a versatile platform for a broad range of biomedical applications, with potential use in numerous areas including: diagnostics and sensing, in vitro and in vivo imaging, and therapeutic techniques. They are attractive for their surface plasmon resonance (SPR) properties. The strong interactions between metallic nanoparticles (NPs) and incident light originate from excitation of the collective oscillations of conduction electrons within these particles. In this talk, I will introduce our recent work on the synthesis of hollow gold nanostructures and their applications in biomedical engineering.

First part describes a facile, robust approach to the synthesis of Au cubic nanoframes. The key to the formation of Au cubic nanoframes is to introduce thin layers of pure Au onto the surfaces of Au-Ag alloyed nanocages before the dealloying step. This modification could prevent the nanocages from collapsing during the dealloying process because the additional coating could greatly strengthen the hollow and porous structure. The nanoframes could exhibit tunable localized surface plasmon resonance peaks in the near-infrared region, but with much lower Ag contents as compared with the conventional Au-Ag nanocages. WST-1 assay was used to investigate their cytotoxicity.

Second part illustrates a SPR-based scattering waveguide sensor by directly imprinting monolayer Au NPs onto flexible polycarbonate (PC) plates—without any surface modification—using a modified reversal nanoimprint lithography (rNIL) technology. Controlling the imprinting conditions, including temperature and pressure, allows for the fine adjustment of the depths of the embedded metal NPs and their SPR properties. This patterning approach exhibits a resolution down to the submicrometer level. We obtained an almost one order of magnitude enhancement in the scattering signal after transferring the metal NPs from a glass mold to a PC substrate.

### BIOGRAPHY

Dehui Wan was born in Taipei, Taiwan in 1981. He received his B.S. (2003) in Chemistry and Ph.D. (2010) in Materials Science and Engineering from the National Taiwan University. He was a postdoctoral fellow with Dr. Younan Xia at the Department of Biomedical Engineering, Institute of Georgia Technology between 2011 and 2012. Currently he is an Assistant Professor of Biomedical Engineering, National Tsing Hua University. Dr. Wan's research integrates controlled synthesis, surface chemistry and optical behaviors of nanostructures to develop novel biosensor, photothermal therapy, and energy devices. He has authored twenty peer-reviewed journals on these topics

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and served on the program and organizing committees of few international conferences.



## **Optoelectrokinetically-Enabled Signal Enhancement for a Bead-Based FRET Fluorescence Immunoassay**

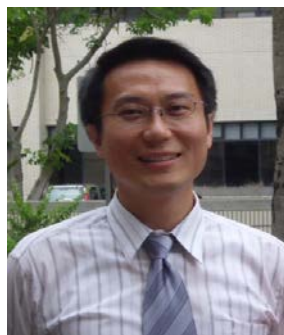
**Han-Sheng (Oswald) Chuang**

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### ABSTRACT

Bead-based immunoassay has been growing as a promising technology in the point-of-care diagnostics due to great flexibility. For dilute samples, the functionalized particles can capture dispersed analytes and act as carriers for advanced particle manipulation. To realize a rapid in-situ immunoassay, Förster resonance energy transfer (FRET) was used herein to ensure only the biomarker lipocalin 1 (LCN1) to be detected. The measurement was made in an aqueous droplet sandwiched between two parallel plate electrodes. With an electric field and a focused laser beam applied on the droplet simultaneously, the immunocomplexes were further concentrated to enhance the FRET fluorescent signal. The optoelectrokinetic technique has been proven to be excellent in dynamic and programmable particle manipulation. Accordingly, the detection can be usually completed within several tens of seconds. A comparison between the based-based diagnostics coupled with the optoelectrokinetic technique and the conventional enzyme-linked immunosorbent assay (ELISA) showed nearly 100-fold improvement in the lower detection limit (LDL). The deliberately combinative use of FRET and optoelectrokinetic technique on the bead-based immunoassay provides a valuable insight to diagnosing the early-stage diseases with dilute analytes.

### BIOGRAPHY



Han-Sheng Chuang is an assistant Professor in the Department of Biomedical Engineering at National Cheng Kung University, Taiwan. Dr. Chuang received his bachelor and master degrees in the Department of Mechanical Engineering from National Cheng Kung University in 1998 and 2000, respectively. He joined Industrial Technology Research Institute (ITRI) as a R&D engineer in 2001. After then, he worked with Professor Steve Wereley for advanced microfluidics and received his Ph.D. in the School of Mechanical Engineering from Purdue University in 2010. After graduation, he received an appointment as a postdoctoral researcher at University of Pennsylvania and worked with Professor Haim Bau on cell sorting and Caenorhabditis elegans manipulation. In 2005, he was awarded a competitive fellowship from Ministry of Education, Taiwan. He and his research fellows were the finalists of the prestigious Burton D. Morgan Business Competition in 2008 and 2009, respectively. Lately, he was awarded the 2014 Young Researcher Career Grant from the Ministry of Science and Technology. In addition, he is also a cofounder of a US-based technical start-up, Microfluidic Innovations, since 2009. Dr. Chuang has dedicated to the fields

of optoelectromechanical microfluidics for more than 10 years. His current research interests are focused on nano-/microfluidics, Bio-MEMS/NEMS, and optical diagnostics.



*Technical Session D2-W1-T4: Bio-Materials, Bio-SoC, Bio-Nanotech, Bio-NEMS/Bio-MEMS, and Water Purification Technology*

**Chia-Yuan Chen**

Assistant Professor, Department of Mechanical Engineering  
National Cheng Kung University  
(成功大學機械工程學系陳嘉元教授)

ABSTRACT

BIOGRAPHY



## **Session Chair**

### **Jwo-Huei Jou**

Professor, Department of Materials Science and Engineering  
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Hsin-chu, Taiwan  
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(清華大學材料工程學系周卓輝教授)

## **BIOGRAPHY**



Prof. Jwo-Huei Jou of the Department of Materials Science and Engineering at the National Tsing-Hua University Taiwan, was the department chairperson from 2006 to 2009, and is serving as the president of Chinese Organic Electronics Association, the Editor of Fluorescent Materials, and an active member of Engineering Ethics Committee of the Chinese Engineers Association. His web page is: <http://www.mse.nthu.edu.tw/~jjou/>

Prof. Jou received his PhD degree in 1986 from Macromolecular Science and Engineering Program, University of Michigan (USA). In 1986 he joined as a Postdoctoral Visiting Scientist at IBM-Almaden Research Center, San Jose, CA, and then joined National Tsing-Hua University in 1988 as an Associate Professor. In 1992, he received academic title Professor.

Professor Jou's research interests include sunlight style organic light emitting diodes (OLEDs); candle light style OLEDs, high efficiency low color temperature OLEDs, ultra-deep blue OLEDs, very high color rendering index OLEDs, spectrum resemblance index to measure the quality of light, flexible OLEDs, long lifetime OLEDs, thin film stress analysis, polymers and expert system applications. He has made several breakthrough inventions, including Sunlight style color-temperature tunable OLED, Candle light style OLED, Chromaticity tunable between dusk-hue and candle-light OLED, and Solution pre-mixed method for OLEDs fabrication etc. He is the author of over 120 international peer reviewed journal papers, and has filed or been granted over 65 patents including 20 US patents. He has delivered more than 35 talks as an invited or plenary speaker in international conferences over the past five years. In the past three years, he has also delivered 24 invited talks on OLEDs and 19 invited talks on Engineering Ethics in Taiwan. He was awarded "Excellence in Industry-Academic Cooperation" Taiwan (2013); International Inventor Prize (IIP) (2012); "Award of Excellence Commercialization" Taiwan (2012); 2012 ITRI (Industrial Technology Research Institute) Laurel lecturer; 2007-2011 Outstanding Academic Teaching Awards; 2009 and 2010 NTHU-Academic Summit Program: Boost Program Research Funding; "Prism award for Photonics Innovation" finalist 2009; "Outstanding Poster Paper Award" International Display Workshop (2007); "Boost Program Research Funding" 2007; "Excellence Research Program Funding" (2006); National Science Council (NSC) Outstanding Research Award-1992; "NSC Grade-A Research Award" 1989-1991, 1995-1999; "Booster Program Research Funding" (1991). Lead guest-editor of

several special issues in International Journal of Photoenergy (<http://www.hindawi.com/journals/ijp/si/905140/cfp/> and <file:///C:/Users/Sudhir%20Dubey/Downloads/948689.pdf>), Journal of Nanomaterials (<http://www.hindawi.com/journals/jnm/si/369109/cfp/>), Advances in Materials Science and Engineering (<http://www.hindawi.com/journals/amse/2012/878301/>), and The Open Optics Journal (<http://benthamopen.com/tooptsj/Special-Issues.htm>). Editor of Fluorescent Materials launched recently by De Gruyter Open ([www.degruyteropen.com](http://www.degruyteropen.com)).

Professor Jou's recent journal publications and patents can be found from the link:  
<http://www.mse.nthu.edu.tw/~jjou/page3.html#成果簡述>

## **Nanostructure Conducting Polymer for Energy-Related Applications**

**Chih-Wei Chu**

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### ABSTRACT

Functional materials with embedded nanostructure are significantly important because they provide unique functionalities to be advantageous for applications including solar cells, sensors, and particularly energy storage devices. Great efforts have been predominantly developed nanostructure inorganic materials. These materials are, however, very expensive to process and poor mechanical flexibility. Conjugated organic materials, possessing electrical and optical properties similar to those of metals and semiconductors, are capable of bringing new opportunities because of their soft nature, and thus allowing high flexibility. As a type of promising functional materials, conducting polymers have been attractive a large of attention, because they are easily synthesized using chemical or electrochemical synthetic methods at room temperatures with low cost. Among them, poly(3,4-ethylenedioxythiophene) has been investigated most often because of their reasonable electric conductivity, low oxidation potentials, biocompatibility, and environmental stability at high temperature. In this presentation, I will introduce two different facile approaches to fabricate nanostructure PEDOT films. First, we utilized different monomers via the electrochemical polymerization to manipulate the morphology of the PEDOT film. Second, we developed a template assisted synthesis to prepare PEDOT periodic arrays. Since those nano-architected PEDOT provide much greater surface area as well as much greater penetration path to ions, which increase the merit of conducting polymer in making novel applications, such as solar cells, supercapacitors, electrochromic devices, and batteries and so forth.

**Keywords:** conducting polymer, energy, nanostructure, flexible electronics,

### BIOGRAPHY



Dr. Chih Wei Chu was born in Taipei, Taiwan, in 1972. He received his B.S. degree in the Department of Chemical Engineering from Chung Yauan University, Taiwan in 1995. He received his M.S. in Department of Civil and Environmental engineering and Ph.D. degree in Department of Materials Science & Engineering from University of California, Los Angeles, USA in 1998 and 2006, respectively.

Between his M.S. and Ph.D. degree, he joined Inteplast Group, Ltd. as R&D engineer in 1998 and worked until 2002. In 2006, he joined as an assistant research fellow in Research Center for Applied Sciences at Academia Sinica and was promoted to associate research fellow and research fellow in 2010 and 2014, respectively. He was a joint-appointment assistant and

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associate Professor (2008-2014). Currently, he serves as the Acting Executive Officer of Thematic Center for Green Technology of Research Center for Applied Sciences. Chu's research focuses on development of emerging materials as well as their practical applications in energy conversion, saving and storage devices.

## **Lead-free ZnS Nanogenerator and Active Sensor**

**Jyh Ming Wu**

Associate Professor, Department of Materials Science and Engineering  
National Tsing Hua University  
Deputy Secretary General, Materials Research Society Taiwan  
(清華大學材料工程學系吳志明教授)

### ABSTRACT

Jyh Ming Wu is an Associate Professor of Materials Science and Engineering at National Tsing Hua University, Taiwan. He was awarded the 2011 Ta-You Wu Memorial Award by the National Science Council, 2012 Youth Leadership Award by Taiwan Vacuum Society, and (2007-2012) Outstanding Research Award by Feng Chia University, Taiwan. Prof. Wu is the editorial board member for The Scientific World Journal (SCI) and Journal of materials. He is also the member of The Electrochemical Society (ECS) in USA, Royal Society of Chemistry (RSC) in UK, Materials Research Society (MRS) in USA, Materials Research Society in Taiwan (MRS-T), and Taiwan Vacuum Society (TVS). Prof. Wu's academic interests are in the areas of the optoelectronic nanodevices, nanosensors, photocatalyst, piezoelectric materials, active sensor, and energy harvesting nanogenerator. He is also the Duty General Secretary for Materials Research Society Taiwan. He has currently published over than 51 SCI journal papers with h-index 18 and total citation in 950.

### BIOGRAPHY



The nanogenerator based sensors made from piezoelectric materials that can convert the mechanical energy in our living environment into the electrical signal output, which have successfully analyzed the mechanical motions to develop a heart-pulse, tire pressure, and bridge vibration sensors. This is also called self-powered nanotechnology that enables to make the sensor self-drive without batteries or external power sources. A pendulum and micro-force active sensors were first made from zinc sulfur (ZnS) nanowires. The x-ray diffraction (XRD) pattern shows that the ZnS belongs to a wurtzite structure. The TEM image shows that the nanowires were grown along a [0001] axis, which is a spontaneous polarization direction. On the basis of our theoretical calculation, as applied a compressive strain along the z axis of ZnS nanowire, the output piezopotential of the ZnS reaches ~2V. A various momentums were able to detect owing to the output voltage and current of the ZnS nanogenerator were proportional to the momentum. The ZnS active sensor can self-power to trace a simple harmonic motion of a pendulum object. It can be acted a useful position and force active sensors.

## **Spintronic Materials Explored by Modern X-ray Absorption Spectroscopy**

**Yuan-Chieh Tseng**

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(交通大學材料科學與工程學系會院介教授)

### ABSTRACT

In this talk I will present how to use x-ray absorption spectroscopy (XAS) and x-ray magnetic circular dichroism (XMCD) to investigate spintronic materials, and how to improve our understanding of spintronic materials by the use of modified XAS/XMCD.

In first part I will report a study focusing on the local symmetry of Cu-dopant and resultant structural imperfections in mediating Zn<sub>1-x</sub>Cu<sub>x</sub>O nanoparticles' ferromagnetism (FM). Prepared by an antisolvent method, Cu appeared to preferably populate on the basal plane of ZnO with a local symmetry of [CuO<sub>4</sub>]. This unique symmetry was antiferromagnetic in nature, while electronically and structurally coupled to surrounded oxygen vacancies (Vo) that yielded a localized FM, because of a strong dependency on the number/location of the [CuO<sub>4</sub>] symmetry. In surprise, the FM of undoped but oxygen-deficient ZnO appeared to be more itinerant and long-range, where Vo percolated the FM effectively and isotropically through oxygen's delocalized orbital. By adopting the approach of structural imperfection, this study clearly identifies Vo's (defect's) true characters in mediating the FM of magnetic semiconductors which has been thought of as a long standing debate, and thus provides a different thinking about the traditional extrinsic ferromagnetic-tuning in the semiconductors. It even illuminates recent researches concerning the intrinsic FM of low-dimensional systems which contain defects but non-magnetic elements.

In second part I will report a developed synchrotron-based setup capable of performing XAS and XMCD with simultaneous electrical control characterizations. The setup can enable research concerning electrical transport, element- and orbital-selective magnetization with an in-situ fashion. It is a unique approach to the real-time change of spin-polarized electronic state of a material/device exhibiting magneto-electric responses. The performance of the setup was tested by probing the spin-polarized states of cobalt and oxygen of Zn<sub>1-x</sub>CoxO dilute magnetic semiconductor under applied voltages, both at low (~20K) and room temperatures, and signal variations upon the change of applied voltage were clearly detected. This setup helps identify the roles of all physical variables affecting the magneto-electric effects, which can fundamentally improve the spintronic technology. Research topics related to (i) electrical control electronic structures and (ii) element-specific study of magneto-electric responses, will be greatly benefited by the use of the setup.

### BIOGRAPHY



### **Education**

Ph.D, Materials Science & Engineering, Northwestern University, U. S. A 2009

M. S., Materials Science & Engineering, National Tsing Hua University, Taiwan 2002

B. S., Materials Science & Engineering, National Tsing Hua University, Taiwan 2000

### **Professional Experiences**

Associate Professor, National Chiao Tung University, 2013 August ~ present

Assistant Professor, National Chiao Tung University, 2009 August ~ 2013 July

### **Scientific Interests**

Spintronics materials, physical properties of materials, synchrotron radiation, magnetic oxides, Interfacial magnetism

### **Major Awards and Honors**

1. Teaching award, National Chiao Tung University, 2014
2. Teacher of the year, College of Engineering, National Chiao Tung University, 2014
3. Dr. Joseph Chou Memorial Scholarship, North America Taiwanese Engineers' Association
4. Argonne student scholarship, Department of Energy (DOE), 2005~2009 (special appointee).
5. Walter P. Murphy Fellowship, McCormic school of Engineering, Northwestern University, 2004
6. Thesis award for Master student, Dept. Materials Science & Engineering, NTHU, 2002



## **Inorganic Nanotube-Polymer Composite Membranes for Separation Technology**

**Dun-Yen Kang**

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National Taiwan University  
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(臺灣大學化學工程學系康敦彥教授)

### ABSTRACT

In the present study, single-walled nanotubes-poly(vinyl alcohol) (SWNT-PVA) mixed-matrix-membranes (MMMs) are prepared and carefully characterized via various solid-state techniques, including scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS). We investigate how the separation performance of SWNT-PVA MMM in an ethanol-water pervaporation system is improved with the loading of SWNTs in the membranes.

### BIOGRAPHY



Dr. Dun-Yen Kang was born in Taipei, Taiwan on October 25th in 1981. In 2004, he completed his B.S. in Chemical Engineering at National Taiwan University. He then pursued an M.S. in Applied Mechanics at the same university. His M.S. thesis was on the subject of light transport and conversion within the phosphor layers of white-light-emitting-diodes. He received the M.S. degree in 2006. In 2008, Dun-Yen enrolled at Georgia Tech where he is jointly advised by Profs. Sankar Nair and Christopher W. Jones. He received the Ph.D. degree in 2012.

He served in the Taiwanese military as sergeant for one year in 2007. He worked as a postdoctoral fellow in Prof. Seth Marder's group in the School of Chemistry at Georgia Tech. He then moved to Taiwan and served in the Department of Chemical Engineering at National Taiwan University as an Assistant Professor. He is now living and working in Taipei.

Dr. Kang has made progress towards many of diverse materials related topics, including nanotube technology, nanoporous materials, hierarchical structure characterization, and conducting soft materials. In each of research areas mentioned above, he has multiple publications in top journals, including Nature Communications, ACS Nano, Nano Letters, and JACS. In addition to his outstanding publication record, he also received several awards, including Zeigler Award (at Georgia Tech in 2010), Best PhD Thesis Award (at Georgia Tech in 2013), and IUMRS-ICA Young Scientist Award (at NTU in 2014). He is a member of TwAIChE and MRS-Taiwan.

**Session Chair**

**Ching-Fuh Lin**

Distinguished Professor, Department of Electrical Engineering and  
Director, Innovative Photonics Research Center  
National Taiwan University

(台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

**BIOGRAPHY**



Prof. Ching-Fuh Lin obtained the B.S. degree from National Taiwan University in 1983, and the M.S. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1989 and 1993, respectively, all in electrical engineering.

He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University. His major research area is in photonics, including organic-inorganic composites for light-emission devices and solar cells, single-crystal Si thin-film solar cells, Si-based photonics, and physics in broadband semiconductor lasers and optical amplifiers.

He is a Fellow of IEEE, a Fellow of SPIE, Member of Asia-Pacific Academy of Materials, and a member of OSA. He has published over 160 journal papers and 450 conference papers and holds more than 50 patents. He is also the sole author of two books, "Optical Components for Communications: Principles and Applications", published by Kluwer Academic Publishers (USA 2004), and "Optics and Photonics: Fundamentals and Applications" (in Chinese, 2012), and co-authors a book, "Organic, Inorganic and Hybrid Solar Cells –Principles and Practice", published by John Wiley & Sons, Inc. and IEEE Press, 2012. He had obtained the Distinguished Research Award and several Class A Research Awards from National Science Council of Taiwan, ROC, and the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering. He and his students had also been granted the 18th Acer Research Golden Award, 18th Acer Research Excellent Award, 14th Acer Research Excellent Award, 6th Y. Z. Hsu Technology Invention Award, Outstanding R&D Innovation Award of NTU 2014, Collins Thesis Awards for years of 1998, 2001, 2002, 2004, 2007, 2009, 2010, and 2012.

Prof. Lin has served in the International Scientific Committee of 27th, 28th & 29th European Photovoltaic Solar Energy Conference and Exhibition and as the Chair of IEEE LEOS Chapter Taipei Section, the Board member of the 17th IEEE Taipei Section, and the Council member of the 10th Optical Engineering Society of ROC and Taiwan Photonics Society.

## **Designer germanium quantum dots for functional sensing/metrology devices**

**Pei-Wen Li**

Professor, Department of Electrical Engineering  
Director, Center for NANO Science and Technology  
Associate Dean of Academic Affairs  
National Central University

(中央大學電機工程學系兼奈米科技研究中心主任兼副教務長李佩雯教授)

### ABSTRACT

Motivation to employ semiconductor quantum dots (QDs) for primary sensing and metrology devices is strong in light of the peculiar, distinctive Coulomb blockade and quantum confinement effects on nanometer-scaled QD structures. The intriguing, size-tunable electronic structures as well as optical and thermal properties for QDs have opened up access to wide-ranging applications in logics, computing, photonics, and metrology. The key challenge for the production of high-sensitivity QD sensing and metrology devices based on the mostly self-assembled semiconductor QDs lies in the precise control over the growth of QDs with desired sizes at targeted locations within embedding matrices.

Our group has successfully demonstrated a unique self-assembly, complementary metal-oxide-semiconductor (CMOS) approach to deliberately locate germanium (Ge) QDs of desired sizes, locations and depths within Si-based semiconductor nanostructures using the control available through lithographic nanopatterning and selective oxidation of the nanopatterned Si<sub>1-x</sub>Ge<sub>x</sub> layers. We are able to precisely mold Ge QDs into a variety of forms, such a single QD, specific number of QDs, or stacked QD array on the Si platform for innovative nanoelectronics, nanophotonics, and high-sensitivity sensing applications.

We have conducted high performance Ge QD single electron transistor (SET) operating in the few-hole regime with narrow, well-spaced energy levels and sharp differential conductance peaks. Full-voltage width-at-half-minimum ( $V_{1/2}$ ) of GD valleys of our Ge-QD SET exhibits fairly linearity with the charge number ( $n$ ) within the QD and temperature following  $eV_{1/2} @ (1-0.11n) \cdot 5.15kBT$ . The depth of GD valley also has superior proportionality to charging energy ( $EC$ ) and  $1/T$  via  $DGD @ EC/9.18kBT$ . Our Ge-QD SHT indeed provides effective building blocks for QD nanothermometers over a wide temperature range with a detection temperature as high as 155 K in a spatial resolution less than 10nm and temperature accuracy of sub-kelvin.

### BIOGRAPHY



Pei-Wen Li was born in Taiwan in 1967 and received the Bachelor degree in electrophysics from National Chiao-Tung University, Taiwan in 1989, and the Master and Ph.D. degree in electrical engineering from Columbia University in New York city in 1991 and 1994, respectively.

Her Ph.D. dissertation was focused on the study of low temperature oxidation of SiGe alloys and she has successfully demonstrated the first pure SiGe-channel pMOSFETs. In 1995, she joined Vanguard International Semiconductor Corporation working on the process integration of 64M DRAM. Then, she joined I-Shou University as a faculty in the department of Electronic Engineering in 1996. She joined the department of Electrical Engineering, National Central University as an associate professor in 2000, was promoted to be a professor since August 2005, and served as the department chair during 2007-2010. Currently she is the associate dean of Academic Affairs and the director of the Center for Nanoscience and Technology, National Central University.

Dr. Li's main research theme focuses on experimental silicon-germanium nanostructures and devices. Her present research encompasses germanium quantum dot single-electron transistors, photodetectors, nonvolatile memory, and energy saving (photovoltaic and thermoelectric) devices, making use of self-assembly nanostructures in silicon integration technology. Her research group has successfully developed a novel CMOS-compatible, self-organized approach for the generation of germanium quantum dots on Si-containing layers through thermal oxidation of silicon-germanium-on-insulator structures. Of particular, the successful demonstration of precise placement and size control of the self-assembled germanium quantum dots shed light on the practical creation of new nano-electronic, nano-photonics, and electromechanical devices. She has published more than 70 journal papers and holds 5 patents in Si device processing.

Technical Session D2-W3-T4: New Green Energy Materials, Ceramic Materials, Metallurgy and Materials

**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)

ABSTRACT

BIOGRAPHY



## **Sequential Vacuum Sublimation: A New Method to Fabricate Perovskite Solar Cells**

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(清華大學材料工程學系林皓武教授)

### ABSTRACT

Organometal halide perovskites have recently attracted great attention as promising materials for solar energy conversion. The planar-type device architecture is particularly interesting due to the simple cell configuration and possible low-temperature fabrication on flexible substrates. However, unlike meso-superstructure-type counterparts, in which perovskite can be scaffolded by mesoporous matrices, incomplete and non-uniform coverage of perovskite films was usually observed in planar-type perovskite solar cells and has been regarded as the major factor resulting in decreased device performance. In this talk, I will demonstrate a novel sequential vacuum sublimation method to fabricate planar-type perovskite solar cells. Pinhole free thin-film morphology is observed. By sandwiching these vacuum-deposited perovskite films between the anode and vacuum sublimed organic electron-transporting layers and the cathode, the simple device architecture delivers a good performance of power conversion efficiency (PCE) up to 15.4%. The cells also exhibit a promising reproducibility with an average PCE of ~14% and a relative standard deviation as small as 6%. We believe that the integration of a simplified device structure, simple layer-by-layer fabrication, a low-contamination and highly homogeneous vacuum process, low-cost raw materials and the compatibility of a matured mass-production infrastructure will make this particular method a promising technology that brings perovskite solar cells a large step closer to commercial production.

### BIOGRAPHY



Prof. Hao-Wu Lin graduated from National Taiwan University in 2002 with a bachelor degree in electrical engineering. He received his Ph.D. degree from graduate institute of photonics and optoelectronics, National Taiwan University in 2007. After his Ph.D. study and military service, he joined AU Optronics Corp. for research and development on organic light emitting displays. In 2009, he joined the faculty of National Tsing-Hua University in the department of materials science and engineering. His current research interests include organic semiconductors for optoelectronic and electronic devices, next-generation photovoltaics, flat panel displays, and nano science and technologies.

## **Environmentally Benign and Health-caring Fluorescence Nano-composites for Warm-white Lighting**

**Ching-Fuh Lin**

Distinguished Professor, Department of Electrical Engineering and  
Director, Innovative Photonics Research Center  
National Taiwan University

(台灣大學電機工程學系光電創新研究中心主任林清富特聘教授)

**Pin-Chun Shen<sup>1,2</sup>, Kuan-Yu Chen<sup>1</sup>, Ming-Shiun Lin<sup>1</sup> and Ching-Fuh Lin<sup>1,2,3,4,5</sup>**

<sup>1</sup>Graduate Institute of Photonics and Optoelectronics, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.)

<sup>2</sup>Innovative Photonics Advanced Research Center, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.)

<sup>3</sup>Graduate Institute of Electronics Engineering, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.)

<sup>4</sup>Director, Innovative Photonics Advanced Research Center, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.)

<sup>5</sup>Distinguished Professor, Department of Electrical Engineering, National Taiwan University, No. 1, Section 4, Roosevelt Road, Taipei, 10617 Taiwan (R.O.C.)

### ABSTRACT

Advanced light-conversion nano-composites for next-generation lighting are developed. This innovative nanotechnology brings an energy-saving as well as environmental benign warm-white light source for solid-state lighting. Unlike the conventional phosphors that involve rare-earth elements (REEs), our light-conversion nanotechnology is REE free and is constructed by integrating II-VI semiconductor nanoparticles with polymeric materials. The hybrid nanostructures can efficiently generate photons corresponding to blue, green and orange light, respectively. As a result, white light can be emitted from the nano-composites upon UV- or blue-LED excitations and exhibits widely tunable color temperatures, ranging from 3000 K to 6000 K, which embraces both candle light and pure white light. Additionally, a warm-white light emission with 90% high quantum efficiency (QE) has been demonstrated under the commercial UV-LED excitation. This light-conversion nanotechnology can serve as a judicious strategy to eliminate the use of REEs for environmentally friendly solid-state-lighting technology and overcome the health issue involved in current blue-YAG-LED lighting.

### BIOGRAPHY

Prof. Ching-Fuh Lin obtained the B.S. degree from National Taiwan University in 1983, and the M.S. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1989 and 1993, respectively, all in electrical engineering.



He is now the Director of Innovative Photonics Advanced Research Center (i-PARC) and a joint distinguished professor in the Graduate Institute of Photonics and Optoelectronics, Graduate Institute of Electronics Engineering, and Department of Electrical Engineering at National Taiwan University. His major research area is in photonics, including organic-inorganic composites for light-emission devices and solar cells, single-crystal Si thin-film solar cells, Si-based photonics, and physics in broadband semiconductor lasers and optical amplifiers.

He is a Fellow of IEEE, a Fellow of SPIE, Member of Asia-Pacific Academy of Materials, and a member of OSA. He has published over 160 journal papers and 450 conference papers and holds more than 50 patents. He is also the sole author of two books, “Optical Components for Communications: Principles and Applications”, published by Kluwer Academic Publishers (USA 2004), and “Optics and Photonics: Fundamentals and Applications” (in Chinese, 2012), and co-authors a book, “Organic, Inorganic and Hybrid Solar Cells –Principles and Practice”, published by John Wiley & Sons, Inc. and IEEE Press, 2012. He had obtained the Distinguished Research Award and several Class A Research Awards from National Science Council of Taiwan, ROC, and the Outstanding Electrical Engineering Professor Award from the Chinese Institute of Electrical Engineering. He and his students had also been granted the 18th Acer Research Golden Award, 18th Acer Research Excellent Award, 14th Acer Research Excellent Award, 6th Y. Z. Hsu Technology Invention Award, Outstanding R&D Innovation Award of NTU 2014, Collins Thesis Awards for years of 1998, 2001, 2002, 2004, 2007, 2009, 2010, and 2012.

Prof. Lin has served in the International Scientific Committee of 27th, 28th & 29th European Photovoltaic Solar Energy Conference and Exhibition and as the Chair of IEEE LEOS Chapter Taipei Section, the Board member of the 17th IEEE Taipei Section, and the Council member of the 10th Optical Engineering Society of ROC and Taiwan Photonics Society.



*Technical Session D2-W4-T4: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings*

**Session Chair**

**Ta-Hui Lin**

Distinguished Professor, Department of Mechanical Engineering and  
Director, the Research Center for Energy Technology and Strategy  
National Cheng Kung University

(成功大學機械工程學系兼能源科技與策略研究中心林大惠特聘教授)

BIOGRAPHY



*Technical Session D2-W4-T4: Smart Grid Technologies and Network Communications, New Green Energy Technologies and Green Buildings*

**Ching-Ming Lai**

Assistant Professor, Department of Vehicle Engineering  
National Taipei University of Technology  
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ABSTRACT

BIOGRAPHY



## **Transportation and living by green energy in campus**

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### ABSTRACT

By incorporating the energy information and communication technologies into energy creating, energy-utility and energy management, this project demonstrates the required key techniques for a micro smart grid platform which can be applied to transportation and living in campus. This project includes two topics. Subproject (I) will focus on the development of an intelligent power socket for smart grid and application in office. Subproject (II) will show an example of green transportation like E-bike on the development of an application service platform for AMI power management of our renewable energy harvesting.

### BIOGRAPHY



I was born in Taipei city of Taiwan in 1975, and spent my early life in north Taiwan. From 1993 to 1997, I attended National Central University to study in physics department. After graduating from NCU, I went to National Tsing Hua University, where I obtained a Master degree and a Ph.D. in electronics engineering and the research was focused on microwave materials and devices. In my final year of my Ph.D., I won the scholarship to Aachen University of Germany for advanced researching on semiconductor device fabrication.

I had worked in SPICE model team of Taiwan Semiconductor Manufacturing Company for four years. After TSMC, I have joined Electrical Engineering Department as an assistant professor of TungHai University in Taiwan till now. My principal interests and research are in the renewable energy material and devices. Except from working on the carbon nano materials early in my career, I began to devote to the energy program development as well. I am currently involved in the project of Green Transportation and Living in campus.

## **A large-eddy simulation framework for wind energy studies**

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### ABSTRACT

A modeling framework is proposed and validated to simulate turbine wakes and associated power losses in wind farms. It combines the large-eddy simulation (LES) technique with blade element theory and a turbine-model-specific relationship between shaft torque and rotational speed. In the LES, the turbulent subgrid-scale stresses are parameterized with a tuning-free Lagrangian scale-dependent dynamic model. The turbine-induced forces and turbine-generated power are modeled using a recently developed actuator-disk model with rotation (ADM-R), which adopts blade element theory to calculate the lift and drag forces (that produce thrust, rotor shaft torque and power) based on the local simulated flow and the blade characteristics. In order to predict simultaneously the turbine angular velocity and the turbine-induced forces (and thus the power output), a new iterative dynamic procedure is developed to couple the ADM-R turbine model with a relationship between shaft torque and rotational speed. This relationship, which is unique for a given turbine model and independent of the inflow condition, is derived from simulations of a stand-alone wind turbine in conditions for which the thrust coefficient can be validated. Comparison with observed power data from the Horns Rev wind farm shows that better power predictions are obtained with the dynamic ADM-R than with the standard ADM, which assumes a uniform thrust distribution and ignores the torque effect on the turbine wakes and rotor power. The results are also compared with the power predictions obtained using two commercial wind-farm design tools (WindSim and WASP). These models are found to underestimate the power output compared with the results from the proposed LES framework.

### BIOGRAPHY



Dr. Yu-Ting Wu is Assistant Professor of the Department of Engineering Science at the National Cheng-Kung University. He received his bachelor degree from the National Taiwan University (NTU) in 2001, and master degrees from the NTU and the University of Minnesota- Twin Cities. He received his Ph.D. in the Department of Civil and Environmental Engineering from the École polytechnique fédérale de Lausanne (EPFL) in 2013. From 2013 to 2014 he worked as a post-doctoral associate at the Wind Engineering & Renewable Energy Laboratory in EPFL. His research interests include wind energy, large eddy simulation, atmospheric boundary layer, and parallel computing.

## **Development and Optimization of a New Energy-saving Glass**

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### ABSTRACT

Modern architectures and skyscrapers have largely employed the glass for its diaphaneity and esthetics. However, they have also suffered the high cost for air-conditioning due to the penetrated infrared radiation. The energy saving glass has been developed to simultaneously allow a high transmission in the visible spectrum while filtering out infrared light.

This work proposes a new energy-saving glass, Ag and Al inlaid with SiO<sub>2</sub> nano-structures. The profile is identified with a genetic algorithm designed to optimize optical responses from the glass. Wavelength-selective reflectance (R) and transmittance (T) are demonstrated with programs based on rigorous coupled-wave analysis. The high T and low R of this type of glass for visible light not only saves energy for lighting but diminishes reflected and stray light, while low T and high R in the near-infrared reduce the cost of air-conditioning.

The superiority of this proposed glass over current commercially available products is also quantitatively described. The fabrication tolerance of each dimension is further investigated to determine the key dimensions and the impacts of dimensions.

### BIOGRAPHY



Dr. Yu-Bin Chen was born in Taipei, Taiwan in 1975. He received his BS degree and MS degree from the Department of Mechanical Engineering at National Taiwan University, Taiwan, in 1998 and 2000, respectively. He received his PhD degree in Mechanical Engineering from Georgia Institute of Technology, USA in 2007.

He is currently an associate professor in the Department of Mechanical Engineering, National Cheng Kung University, Tainan, Taiwan. His research interests cover optical and radiative properties. He has authored over 30 journal publications.

In 2013, Dr. Chen got the outstanding reviewer award of Journal of Heat Transfer, ASME. Dr. Chen is associate editor-in-chief of Smart Science and associate editor of Journal of Heat Transfer Augmentation. Moreover, he is a reviewer of many SCI journals, such as Optics Express, Optics Letters, Journal of Quantitative Spectroscopy and Radiative Transfer, and International Journal of Heat and Mass transfer.