*The Golden Academy Conference Series*

**2016 Global Research Efforts on Energy and Nanomaterials (GREEN 2016)**

**Dec 22 –Dec 25 2016**

**Conference Proceedings**

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**Message from the organizers**

Dear Colleagues and Friends,

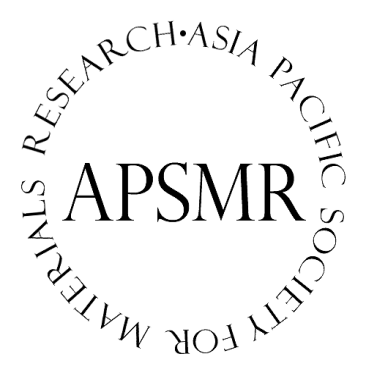
2016 Global Research Efforts on Energy and Nanomaterials (GREEN 2016) will be held in Taipei, Taiwan during December 22–25 2016

GREEN is being held every year and intends to provide a platform for the exchange and networking between top scientists, emerging young researchers, and students across a wide spectrum of materials science and engineering.

We would like to invite you to participate in GREEN 2016. Your active participation is the key to the success of this conference.

Yours Sincerely,

GREEN 2016 Committee

Asia Pacific Society for Materials Science (APSMR)

[www.apsmr.org](http://www.apsmr.org)

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**Conference organizing committee**

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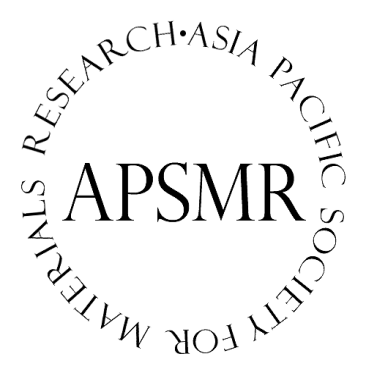
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**Continue to next page……….**

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**Conference organizing committee (Continued from previous section)**

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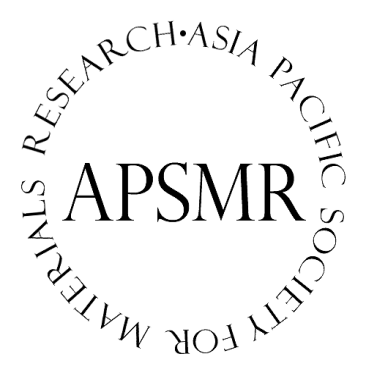
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**Prof. Shih-Chieh HSU (Tamkang University)**

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**Ms. Yaru WU (APSMR)**

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**Conference topics**

***1. Structure materials and Functional Coatings (metals, ceramics, and composites): No. 202(24)   
2. Materials for Energy (saving, conversion, transfer, storage) and Environment plus Electrochemistry***

***2.1. Photovoltaics: No. 204(2-5, 11, 13, 23, 24, 26, 27), No. 202(11, 22)***

***2.2. Rechargeable* *Batteries and Fuel Cells: No. 205(3), No. 202(9, 10, 18, 19, 21)***

***2.3. Materials for Thermal Management and Thermal Energy Utilization:***

***2.4. Materials for Energy and Environmental Applications: No. 205(4-5, 12-22), No. 202(3)***

***3. Optics and Photonic Materials: No. 204(1, 12, 20-22), No. 202(2, 25)   
4. Electronics, Magnetics and Nanomaterials: No. 204(6-10, 14-19), No. 202(12)  
5. Polymer Science and Molecular Chemistry: No. 205(1, 2), No. 202(4, 5, 11-B, 14-16, 23)  
6. Organic Materials and Biomaterials: No. 204(25), No. 202(1, 13, 20)   
7. Theory, Characterization and Computational Modeling of Materials: No. 202(6-8, 17)***

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| --- | --- | --- | --- | --- | --- |
|  | **THU, 12/22** | **FRI, 12/23** | **SAT, 12/24** | **SUN, 12/25** | |
| **9:00 – 10:20** | Pre-session technical and discussion forums | Plenary Presentation | | | |
| **10:20 – 10:30** | Coffee & Tea Break | | | |
| **10:30 – 12:00** | Oral Presentation | | | |
| **12:10 – 13:00** |  | Lunch Break | | | **Conference Excursion** |
| **13:10 – 14:40** | Oral Presentation | | |
| **14:40 – 14:50** | Coffee & Tea Break | | |
| **14:50 – 16:30** | Conference Registration | Oral Presentation | | |
| **17:00 –18:30** |  | Poster Session | |
| **19:00 –20:30** |  | Conference Banquet  (Approx. 1.5 hrs) | |
| **20:30 – 22:00** | Reception |  | | | |

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**Presentation List (No. 205 Meeting Room)**

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| --- | --- | --- | --- | --- |
|  | **THU, 12/22** | **FRI, 12/23** | **SAT, 12/24** | **SUN, 12/25** |
| **9:00**  **–**  **10:20** | Pre-session technical and discussion forums | **1. J.I. KADOKAWA**  **2. S. YAO** | **12. Y.A. KIM**  **13. R. FUNAHASHI** |  |
| **10:20　 –　 10:30** | Coffee & Tea Break | | |
| **10:30　 – 　12:00** | **3. C. PAK**  **4. C.C. HU**  **5. K. LOH** | **14. B. SARAVANAKUMAR**  **15. D. LEI**  **16. T.H. KO** |  |
| **12:10　 –**  **13:00** |  | Lunch Break | | **Conference Excursion** |
| **13:10　 – 　14:40** |  | **17. S.S. JAYASEELAN**  **18. K. MORI**  **19. T. TACHIKAWA** |
| **14:40　 – 　14:50** | Coffee & Tea Break | |
| **14:50　 – 　16:30** | Conference Registration |  | **20. Y. NONOGUCHI**  **21. S.W. LEE**  **22. S. ATA** |
| **17:00　 –**  **18:30** |  | Poster Session |
| **19:00　 –　 20:30** |  | Conference Banquet  (Approx. 1.5 hrs) |
| **20:30　 – 　22:00** | Reception |  | | |

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**Presentation List (No. 204 Meeting Room)**

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| --- | --- | --- | --- | --- |
|  | **THU, 12/22** | **FRI, 12/23** | **SAT, 12/24** | **SUN, 12/25** |
| **9:00**  **–**  **10:20** | Pre-session technical and discussion forums | **1. D.P. TSAI**  **2. Z.L. TSENG** | **12. P.K. WEI**  **13. H. MIZUNO** | **23. J.C. LIOU**  **24. Z.C. HE** |
| **10:20　 –　 10:30** | Coffee & Tea Break | | |
| **10:30　 – 　12:00** | **3. F.R. ZHU**  **4. M. HARUTA**  **5. D.H. KIM** | **14. T. SANNOMIYA**  **15. S. HATA**  **16. K. SAWANO** | **25. B.E. YOON**  **26. Y.T. CHANG**  **27. C.L. HO** |
| **12:10　 –**  **13:00** |  | Lunch Break | | **Conference Excursion** |
| **13:10　 – 　14:40** | **6. K.L. LU**  **7. J. YAMANAKA**  **8. C. HSU** | **17. M. SASAKI**  **18. K. ARIMOTO**  **19. Y. NISHIOKA** |
| **14:40　 – 　14:50** | Coffee & Tea Break | |
| **14:50　 – 　16:30** | Conference Registration | **9. A. MIURA**  **10. K.O. HARA**  **11. S.H. CHANG** | **20. S. NOMURA**  **21. P.C. WU**  **22. H. SAIGO** |
| **17:00　 –**  **18:30** |  | Poster Session |
| **19:00　 –　 20:30** |  | Conference Banquet  (Approx. 1.5 hrs) |
| **20:30　 – 　22:00** | Reception |  | | |

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**Presentation List (No. 202 Meeting Room)**

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| --- | --- | --- | --- | --- |
|  | **THU, 12/22** | **FRI, 12/23** | **SAT, 12/24** | **SUN, 12/25** |
| **9:00**  **–**  **10:20** | Pre-session technical and discussion forums | **1. H. IMANAKA**  **2. T. OKA** | **12.Y. CHANG**  **13. H. AOKI** | **23. K.W. CHEAH**  **24. T. IMAE** |
| **10:20　 –　 10:30** | Coffee & Tea Break | | |
| **10:30　 – 　12:00** | **3. T. KWAI**  **4. Y. KATSUMOTO**  **5. M. NISHIHARA** | **14. K. KUPERKAR**  **15. M. YAMAGUCHI**  **16. H.J. CHOI** | **25. Y.J. CHENG**  **26. R. WU**  **27. RESERVED** |
| **12:10　 –**  **13:00** |  | Lunch Break | | **Conference Excursion** |
| **13:10　 – 　14:40** | **6. P.H. LEE**  **7. Y.K. WANG**  **8. G.M. HU** | **17. J. KIM**  **18. I. M. HUNG**  **19. C.T WANG** |
| **14:40　 – 　14:50** | Coffee & Tea Break | |
| **14:50　 – 　16:30** | Conference Registration | **9. K. CHO**  **10. Y.G. LEE**  **11-A. A.L.R.**  **VELLAISAMY**  **11-B. T. NISHINO** | **20. K. HARA**  **21. C.Y. CHEN**  **22. Y. MORITOMO** |
| **17:00　 –**  **18:30** |  | Poster Session |
| **19:00　 –　 20:30** |  | Conference Banquet  (Approx. 1.5 hrs) |
| **20:30　 – 　22:00** | Reception |  | | |

**Presentations for GREEN 2016**

**FRIDAY 12/23**

**Meeting Room No 205**

1. Fabrication and Application of Self-assembled Chitin Nanofibers Through Gelation with Ionic Liquid (J.I. KADOKAWA)
2. The Basic Mechanism and Application of Crystalline Supramolecular Interaction of Side Chain Crystalline Block Co-Polymer (S. YAO)
3. Development of Supported Catalyst for Fuel Cells (C. PAK)
4. Coupling of Bi5O7I and Sr2TiO4 for Photocatalytic Degradation of Organic Pollutant Irradiated with Visible Light (C.C. HU)
5. Densely Distributed Sensing Enabled by Multifunctional Materials Coupled with Tomographic Algorithms (K. LOH)

**Meeting Room No 204**

1. Plasmonic Metasurface for Photonic Applications in Demand (D.P. TSAI)
2. Low-temperature ZnO Films as Electron Transporting Layers for Perovskite-Based Solar Cells (Z.L. TSENG)
3. An Insight on Metal Oxide Interlayer in Organic Photovoltaics: From Light Harvesting, Charge Recombination and Collection Perspectives (F.R. ZHU)



1. An Implantable Imaging Device for Observing the Recovery Process from Cerebrovascular Disease in Small Animal Brains (M. HARUTA)
2. Advanced Perovskite and Plasmonic Solar Cells via Unconventional Sterategies (D.H. KIM)
3. Metal–Organic Frameworks: Potential Applications in Microelectronics (K.L. LU)
4. STEM Moiré Observation of Ge/Si Produced by MBE and New Heating Method Using Plasma Technique (J. YAMANAKA)
5. Magnetic-Levitation Characteristics of Materials on Motor-Driving Gyro in Low Alternately Magnetism (C. HSU)
6. Structure, Properties and Exfoliation of LaOBiS2 and Related Materials (A. MIURA)
7. Close Relationship between Electrical Properties and Microstructure of Semiconducting BaSi2 Films (K.O. HARA)
8. Inverted Lead Halide Perovskite Thin-Film Based Solar Cells (S.H. CHANG)

**Meeting Room No 202**

1. Influence of Orientation and Spatial Arrangement of Ligand Biomolecules on Functionality after Immobilization on Solid Materials (H. IMANAKA)
2. Enhancement of Two-Photon Absorption in a Molecule by Plasmonic Nanoantenna (T. OKA)



1. Photochemical Approach for Efficient Use of Photons; Highly Photosensitive Photochromic Compounds and Photoacid Generators (T. KWAI)
2. Impact of the Primary Structure on the Thermoresponsiveness of Amphiphilic Polymers in Water (Y. KATSUMOTO)
3. Simple Functionalization of Polymeric Materials by Charge-Transfer Interaction -Method and Fuel Cell Application (M. NISHIHARA)
4. Magnetism of Mn1-xFexB Alloys: First-Principles Electronic Structure Calculations (P.H. LEE)
5. Large-gap Topological Insulators A2TePoO6 (A = Ca, Sr, Ba) with Effective Spin-Orbit Coupling (Y.K. WANG)
6. A Computational Study of Photosynthesis Proteins: Network Views of Photosystem Complexes from Sequence Similarity (G.M. HU)
7. Materials by Design for Li ion battery and fuel cell Applications (K. CHO)
8. Thixotropic Gel Polymer Electrolytes Based on Poly(vinylidene fluoride-co-hexafluoropropylene)/Hydroxypropyl Celluose Blend for Screen-Printing Process of 4V-Class Flexible Lithium Rechargeable Batteries (Y.G. LEE)

11-A. Thermoelectric Materials for Waste Heat Recovery (A.L.R. VELLAISAMY)

11-B. Adhesion and Interphase of Polyolefins (T. NISHINO)



**SATURDAY 12/24**

**Meeting Room No 205**

1. Substitutional Boron Doped Single Layer Graphene (Y.A. KIM)
2. Enhancement of Thermoelectric Properties of Oxide And Intermetallic Materials and Modules (R. FUNAHASHI)
3. Fabrication of High Performance Cable-Type Supercapacitor Using NiCo2S4 Nanosheets Decorated 3D-Ni/Ni Wire (B. SARAVANAKUMAR)
4. Fabrication of Biomass-Derived Composite Electrodes for Supercapacitors (D. LEI)
5. Fabrication and Supercapacitive Properties of Polyprrole@NiCo2O4 Nanoneedles/Carbon Fiber Papers via Hydrothermal and Electrochemical Depositon Methods (T.H. KO)
6. MWCNT Interconnected Binary, Ternary Metal Oxide Aerogel Electrodes for Supercapacitor Applications (S.S. JAYASEELAN)
7. Design of Nano-Catalysts for the use of Formic acid as a Hydrogen Energy Storage Material (K. MORI)
8. Developments of Titanium Dioxide Mesocrystals for Heterogeneous Photocatalysis (T. TACHIKAWA)



1. Stable N-Doped CNTs with Enhanced Thermoelectric Properties (Y. NONOGUCHI)
2. Principle and Application of the Plasma Electrochemistry: A Novel Chemical Process for the Synthesis and Assembly of Nanomaterials (S.W. LEE)
3. Improvement in the Thermal Resistance of Polymers by the Addition of Carbon Nanotubes as a Thermally Stable Radical Scavenger (S. ATA)

**Meeting Room No 204**

1. Aluminum-based Plasmonic Nanostructures for Highly Sensitive Biosensors (P.K. WEI)
2. Photoconversion Properties of Thin Film Photovoltaics Using a Soluble Zinc Phthalocyanine (H. MIZUNO)
3. High-Resolution Cathodoluminescence Scanning Transmission Electron Microscopy on Functional Plasmonic Nanopores (T. SANNOMIYA)
4. Time-Resolved 3D Observation of Nanoscale Plastic Deformation in Transmission Electron Microscopy (S. HATA)
5. Anisotropic Strain Engineering of Si/Ge Heterostructures (K. SAWANO)
6. Hydrogen Adsorption on Electron-Doped Fullerenes Observed with Helium Atom Scattering (M. SASAKI)



1. Growth of (110)-Oriented SiGe-Based Heterostructures for High Hole Mobility Devices (K. ARIMOTO)
2. Graphene-Coated Carbon Fiber Cloth for Flexible Electrodes of Miniaturized Glucose Fuel Cells (Y. NISHIOKA)
3. Circularly Polarized Near-Field Scanning Optical Microscope for Characterization of Nano-Devices and Nano-Materials (S. NOMURA)
4. Light Manipulation with Aluminum Plasmonic Metasurfaces (P.C. WU)
5. Who Has Seen a Free Photon? (H. SAIGO)

**Meeting Room No 202**

1. High-K Dielectric and Metal Gate Materials for Low Power Consumption III-V FinFETs (Y. CHANG)
2. Integrated Sensor Array Chips for Simple and Rapid Diagnosis of Biologically-Significant RNA Sequences (H. AOKI)
3. Surfactant-Polymer Templates In Morphology Modification Of Precipitated Calcium Carbonate Particles (K. KUPERKAR)
4. Migration of a Third Component Between Immiscible Polymers and Its Application to Material Design (M. YAMAGUCHI)
5. Synthesis and Electrorheology of Polyaniline@Attapulgite Nanoparticles (H.J. CHOI)



1. Computational Modeling and Screening of Metal Organic Frameworks (J. KIM)
2. Performance of High Temperature Sr(Ce0.6Zr0.4)1-xYxO3-δ Ceramic Proton Conductor (I.M. HUNG)
3. Exposed Area Ratio Effect of Cathode Electrode On The Performance of Sediment Microbial Fuel Cells (C.T. WANG)
4. High-Density Monolayer of Metal Complex: Preparation and Catalysis (K. HARA)
5. Characteristic Studies of a PBI/H3PO4 High Temperature PEMFC under Various Conditions (C.Y. CHEN)
6. Carrier Formation Dynamics in Prototypical Organic Solar Cells as Investigated by Transient Absorption Spectroscopy (Y. MORITOMO)

**POSTER SESSION**

P1. Efficient Inverted-Type Perovskite Solar Cells Using UV-Ozone Treated MoOx and WOx as Hole Transporting Layers (Z.J. LIN)

P2. Low-Temperature ZnO Films as Electron Transporting Layers for Perovskite-Based Solar Cells (H.H. CHEN)

P3. High-Transparent MoO3 Films for Hole Transporting Applications of Perovskite Solar Cells (Y.J. WU)



P4. Low-Temperature Deposited AZO/Ag/AZO used as Transparent Electrodes of Organic Polymer Solar Cell (W.W. LIN)

P5. Multi-area Imaging Device by Using Implantable Image Sensors for Simple Brain Functional Imaging (H. HAYAMI)

P6. A New Design of Convergent-Type Serpentine Flow Slab on Enhancing the Power Performance of Proton Exchange Membrane Fuel Cells (Y.T. OU)

P7. An Innovative Bio-Sensing Design and Applied in Micro-Microbial Fuel Cells (J.C. WU)

P8. Fabrication of Flexible Transparent Electrodes based on Nylon-6 Nanofiber-reinforced Cellulose Acetate Thin Films for Electrochromic Application (I.C. KIM)

P9. Facile Synthesis of Porous Nickel Phosphate Nanoparticles and its Application Towards Electrooxidation of Ethanol (P. SHARMA)

P10. Effects of Ni Seed Layer and Annealing on Supercapacitive Properties of Hierarchical NiCo2O4-Decorated Ni Foams for High Performance Supercapacitor Electrodes (J. PARK)

P11. Direct writing for highly stretchable electrode based on atmospheric pressure AC microplasma (T.H. KIM)



P12. Facile Synthesis of Graphene Quantum Dots by Microplasma-Assisted Electrochemistry (J.S. YANG)

P13. An Effective Surface Enhanced Raman Scattering (SERS)-Active Silver Nanoparticle/Boron-doped Graphene Nanoribbon Nanocomposite (W.T. LI)

P14. Time Resolved Magneto Photoluminescence Study of Inter-Well Excitation Transfer via Optical Near Field Interactions in Diluted-Magnetic/Nonmagnetic Triple Quantum Wells (S. KUBOTA)

P15. Collective Excitation Transfer Dynamics Due to Locally Non-Thermal Phonon Environment (R. OKADA)

P16. Fractal Dimensional Analysis of the Self-Accomodation in the SMA (M. NOMOTO)

P17. Multipole Mode Selection and Phase Measurement of Plasmonic Particles Using STEM Cathodoluminescence (Z. THOLLAR)

P18. Spectral Properties Of Hexagonal Plasmonic Nanohole Arrays (T. OHNO)

P19. Study on the Hysteresis of Hydration and Dehydaration Processes for PNiPAm and PNdEAm in Water by Fluorescence Probe Method (R. IKEMOTO)



P20. Hysteresis in the Thermo-Responsiveness of the a, w-hydroxyl telechelic poly(2-isopropyl-2-oxazoline) in Water (T. BEKKI)

P21. Influence of Self-Organization Process to the Polyimide Membrane Properties Formed by Using a Different Substrate (N. NISHIKAWA)

P22. Evaluation of Molding Condition Dependence of Mechanical Properties of Waste Recycling Plastics (A. TOMINAGA)

P23. The Modeling of Phonons for Near Constant Electricity of High-Entropy Metals (Y.A. CHEN)

P24. Adsorption of Plasmonic Confeito-Like Gold Nanoparticles on Self-Assembled Monolayers and Their SERS Efficiency (C.C. CHANG)

P25. Cellulose Fibers Functionalized by Metal Nanoparticles Stabilized in Dendrimer for Formaldehyde Decomposition and Antimicrobial Activity (M.A. KEBEDE)

P26. Development and Characterization of an Ultra-low Thermal Conductivity 2-D Material based on WSe2 for Thermal Management Applications (S.H. HSU)

**SATURDAY 12/25**

**Meeting Room No 204**



1. Design and Fabrication of Low Power Consumption Inkjet Nanomaterials with Identification Circuit (ID) Fuse System (J.C. LIOU)
2. Interfacial Engineering of Polymer Solar Cells (Z.C. HE)
3. Glia and Gliotransmitters on Carbon Nano Tubes (B.E. YOON)
4. Graphene Oxide Cathode of Field Emission Emitter with Square Lattice Island Array (Y.T. CHANG)
5. Functional Materials for Energy Conversion (C.L. HO)

**Meeting Room No 202**

1. Harmonics Generation from Mata-surface (K.W. CHEAH)
2. Carbon-Based Composites for Energy Generation/Storage Systems (T. IMAE)
3. Direct Full Visible Spectrum Emission Microrod Light-Emitting Diode (Y.J. CHENG)
4. Materials for Thermal Insulation and Thermal Management (R. WU)

**Conference Presentation Abstracts**

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**Fri/12/23**

**Meeting Room No 205**

**Abstract ID: 1**

**Fabrication and Application of Self-Assembled Chitin Nanofibers through Gelation with Ionic Liquid**

Jun-ichi KADOKAWA, Kagoshima University, Japan

Natural polysaccharides, such as cellulose, starch, and chitin, are widely distributed in nature and thus considered as the very important biomass resources. Although chitin is identified to show poor solubility and processability, leading to mostly its unutilization as materials, some ionic liquids have been found to dissolve chitin in certain concentrations. For example, the author found that an ionic liquid, 1-allyl-3-methylimidazolium bromide (AMIMBr), dissolved chitin in concentrations up to 4.8 wt% and formed ion gels at higher contents of chitin. Self-assembled chitin nanofibers were fabricated in a methanol dispersion obtained by regeneration from the chitin ion gel with AMIMBr using methanol, which formed a film by subjecting the dispersion to filtration. A chitin nanofiber/poly(vinyl alcohol) composite film was also obtained by co-regeneration approach. Furthermore, the self-assembled chitin nanofibers have been used as a reinforcing agent for cellulose derivatives to produce composite films. Chitin nanofiber-graft-synthetic polymer composite films were successfully prepared by surface-initiated graft polymerization technique. For example, the preparation of chitin nanofiber-graft-biodegradable polyester composite film was achieved by surface-initiated graft polymerization from the chitin nanofiber film. The similar procedure also gave chitin nanofiber-graft-polypeptide composite film. The surface-initiated graft atom transfer radical polymerization was conducted from a chitin macroinitiator film derived from the chitin nanofiber film.

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**Fri/12/23**

**Meeting Room No 205**

**Abstract ID: 2**

**The Basic Mechanism and Application of Crystalline Supramolecular Interaction of Side Chain Crystalline Block Co-Polymer**

Shigeru YAO, Yuri KANAZAWA, Yuriko TATEISHI, Ryoko NAKANO, Hiroshi SEKIGUCHI, Fukuoka University, Japan

The high crystalline polymer, such as Polyethylene (PE) and Polyterafluoroethylene (PTFE), is known to be a difficult polymer to change the surface properties by chemical method. Also, there is no material that chemically absorbs on their surface. On the other hand, Gecko can climb up the vertical PE wall. That is because their toes have pads with countless cilia under their foot, and it is said that the van der Waals force between the cilia and the wall generate the adhesion force.

Recently, we found that a polymer having long alkane side chains show very strong adhesion to PE. The adsorption force is generated by the van der Waals force between PE surface molecule and the side chain. They construct pseudo crystal and we name this interaction force “Crystalline Supramolecular Interaction”. By using this function, we synthesized side chain block copolymer constructed with the monomer having long alkane side chain and functional monomer. The block copolymer become side chain crystalline block copolymer (SCCBC) and has a function to modify the surface of PE to any property. We also synthesized same SCCBC that can modify the PTFE surface property.

In this presentation, we will discuss the mechanism of crystalline supramolecular interaction and application abilities of the SCCBC.

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**Fri/12/23**

**Meeting Room No 205**

**Abstract ID: 3**

**Development of Supported Catalyst for Fuel Cells**

Chanho PAK, Gwangju Institute of Science and Technology; Daejong YOU, Sungkyunkwan University; Eunyoung YOU, Jun Young KIM, Samsung SDI; Jiman KIM, Sungkyunkwan University, Korea

Fuel Cell is a promising energy conversion device because it can convert the chemical energy of fuel such as hydrogen and methanol directly into the electrical energy in one-step process, which results in a high energy efficiency, quiet operation and less emission of harmful gas. To generate the electricity, two electrochemical reactions like hydrogen oxidation reaction (HOR) and oxygen reduction reaction (ORR) is occurred inside the fuel cell. For these reactions, electrocatalysts are essential materials in the case of polymer electrolyte fuel cell (PEFC) due to the low operation temperatures. Until now, Pt and Pt alloy nanoparticles dispersed on the carbon support has been used and developed for several decades. However, there are remaining cMeeting Room No 205enges to address for enhancing the durability and performance of fuel cell.

In this presentation, I would like to discuss the development of supported catalysts in a view of support and metal composition sides, respectively. For the support, the ordered mesoporous carbon (OMC), which have very regular order of mesopore, will be discussed. Especially, OMC and SiC composite support for Pt catalyst will be presented in detail for example. The ORR activitiy of Pt supported on OMC-SiC Composite support showed superior stability under the accelerated voltage cycling condition compared to the conventional OMC support and the commercial Pt/C catalyst. For the metal composition, the non-Pt alloy compositions supported catalyst for HOR and ORR reactions, respectively, will be discussed for the high temperature PEFC and automotive PEFC applications. For example, PdIr based catalyst with core-shell structure showed enhanced durability under high-temperature operation condition at 150 °C for several hundred hours.

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**Fri/12/23**

**Meeting Room No 205**

**Abstract ID: 4**

**Coupling of Bi5O7I and Sr2TiO4 for Photocatalytic Degradation of Organic Pollutant Irradiated with Visible Light**

Chechia HU, Hui-Hsin HUANG, Tzu-Hsin CHEN, Chung Yuan Christian University, Taiwan

The demand for the development of visible-light-active photocatalysts is increasing. In the present study, Sr2TiO4 was coupled with Bi5O7I for degradation of methyl orange dye using visible light. X-ray diffraction (XRD), UV-vis diffuse reflectance spectroscopy (UV-vis DRS), and scanning electron microscopy (SEM) analyses revealed that the bismuth ions penetrate and replace titanium ions within the Bi5O7I/Sr2TiO4 heterojunction because of the pH changes and their identical layered structures, thus creating a p-n junction at the interface to improve the charge separation between Sr2TiO4 and Bi5O7I. Thanks to Ag nanoparticles loading as a co-catalyst onto the Bi5O7I/Sr2TiO4 surface, photoexcited electrons and holes separated and migrated effectively and the photocatalytic activity of Ag-Bi5O7I/Sr2TiO4 increased significantly. These results suggest that the Ag-loaded Bi5O7I/Sr2TiO4 heterojunction can serve as a promising visible-light-active photocatalyst.

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**Fri/12/23**

**Meeting Room No 205**

**Abstract ID: 5**

**Densely Distributed Sensing Enabled by Multifunctional Materials Coupled with Tomographic Algorithms**

Kenneth J. LOH, UC San Diego, USA

Structural systems are susceptible to damage and, if they remain undetected, can propagate to cause catastrophic failure. Structural health monitoring (SHM) is crucial for identifying damage initiation, directing repair, and ensuring system safety/reliability. This presentation outlines a new paradigm shift in SHM, where sensors are designed from a materials perspective stemming from a “bottom-up” design methodology. In doing so, one can engineer multifunctional materials that possess a diverse suite of engineering functionalities, such as sensing of specific external stimuli (e.g., strain and pH). A few examples will be highlighted. The first case examines multifunctional nanocomposite thin films engineered with electrical properties that are sensitive to strain (for monitoring deformation, impact, and cracks) or pH (for monitoring corrosion). A scalable fabrication method based on spray-coating is proposed so that it is amenable to large-scale implementation. In addition, by coupling the films with an electrical impedance tomography (EIT) algorithm, these “sensing skins” are able to localize and characterize damage severity. Its applications for SHM of composite structures (such as wind turbine blades), metallic systems, and cement composites will be presented. However, one limitation of EIT is that it requires a set of electrodes to be permanently installed at the boundaries of the sensing skin. Thus, the second example illustrates how one can leverage a different modality of electrical excitation to interrogate structures and characterize subsurface damage without requiring pre-installed electrodes. In that regard, nanocomposites embedded in structural components then serve as passive elements that accentuate damage occurring in the system through electro-mechanical or electro-chemical means. An electrical capacitance tomography algorithm and interrogation system can map electrical property changes within the material, thereby enabling non-contact, non-invasive, surface and subsurface damage characterization. Numerical modeling and experimental results will be presented for validating this proposed SHM method.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 1**

**Plasmonic Metasurface for Photonic Applications in Demand**

P. C. WU, W.-Y. TSAI, C. Y. LIAO, W. T. CHEN, Y.-W. HUANG, National Taiwan University, Taiwan; C.-M. WANG, National Dong Hua University, Taiwan; S. SUN, Fudan University, China; G. SUN, University of Massachusetts Boston, U.S.A; H. ATWATER, California Institute of Technology, U.S.A; Din Ping TSAI, National Taiwan University, Taiwan

Plasmonic metasurfaces composed of two-dimensional (2D) artificial structures have attracted a huge number of interests due to their ability on controlling the electromagnetic phase as well as amplitude at subwavelength scale. The feasible applications based on plasmonic metasurfaces include polarization generation and manipulation, focusing meta-lens and imaging applications, anomalous beam deflection etc. They therefore pave a promising way for the development of flat optical devices and integrated optoelectronic systems. In this talk, four research topics for photonic applications in demand will be performed and discussed: high efficiency anomalous beam deflection, holographic imaging, versatile polarization generation and tunable metadevices.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 2**

**Low-Temperature ZnO Films as Electron Transporting Layers for Perovskite-Based Solar Cells**

Zong-Liang TSENG, Hui-Hsin CHEN, Lung-Chien CHEN, National Taipei University of Technology; Sheng-Hsiung CHANG, Cheng-Chiang CHEN, Chien-Hung CHIANG, Chun-Guey WU, National Central University, Taiwan

In this study, a low-temperature sol-gel deposited ZnO thin film was used as the electron-transport layer in planar type CH3NH3PbI3 perovskite-based solar cells. The CH3NH3PbI3 films was prepared via a two-step spin-coating method and the relationship of the concentration of methylammonium iodide (CH3NHI) was discussed. Devices fabricated based on the ZnO coated on glass and with flexible substrates are discussed. The results show that we can achieve a record efficiency of 13.5% (glass) and 10.2% (PET) under AM1.5G irradiation for the low-temperature prepared ZnO based planar type perovskite solar cell.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 3**

**An Insight on Metal Oxide Interlayer in Organic Photovoltaics: From Light Harvesting, Charge Recombination and Collection Perspectives**

Furong ZHU, Department of Physics, Hong Kong Baptist University, Hong Kong

A comprehensive study of the effect of oxide interlayer on the performance of bulk-heterojunction organic solar cells (OSCs) is carried out by optical simulation, interfacial exciton dissociation, charge recombination and collection analyses. This talk discusses the understanding of the organic/electrode interfacial exciton dissociation, charge recombination processes and charge collection, which underpin the optimum cell design and performance. The charge transport and recombination properties in the bulk heterojunction OSCs are investigated using the transient photocurrent and photo-induced charge extraction by linearly increasing voltage techniques. Combined with light intensity-dependent current density–voltage characteristic, it is found that the origin of unfavorable electron collection is mainly due to the trap-limited bimolecular recombination, resulting in the compensation of drifted photo-generated electrons at the organic/cathode interface. The undesired charge collection can be eliminated by inserting a thin metal oxide interlayer between the organic layer and electrode. Suppression of the metal oxide subgap states significantly improves the charge extraction and performance reproducibility.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 4**

**An Implantable Imaging Device for Observing the Recovery Process from Cerebrovascular Disease in Small Animal Brains**

Makito HARUTA, Yoshinori SUNAGA, Takahiro YAMAGUCHI, Toshihiko NODA, Kiyotaka SASAGAWA, Takashi TOKUDA, Jun OHTA, Nara Institute of Science and Technology, Japan

The process of recovery from cerebrovascular disease is interesting from the standpoint of medical treatments. To reveal details of the recovery process from cerebrovascular disease in small animal brains, we have developed an implantable imaging device with a two-color light source. Our device measures two brain phenomena, blood flow and brain activity. The device includes a CMOS image sensor mounted on a flexible polyimide substrate and a two-color light source with green and red LEDs. The image sensor which was designed based on a modified three-transistor active pixel sensor circuit has a 126 × 268 pixel array. For the biological use, the device is coated and waterproofed with epoxy resins and parylene. Our proposed device is so small that it can be implanted into the small brain. The weight of this device is only 0.02 g that the value is 1/1,000 of an adult mouse. These small and light features enable observation of brain activities with minimum limitation of animal behaviors. For observing the blood flow on the brain surface, the device uses the green LEDs with an emission wavelength of 535 nm, at which one of the absorption peaks of total hemoglobin in blood appears. For observing the brain activity, the device uses the red LEDs with an emission wavelength of 605 nm by measuring the oxyhemoglobin absorption intensities.

We measured blood flow and brain activity on the mouse brain surface using this device at the same time. In freely moving experiment of the mouse, the device performed stably imaging of blood flow and brain activity. In the next work, we will try to observe the correlation between animal behaviors and the brain blood flow and the brain activity in the cerebrovascular disease.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 5**

**Advanced Perovskite and Plasmonic Solar Cells via Unconventional Sterategies**

Dong Ha KIM, Ewha Womans University, Korea

Plasmonics have been recognized as a promising platform that may premise the performance enhancement of diverse optoelectronics. Representative examples include the exploitation of plasmonic nanostructures for photovoltaic devices. It is noted that a universal paradigm to construct high-efficiency plasmonic solar cells with long term stability has not been established. Here, we propose a few strategies to develop viable plasmonic dye-sensitized solar cells and organic photovoltaic devices based on the integration of metal-graphene oxide core-shell nanostructures or lithographically-induced plasmonic nanopatterns.

Metal halide perovskites have rapidly advanced thin-film photovoltaic performance; as a result, the materials’ observed instabilities urgently require a solution. Using density functional theory (DFT), we show that a low energy of formation, exacerbated in the presence of humidity, explains the propensity of perovskites to decompose back into their precursors. We find, also using DFT, that intercalation of phenylethylammonium between perovskite layers introduces quantitatively appreciable van der Waals interactions. These drive an increased formation energy and should therefore improve material stability. Here we report reduced-dimensionality (quasi-2D) perovskite films that exhibit improved stability while retaining the high performance of conventional three-dimensional perovskites. Continuous tuning of the dimensionality, as assessed using photophysical studies, is achieved by the choice of stoichiometry in materials synthesis. We achieve the first certified hysteresis-free solar power conversion in a planar perovskite solar cell, obtaining a 15.3% certified PCE, and observe greatly improved performance longevity.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 6**

**Metal–Organic Frameworks: Potential Applications in Microelectronics**

Kuang-Lieh LU, Institute of Chemistry, Academia Sinica, Taiwan

Metal–organic frameworks (MOFs) have emerged as a promising class of materials with a variety of applications. Since MOFs contain both inorganic and organic components, they have been extensively studied for applications in gas storage, chemical separation, sensing, catalysis, drug delivery and biomedical imaging. MOFs with a high porosity, good thermal stability and ease of tunability of their structures make them a suitable choice for use as electronic materials in the years to come. Nevertheless, efforts directed towards their use in microelectronic applications have been much less. We have been investigating fundamental dielectric, semiconducting and optical properties of various MOFs and have summarized current state of the initial theoretical and experimental research which promises to pave the way for further studies of MOFs with interesting potential applications in microelectronics.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 7**

**STEM Moiré Observation of Ge/Si Produced by MBE and New Heating Method Using Plasma Technique**

Junji YAMANAKA, Chiaya YAMAMOTO, Kosuke HARA, Keisuke ARIMOTO, Kiyokazu NAKAGAWA, Center for Crystal Science and Technology, University of Yamanashi, Japan

Ge has a potential to be a base material for the high-speed transistors in a near future because of its high carrier mobility.

In order to realize high-speed devices using Ge, formation of Ge/Si hetero-structure is a practical road rather than using a bulk Ge crystal. Therefore it is important to grow high quality Ge thin films onto Si substrate. The key point is how to produce a Ge film which has both flat surface and high crystallinity. Recently our group proposed a new heating method using plasma technique. This new method enabled us to heat specimens quite rapidly. For example, we could heat the specimen up to 1000 C within 1 second. Thus we could anneal the Ge/Si specimen to remove defects located around the Ge surface before progressing the inter-diffusion between Ge and Si.

In general, TEM and STEM observations are useful in order to evaluate the crystallinity of thin films. However, usually it is not easy to show large area strain distribution using TEM/STEM method although it is a very important factor for the device performance. Recently, new STEM technique using moiré between STEM beam-scanning lines and lattice spacing was proposed by other researchers. (e.g., Yukihito Kondo and Noriaki Endo, Kenbikyo, Vol. 49, 2014, 226) This new method is quite useful to analyze lattice-space distribution for large area (e.g., about 10 square microns). We applied this technique to our specimens and it was revealed that the Ge thin films were uniformly relaxed on the Si substrates. It was also revealed that almost all dislocations were localized around the Ge/Si interface. In this presentation, we will show the experimental results using this new method together with other TEM/STEM observations.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 8**

**Magnetic-Levitation Characteristics of Materials on Motor-Driving Gyro in Low Alternately Magnetism**

Chen HSU, Zhi-yi ZHONG, Yi-jun HUANG, Yi-jun WANG, Zhi-ren XIAO, Lunghwa University of Science and Technology, Taiwan

Magnetic-levitation characteristics of various materials as rotors on motor-driving gyroscopes in low alternately magnetism are investigated. The magnetic materials of rotors include ferromagnetic, paramagnetic, superparamagnetic, and diamagnetic materials. All magnetic materials exhibit magnetization and increase with increasing rotating speed, especially for the linear relationship of superparamagnetic material. All tested materials show magnetic-levitation forces, including of diamagnetic material. Magnetic-levitation results in vertical forces on rotor of gyro stabilize rotating gyro, and speed determines the value of magnetic-levitation force. Superparamagnetic material, Fe3O4, prepared by so-gel method shows nano powder. The resulted magnetic-levitation force expresses widely linear range. The rotating stability was monitored with the size of a red laser spot. The size decreases and increases stability. Meanwhile, stability depends on rotating speed. It also depends on materials. Low magnetic materials, such as paramagnetic and diamagnetic materials, show high stability. In further, inversion recovery tests demonstrate improved stabilization of gyro for paramagnetic and superparamagnetic materials.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 9**

**Structure, Properties and Exfoliation of LaOBiS2 and Related Materials**

Akira MIURA, Hokkaido University; Nagao MASANORI, University of Yamanashi; Satoshi ISHII, Tokyo Denki University; Yoshikazu MIZUGUCHI, Tokyo Metropolitan University; Mikio HIGUCHI, Kiyoharu TADANAGA, Hokkaido University, Japan

BiS2-based layered materials, such as La(O,F)BiS2, have been extensively studied for their unique crystallographic and electronic structures and their various properties such as superconductivity and thermoelectronics. The BiS2 layer can be drewed as a distorted rocksalt structure, which is sandwiched by block layers. In this presentation, we show how the structure of BiS2 layer affect superconductive and thermoelectronic properties. The correlation among S-Bi-S length, angle and superconductivity is highlighted. We also show the fabrication of BiS2 nanosheets, which prospectively exhibit various properties including light absorption, electronic conduction, or other unprecedented properties.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 10**

**Close relationship between electrical properties and microstructure of semiconducting BaSi2 films**

Kosuke O. HARA, University of Yamanashi; Cham Thi TRINH, Nagoya University; Junji YAMANAKA, Keisuke ARIMOTO, Kiyokazu NAKAGAWA, University of Yamanashi; Yasuyoshi KUROKAWA, Noritaka USAMI, Nagoya University, Japan

For further large-scale deployment of photovoltaic power generation systems, it is strongly desired to produce a new type of high-efficiency solar cell with earth-abundant elements. BaSi2 semiconductor is attracting attention as a new absorber-layer material because of suitable optical properties and the abundance of constituent elements. For photovoltaic applications, it is very important to control the electrical properties. In this study, we modified the microstructure of evaporated BaSi2 films by two approaches and investigated these effects on the electrical properties of BaSi2 films. One is the usage of different substrate materials: Si(100) wafer, CaF2, and soda-lime glass. The other is to change the deposition rate of BaSi2.

Hall measurement revealed that carrier (electron) density of BaSi2 films on CaF2 and soda-lime glass substrates are considerably higher than those of the films on Si substrates. By cross sectional observation using transmission electron microscopy, it was found that the films on CaF2 and soda-lime glass substrates contain defective bottom layers of small grains, which were presumably fabricated by the reaction between Ba-rich vapor and the pre-deposited amorphous Si layer. It is thus suggested that the defective layer contributed to the high electron density of the BaSi2 films. Electron density increased also with decreasing deposition rate. Raman spectroscopy detected the increase of the full-width at half maximum of the Raman line of BaSi2, which indicates that the amount of defects is larger with lower deposition rates. Thus, films with more defects showed higher carrier density. From the above two investigations, it is concluded that the electrical properties of BaSi2 films are strongly related to their microstructure, and that electron density would be lower with less defective films. This is an useful insight toward the photovoltaic application of BaSi2.

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**Fri/12/23**

**Meeting Room No 204**

**Abstract ID: 11**

**Inverted Lead Halide Perovskite Thin-Film Based Solar Cells**

Sheng Hsiung CHANG, Research Center for New Generation Photovoltaics, National Central University, Taiwan

In this talk, inverted lead halide perovskite thin-film based solar cells will be discussed. The photovoltaic performance of perovskite based solar cells can be increased by optimizing the properties of the hole transporting layer (HTL), active layer and electron transporting layer (ETL). PEDOT:PSS thin films were used as the HTL in the inverted perovskite based solar cell. The work function of PEDOT:PSS thin films can be increased by manipulating the PEDOT molecular structure from a benzoid-like form to a quinoid-like form, which influences the open-circuit voltage (Voc) of solar cells. The lead halide perovskite thin film was deposited on top of the PEDOT:PSS/ITO using a fast deposition-crystallization method with different antisolvents. The properties of perovkite thin films strongly influence the short-circuit curent density (Jsc) of solar cells. PCBM and C60/BCP thin films were used to effectively extract the electrons from the photo-excited carriers in perovskite thin films. The experimental results shows that the coverage of the HTL on the perovskite thin film highly influences the fill factor (FF) of solar cells. Therefore, the high power conversion efficiency of perovskite based solar cells can be achieved by optimizing the HTL (Voc), active layer (Jsc) and ETL (FF).

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 1**

**Influence of Orientation and Spatial Arrangement of Ligand Biomolecules on Functionality after Immobilization on Solid Materials**

Hiroyuki IMANAKA, Koki DATE, Haruka MATOBA, Koreyoshi IMAMURA, Okayama University, Japan

Biomolecules such as protein, peptide, sugar chain and nucleic acid interact with each other in the cell while controlling its life activities. Therefore development of techniques that enables functional biomolecular immobilization on solid materials would be a good versatile way to improve various biotechnological applications. In this research, in order to maintain the function of ligand after immobilization with controlling its orientation, we focused on the newly proposed ligand immobilization method utilizing affinity peptide tag and proteinaceous cushion from hyperthermophiles.

A candidate cushion protein, homotrimeric CutA1, was selected from the databases to reduce direct interaction of ligand molecule with substrate surface and for relatively easy ligand preparation. Then the influence of orientation control and spatial arrangement of ligand biomolecule on interaction detection sensitivity, namely maintained function of ligand biomolecule, was examined by Enzyme-Linked Assay on phi-PS and by Quartz Crystal Microbalance on gold after ligand immobilization. The Interactions between StrepTagII (STII) and Streptavidin (SA) (Kd = 72 μM), and between VHHegfp and EGFP (Kd = 1.4 nM), were adopted as model of peptide-protein and protein-protein interaction, respectively. By investigating interactions with analyte on variously designed ligand immobilized surface, it was revealed that the interaction detection sensitivity was significantly increased not only by the conjugation of affinity peptide but also by using CutA1 as the cushion irrespective of solid substrate. In addition, in the case of very weak STII–SA interaction detection, constraint of ligand and insertion of artificial coiled coil structure drastically increased the sensitivity by more than tenfold when CutA1 was used for cushion, probably due to the alleviation of steric hindrance of interaction. On the other hand, in the case of VHHegfp–EGFP interaction detection, the highest detection sensitivity was observed in the case of immobilization of VHHegfp conjugated to C-terminal of affinity tag inserted CutA1.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 2**

**Enhancement of Two-Photon Absorption in a Molecule by Plasmonic Nanoantenna**

Toshiki OKA, Niigata University, Japan

Two-photon absorption has potential applications to various leading-edge techniques, such as two-photon microscopy and coherent control of molecular processes. The realization of efficient two-photon absorption requires simultaneous absorption of two photons. Generally, this can be achieved by controlling spatiotemporal feature of light, i.e., light focusing and/or light pulsing, so that the photon density interacting with molecules can increase. For many of interesting molecular processes, however, highly intense light might lead to deterioration and structural change of the molecules. Therefore, from the viewpoint of device applications, high excitation by low light intensity is preferable, however this is irrealizable in conventional methods.

Localized-surface-plasmon (LSP) nanoantenna provides a useful solution to this problem. LSP is the plasmon generated on the surface of a nanometer-scale metallic particle and greatly enhances the electric filed near the nanometals. In fact, the LSP nanoantenna has been applied to the enhancement of molecular fluorescence, where the LSP plays the role of light harvesting, the so-called antenna effect. The antenna effect of LSPs in single-photon process has been investigated in detail, however the antenna effect in two-photon process has been only recently discussed because the quantum-mechanical treatment of LSP is required.

In this presentation, we introduce a simple way to quantize the LSP and show that the LSP nanoantenna enhances molecular two-photon absorption.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 3**

**Photochemical Approach for Efficient Use of Photons; Highly Photosensitive Photochromic Compounds and Photoacid Generators**

TSUYOSHI KAWAI, National Institute of Advanced Industrial Science and Technology, Japan

Photochromic molecules are widely studied for future photoswitching and photomemory materials. Their photochemical sensitivity is determined by photochemical quantum yield, which is enhanced in our previous studies close to 100% in the terarylene derivatives. Currently, we are focusing on highly photosensitive photoacid generators, PAGs, which are based on the terarylene scaffold and reprivatized by introducing proton and conjugated anions unit at the reaction center carbon atoms. These compounds showed photochemical quantum yields of 50 to 70 %, which are two to three times higher than those of practical ones practically used in LSI-lithography processes. Our new PAGs are compatible to practical photopolymerization process of epoxy-resins and also to the chemically amplified photopolymer systems. We also studied oxidation-induced isomerization reaction of terarylenes. Some of terarylene derivatives exhibited spectral change along with the isomerization reaction upon chemical and electrochemical oxidation with extremely high efficiency. That is, one electron oxidation induces isomerization of 1000 molecules because of domino-like reaction mechanism. In this presentation, detailed mechanism and molecular design will be discussed.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 4**

**Impact of The Primary Structure on the Thermoresponsiveness of Amphiphilic Polymers in Water**

Yukiteru KATSUMOTO, Fukuoka University, Japan

Because of the recent development in the polymerization techniques, it has become possible to investigate the effects of the primary structure of polymers such as the configuration and tacticity on the solution properties in details. In this presentation, two examples will be shown: (1) tacticity effects on the phase boundary of poly(N-isopropylacrylamide) (PNiPAm) and poly(N,N-diethylacrylamide) (PNdEAm) in water and (2) differences between the alternating multiblock and triblock configurations in the micellization of amphiphilic polymers in water.

For the former subject, the stereospecific reversible addition-fragmentation chain transfer (RAFT) polymerization has been employed to prepare a set of well-defined polymer samples that have a similar molecular weight (Mn) and polydispersity (Mw/Mn) but a different meso diad (m) content. The phase boundary curve of PNiPA with a higher m content appears in a lower temperature region. The tacticity also gives an influence to the shape of phase boundary curves. On the other hand, the phase boundary curves for the stereocontrolled PNdEAms in water shifts to higher temperature with increasing m, and the shape of the phase boundary curve seems not to change depending upon the m value.

For the latter, we focus on the block copolymer of poly(ethylene oxide) (PEO) and poly(propylene oxide) (PPO). This kind of amphiphilic block copolymers has attracted keen interests for many decades because of the potential use as nonionic macromolecular surfactants and drug carriers. In contrast to PEO-PPO-PEO triblock copolymers, which are known as Pluronic or Poloxamer, the effects of alternating multiblock (AMB) copolymers on the solution properties have been much less investigated. The characteristics of the AMB configuration for amphiphilic copolymers are the following; (i) a low critical micelle concentration (< 10-5 M), (ii) a less population of unimer coexisting with micelle, and (iii) a low Tc of the aqueous solution.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 5**

**Simple Functionalization of Polymeric Materials by Charge-Transfer Interaction -Method and Fuel Cell Application**

Masamichi NISHIHARA, Next-Generation Fuel Cell Research Center (NEXT-FC), Kyushu University, Japan

We have developed new method for polymer functionalization using supramolecular interaction. In our study, we have applied charge-transfer (CT) interaction for polymeric materials. Although CT interaction is not strong interaction, it is known that multilayered CT complex showed higher affiliation constant than 1 : 1 CT complex. On the basis of this fact, we have applied CT complex in polymeric materials as a physical cross-linker

CT complex can be formed by structurally suitable electron-donating units and electron-accepting units. Therefore, CT complex hybrid materials can be developed by several CT complex combinations. As one of the combinations, we have reported CT complex hybrid films consisting of an electron-accepting polyimide (sulfoated polyimides, SPIs) and an electron-donating small molecules (dihydroxy napththalenes, DHNs). The CT complex hybrid films could be prepared very easily and simply, and the polymer properties could be controlled by changing the concentration of CT complex in the films. From these results, we confirmed that CT complex formed by SPI and DHN could work as a molecular glue in the films. And the one of the interesting point of CT complex method is that the position of CT complex can be controlled in molecular level. Therefore, we can design the molecular structures of CT complex hybrid materials in order to introduce functions into the polymeric materials.

As one of the applications of CT complex hybrid films, we applied this method to develop novel polymer electrolyte membranes (PEMs) for polymer electrolyte fuel cell (PEFC) application. The obtained materials showed high performance as alternative PEMs for PEFC.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 6**

**Magnetism of Mn1-Xfexb Alloys: First-Principles Electronic Structure Calculations**

Po-Han LEE, Affiliated Senior High School of National Taiwan Normal University; Tzu-Han CHEN, Chung Shan Medical University; Yi-An CHEN, Affiliated Senior High School of National Taiwan Normal University; Ta-Wei WANG, National Tsing Hua University; Shih-Wei WANG, Stevenson School, Pebble Beach, CA USA; Kuan-Lin CHEN, Cornell University, NY USA; Wan-Sheng SU, National Taiwan Education Center, Taiwan

The electronic structures and magnetic properties of the transition metal monoborides of Mn1-xFexB, at a scale 0≤ x ≤ 1, are investigated. Virtual crystal approximation (VCA) based on the density-functional theory (DFT) with generalized gradient approximation (GGA) was utilized to compute the ferromagnetic variation of transition metal monoborides. Mn0.9Fe0.1B exhibits the state of the highest ferro-magnetic moment instead of the state of anti-magnetic moment existing in Mn element. Our findings from the first-principle spin-polarized calculations are in agreement with the Stoner model and also with well-known experimental data. Finally, the properties of ferrimagnetism with GGA + U are also discussed.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 7**

**Large-gap topological insulators A2TePoO6 (A = Ca, Sr, Ba) with effective spin-orbit coupling**

Po-Han LEE, Affiliated Senior High School of National Taiwan Normal University, Taiwan; Jian ZHOU, Nanjing University, China; Yin-Kuo WANG, National Taiwan Normal University, Taiwan

Based on first-principle calculations from which Wannier functions are constructed to calculate the surface state spectrum, we predict the new topological insulators with the larger bulk band gap ~0.4 eV in double perovskite materials A2TePoO6 (A = Ca, Sr, Ba). The gaps from A2TePoO6 are generated by the effectiveness of spin-orbital coupling existing in the band structure. Due to the reason of spin-orbital coupling being absent, the fact that the conduction and valence bands of p-character contact at Fermi energy and an s-band lies above the conduction band nearly results in a nontrivial Z2 state if an infinitesimal gap presents. Therefore, the spin-orbital coupling is able to effectively generate a sizeable gap without going through the topologically trivial phase. The proposed materials are chemically inert and exhibit TI state without tuning of the Fermi level, providing a rich platform to design new TI-based electronic devices.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 8**

**A Computational Study of Photosynthesis Proteins: Network Views of Photosystem Complexes From Sequence Similarity**

Geng-Ming HU, National Taiwan Normal University, Taiwan

Photosynthesis is the key process to transform solar energy into chemical energy in plants. In this process, carbon dioxide and water converted into oxygen and carbohydrate by the catalysis of light, which generated fuel and nutrition and also contributed to carbon fixation. The core unit to carry out the primary photochemistry of photosynthesis is photosystem, which is a membrane protein complex in the thylakoid membranes of chloroplast. The main structure of photosystem complex contains two kinds of membrane proteins: reaction centers and light harvesting proteins around them.

The biological functions of membrane proteins are strongly related to their three-dimensional (3D) structures. However, caused by the difficulties in crystallizing membrane proteins, only several hundreds of structure have been derived so far. To face with the difficulty of solving 3D structure of membrane proteins by experiments, there exists a great motivation for developing computational and statistical methods to investigate about them. One of the novel and effective methods is to study the sequence-structure-function relationship from the protein sequence similarity network of huge biological data. The full information of known amino sequences may provide some guides for the unknown information of 3D structures.

In this talk I will demonstrate the recent work about analyzing the protein sequence similarity network of over 6000 photosystem-related sequences. The protein data was clustered by a fast and unsupervised clustering method, minimum span clustering (MSC), for analyzing the sequence–structure–function relationship. The network was visualized by minimum spanning tree method to see the network pattern of photosystem sequence similarity network. We looked forward the network view of enormous protein sequences may provide some insights into the development of artificial photosystem synthesis.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 9**

**Materials by Design for Li ion battery and fuel cell Applications**

Kyeongjae CHO, The Univesity of Texas at Dallas, USA.

Computational materials science (CMS) is a relatively recent development as an interdisciplinary area among physics, chemistry and mathematics with practical applications in diverse engineering and technology. Experimental materials study may be as old as human history, and the theoretical materials science research also has a long history connecting back to alchemy. Practical computational study of the governing equations of material systems (Newton’s equation for classical systems and Schrödinger’s equation for quantum mechanical systems) became possible only during the 2nd half of the 20th century. Diverse computational methods are developed and applied to diverse material systems. As the predictive capability of CMS increases rapidly, there is a vision of designing new materials before or along with experimental development. In the USA, such vision was captured by the Materials Genome Initiative (MGI). At the core of MGI, the mathematical capacity of solving Newton’s and Schrödinger’s equations of model material system plays a critical role. However, there are many outstanding challenges to realize the vision of MGI.

In this talk, we will discuss about the application of ‘materials by design’, to battery and fuel cell materials research problems. I will discuss the design and validation experimental research on high capacity cathode materials for Li ion battery (LIB) and design of cathode catalyst for fuel cell (FC) applications. Using the first-principles density functional theory method, we have designed electrode materias for LIB and FC cathodes, and subsequently performed experimental studies to validate the material designs. Through the integrated material design - experiment research, we have developed highly efficient cathode materials. I will address the key challenges in achieving this promising vision of 'materials by design' and how we are developing material solution (design and experimental validation) to overcome those challenges.

This work was supported by DOE, Samsung, WPM and KETEP projects.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 10**

**Thixotropic Gel Polymer Electrolytes Based on Poly(vinylidene fluoride-co-hexafluoropropylene)/Hydroxypropyl Celluose Blend for Screen-Printing Process of 4V-Class Flexible Lithium Rechargeable Batteries**

Young-Gi LEE, Dong Ok SHIN, Ju Young KIM, Kwang Man KIM, Ji Min OH, Ju Mi KIM, Electronics & Telecommunications Research Institute(ETRI), Korea

Flexible lithium rechargeable batteries have received a lot of attention together with the rapid development of bendable or even foldable electronic devices such as flexible display, e-paper, foldable/bendable cellular phone, wearable PC, and so on. Recent efforts on unique and flexible battery designs are working towards advanced batteries that can be applied to devices and applications without limiting their form factors. Recently, several groups have demonstrated promising results in the area of flexible lithium rechargeable batteries using various types of materials and processes. Importantly, liquid electrolytes limit choices in cell design of flexile lithium rechargeable batteries due to their fluidic characteristics and the need of separators in cell assembly even though their excellent electrochemical performance and good physical contact with electrode. This situation motivates us to develop self-supporting electrolytes paste that can be prepared on the electrode surface directly via roll-to-roll screen-printing process. In this work, we have newly designed novel polymer electrolytes with thixotropy based on Poly(vinylidene fluoride-co-hexafluoropropylene)(PVdF-HFP)/Hydroxy-propyl cellulose(HC) blend. The thixotropic gel polymer electrolytes pastes were composed of PVdF-HFP/HC blend and liquid electrolytes. To control the solvent evaporation time and medium viscosity, NMP/Acetone co-solvent was used. Adhesive gel polymer electrolytes were prepared on the electrode surface throughout direct screen-printing. The maximum ionic conductivity is 3.6mS/cm at 25℃ and no significant decomposition of any components in the thixotropic gel polymer electrolytes takes place below 4.5V.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 11-A**

**Thermoelectric Materials for Waste Heat Recovery**

A.L. Roy VELLAISAMY, Joseph C. K. WONG, City University of Hong Kong, Hong Kong

Thermoelectric (TE) materials directly convert thermal energy into electrical energy, offering a promising solid-state solution for clean energy application. TE generators needs less area and less expensive in construction and which can be operated in various kinds of environmental conditions. Therefore, TE generator could be much more attractive for waste heat regeneration. For thermoelectric devices to make a significant impact on energy and environment, the major impediment is the efficiency and the cost of current thermoelectric materials. In this talk, I focus on inexpensive doped nanostructured TE materials and TE power generator modules. On the other hand, thermoelectric generators (TEG) have long been relegated to use in space-based or other niche applications, but are now being actively considered for solid state cooling systems. We construct a solid state air conditioner consisting of TEGs to extract heat from the lift with the use of the electricity. No noise and water are produced during the cooling process; therefore, such an instrument is extremely promising for thermoelectric (i.e. TE) cooling application because it has outstanding cooling capacity and rapid cooling process as well as long working life. In addition, the refrigeration and air conditioning technology based on thermo-electricity is “green” initiatives due to the absence of a harmful chemical refrigerant.

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**Fri/12/23**

**Meeting Room No 202**

**Abstract ID: 11-B**

**Adhesion and Interphase of Polyolefins**

Takashi NISHINO, Kobe University, Japan

Structure and properties of surface and interphase of crystalline polymers were investigated from different viewpoints / principles / space resolutions using various surface/interphase analyses such as a small angle incidence X-ray diffraction (a grazing incidence X-ray diffraction), a synchrotron micro-beam X-ray diffraction, a nano-Raman scattering, an atomic force microscopy, a scanning thermal probe microscopy, an electron microscopy, an X-ray CT and so on. The surface crystallinity of isotactic polypropylene (it.PP) was found to be lower compared with that of bulk, which has been recognized as weak boundary layer for half century. Low crystallinity was also observed for many other polymers, such as poly(vinyl alcohol), polyimide, polyamides, polyesters. Even after adhering it. PP with polyethylene (PE), the low crystallinity of it.PP was maintained at the interface. The adhesion strength between it.PP and PE decreased with the increase of annealing temperature, which synchronized with the decrease of the thickness of interphase between it.PP and PE. On the contrary, both the adhesion strength and the thickness of interphase between PE and PE increased with annealing. The nanometer order thickness has been reported as the surface / interface layer through polymer diffusion mechanism. However, the thickness observed in this study were in the order of micrometer, so terms “surface / interface” should be replaced with the terms “surphase / interphase”. The surphase / interphase structure could be well correlated to adhesion properties of polyolefins.

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**Sat /12/24**

**Meeting Room No 205**

**Abstract ID: 12**

**Substitutional Boron Doped Single Layer Graphene**

Yoong Ahm KIM, RCAST, Chonnam National University, Korea

In recent years, chemical doping with foreign atoms has been the hottest topic as an effective tool to tailor the intrinsic properties of graphene. It is natural to select boron atom as the promising substitutional doping agent with regard to graphene since boron is the neighbouring to carbon in the periodic table, the atomic radius of boron is roughly close to that of carbon and boron is trivalent with a coplanar orbital sp2 structural identical to graphene. Herein, we prepared the substitutionally boron doped single-layer graphene via mechanical exfoliation of boron doped graphite that is prepared by thermally treating graphite with boron compound at 2450C using a graphite a graphite furnace. We proved that the substitutional boron atoms act like vacancies in Raman lines because of the large B-C bond length. In addition, we tried to extract boron atoms using high temperature thermal treatment to creae point like defects in single layer graphene. The effect of the boron doping and de-doping on graphene was evaluated usign optical tool in detail.

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**Sat /12/24**

**Meeting Room No 205**

**Abstract ID: 13**

**Enhancement of thermoelectric properties of oxide and intermetallic materials and modules**

Ryoji FUNAHASHI, National Institute of Advanced Industrial Science & Technology, Japan

In order to improve thermoelectric properties, Ca2.7Bi0.3Co4O9 (Co-349) bulks were prepared by hot-forging to make the bulk density and the grain alignment high. The repetition of hot-forging is effective to suppress the electrical resistivity. As a result, the power factor is higher than 0.6 mW/mK2 for the sample hot forged twice, which corresponds to a factor of 1.5 of the sample hot forged once. Long life time test has been carried out for oxide thermoelectric modules composed of the Co-349 and CaMn0.98Mo0.02O3 (Mn-113) bulks for the p-type and n-type legs, respectively up to 1073 K for the hot-side temperature in the air atmosphere. A cooling jacket composed of Cu was put on the other side the module and cooled at 293 K by water circulation (TC). Measurement of the power generation, in which current (I)-voltage (E) lines and I-power (P) curves, was carried out in air by scanning the load resistance using a DC power supply device in every 2 h for totally one month. The load resistance was connected continuously to generate 1 A from the module and the generated voltage was measured in every 1 min between scanning the load resistance. Namely, two different output powers, maximum power (Pmax) and power in a condition of 1 A output (P1A) by scanning the load resistance and measuring voltage respectively, were measure for one month in each TH. Both Pmax and P1A increase with TH. Although the Pmax and P1A change due to the changes of temperature difference between TH and TC in the initial stages for each TH, no degradations in both generated powers are observed up to 1073 K of TH.

This work was supported by Thermal Management Materials and Technology research Association (TherMAT), Japan.

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**Sat /12/24**

**Meeting Room No 205**

**Abstract ID: 14**

**Fabrication of high performance cable-type supercapacitor using NiCo2S4 nanosheets decorated 3D-Ni/Ni wire**

Balasubramaniam SARAVANAKUMAR, Santhana Sivabalan JAYASEELAN, Tae Hoon KO, Jiyoung PARK, Hak-Yong KIM, Byoung-Suhk KIM, Chonbuk National University, Korea

The development of hierarchical structured porous film based current collector has created huge interest in the area of energy storage, sensing, and electrochemical catalysis due to higher surface area, good electrical conductivity and porous nature increases the electrode-electrolyte interface. Supercapacitor is class of energy storage device, which have higher power density, long cycle life and fast charge- discharge. Advancement in electronic devices reduced the operating voltage, which opens up the possibility to fabricate portable and wearable devices combined with energy storage device. For wearable application, the energy storage device should meet some key properties like light weight, flexible, higher energy and power density and higher rate and life time. In this study, we fabricated cable type supercapacitor using NiCo2S4 nanosheets decorated 3D Ni/ Ni wire. We fabricated porous 3D Ni over Ni wire by dynamic hydrogen bubble templated electrodeposition method. Further, we successfully coated NiCo2S4 nanosheets by simple, low cost electrochemical deposition. The fabricated hierarchal electrode was well characterized by physiochemical method such as X-ray diffraction pattern (XRD), Field effect scanning electron microscopy(FE-SEM), and energy dispersive X-ray (EDX) and electrochemical properties such as cyclic voltammetry (CV), galvanostatic charge-discharge analysis, electrochemical impedance (EIS) analysis. The fabricated electrode showed an excellent capacitive performance and good rate capability. In this presentation I am going to discuss in details about the fabrication and measurement of cable type supercapacitor.

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**Meeting Room No 205**

**Abstract ID: 15**

**Fabrication of Biomass-Derived Composite Electrodes for Supercapacitors**

Danyun LEI, Hak-Yong KIM, Byoung-Suhk KIM, Chonbuk National University, Korea

Biomass-derived materials, like kenaf and lignin, are potential materials for supercapacitors due to their unique properties such as low-cost, eco-friendly and chemical stability. In this study, we prepared two kinds of biomass-derived composite electrodes. One is polyaniline-decorated kenaf-derived 3D porous carbon (PC). Firstly, we carbonized two different kinds of kenafs (kenaf stem and NaOH retting kenaf) to obtain the porous carbons (KPC1 and KPC2), and then PANi was synthesized by in-situ polymerization in the presence of KPCs. The 3D porous structures of the obtained KPCs were confirmed by SEM images. The SEM image of PANi-decorated KPCs (PANi/KPCs) demonstrates that the PANi was uniformly formed as fibrous and nano-textured structures on the surface of the KPCs. The specific capacitance of PANi/KPC1 and PANi/KPC2 were found to be around 76 F/g and 136 F/g, which was obviously enhanced capacitance than pure KPC1 (26 F/g) and KPC2 (37 F/g), respectively. Further, it showed good cycle stability retaining more than 97% of their capacitance after 2000 charge-discharge cycles at a scan rate of 5 mV/s. The other is NiCo2O4 decorated PAN/lignin carbon fibers. Firstly, we prepared the polyacrylonitrile (PAN)/lignin nanofibers with various contents of lignin, which were simply fabricated from different ratios of PAN/lignin blended solutions via electrospinning. Then, the stabilization and carbonization process were utilized to obtain the PAN/lignin carbon fibers (CFs). Finally, the NiCo2O4 decorated PAN/lignin carbon fibers (NiCo2O4/CFs) were fabricated via a facile hydrothermal method without any toxic reagents. The SEM images confirmed that the flower-liked NiCo2O4 nanostructures were homogeneously grown on the surface of every fibers. The obtained NiCo2O4/CF with 30% lignin exhibited excellent electrochemical properties. The NiCo2O4/CF showed a specific capacitance of 558 F/g at a current density of 1A/g. In addition, this electrode maintained 53% capacitance after 1000 cycles at a current density of 10 A/g. .

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**Meeting Room No 205**

**Abstract ID: 16**

**Fabrication and Supercapacitive Properties of Polyprrole@NiCo2O4 Nanoneedles/Carbon Fiber Papers via hydrothermal and electrochemical depositon methods**

Tae-Hoon KO, Balasubramaniam SARAVANAKUMAR, Chonbuk National University, Korea; Min-Kang SEO, Korea Institute of Carbon Convergence Technology, Korea; Hak-Yong KIM, Byoung-Suhk Kim, Chonbuk National University, Korea

Supercapacitors are expected to become a promising energy storage device, because of higher power density, life times, fast charging/discharging compare to battery. Recently, electrochemical capacitor has been extensively studied to improve the performance supercapacitor using various electroactive materials such as metal oxide, carbon materials and conducting polymers. Further, the research required in the development of new electroactive materials with multiple oxidation state and hybrid with conducting polymers, carbon materials to achieve the energy density of supercapacitor. So far, metal-conducting polymer nanocomposites have been often used as a electrodes for electrochemical supercapacitors owing to their good electrochemical properties, low density and high conductivity and large active surface area. In this work, we have fabricated NiCo2O4-polypyrrole (NiCo2O4-PPy) nanohybrid on carbon fibre paper (CFP) via a hydrothermal and electrochemical deposition method. The as-prepared NiCo2O4-PPy/CFP showed maximum specific capacitance of 910 F/g at current density of 1.0 A/g. In addition, it showed good charging/discharging cycle stability and capacity retention up to 88.0% after 10000 cycles. Therefore, NiCo2O4-PPy/CFP composites could be successfully utilized for high performance supercapacitor applications.

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**Meeting Room No 205**

**Abstract ID: 17**

**MWCNT Interconnected Binary, Ternary Metal Oxide Aerogel Electrodes for Supercapacitor Applications**

Santhana Sivabalan JAYASEELAN, Balasubramaniam SARAVANAKUMAR, Byoung-Suhk KIM, Chonbuk National University, Korea

Nowadays, the researchers have more attention in the fabrication of highly porous materials due to their higher efficiency, activity and environmentally friendly nature. In this context, aerogel is potential candidature materials because it consists ultralow density mesoporous solids and exhibits high surface area and porosity. Based on the preparation materials aerogels are named as organic and inorganic aerogels. Resorcinol-Formaldehyde based organic aerogel materials showed higher electrochemical properties compared with other conventional materials used for aerogel. In inorganic aerogels, Metal oxide aerogels are 3-Dimentional architecture with interconnected metal oxide nano particles with mesoporous structure. In present work, we have prepared ternary metal(Ni,Mn,Co) oxide/MWCNT nanocomposite aerogel by simple sol-gel approach followed by supercritical CO2 drying. The prepared material exhibited relatively high crystallinity, and interconnected metal oxides were confirmed by X-ray diffraction and FE-SEM studies. The prepared ternary metal oxide composite aerogel showed higher specific capacitance as 262 F/g at current density of 0.1 A/g. It exhibited relatively high stable nature upto 1000 potential cycles.

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**Meeting Room No 205**

**Abstract ID: 18**

**Design of Nano-Catalysts for the use of Formic acid as a Hydrogen Energy Storage Material**

Kohsuke MORI, Osaka University, Japan

Hydrogen (H2) has been regarded as an ultimate ideal clean energy to solve the long-term environmental and energy issues originated from fossil fuels. There has been emergent demand for the exploration of suitable hydrogen storage system based on highly efficient heterogeneous catalysts that can release hydrogen in situ under mild reaction conditions. Among investigated, formic acid (HCOOH), which is a liquid at room temperature and contains 4.4 wt% hydrogen, is one of the major products formed during biomass processing and is widely recognized as a non-toxic and convenient hydrogen carrier for fuel cells. Additionally, carbon-neutral hydrogen storage cycle can be attained when formic acid can be regenerated via CO2 hydrogenation.

We have developed the PdAg and PdCu alloy nanoparticle catalysts for the efficient production of high-purity H2 from formic acid dehydrogenation. Experimental and DFT calculation studies revealed not only the synergic alloying effect but also cooperative action by the amino-functional groups in the vicinity of the active metal centers plays crucial roles in achieving exceptional catalytic performances.

On the contrary, a stable and well-defined single-atom Ru catalyst on the surface of a layered double hydroxide (LDH) was proven to be efficient for selective hydrogenation of CO2 to formic acid under mild reaction conditions. The electron-donating ability of triads of basic hydroxyl ligands as well as a CO2 concentration effect result in a significant positive influence on the catalytic activity.

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**Meeting Room No 205**

**Abstract ID: 19**

**Developments of Titanium Dioxide Mesocrystals for Heterogeneous Photocatalysis**

Takashi TACHIKAWA, Kobe University, Japan

Mesocrystals are superstructures with a crystallographically ordered alignment of nanoparticles. Owing to their well-ordered structures, mesocrystals have unique characteristics such as a high surface area, pore accessibility, and good electronic conductivity. This paper presents recent developments of titanium dioxide mesocrystals in the fields of heterogeneous photocatalysis. Anatase titanium dioxide mesocrystals were newly synthesized by a topotactic structural transformation, and their structures were fully characterized. The photoconductive atomic force microscopy, time-resolved diffuse reflectance spectroscopy, and single-molecule, single-particle fluorescence spectroscopy were utilized to determine the charge transfer dynamics in the mesocrystals. For example, novel visible-light-responsive photocatalysts were synthesized by the modification of titanium dioxide mesocrystals with plasmonic gold nanoparticles by a simple impregnation method. It was found that a substantial part of electrons injected from modified gold nanoparticles to the mesocrystals by the surface plasmon excitation, directionally migrate from the basal surfaces to the edges of the plate-like mesocrystals through the titanium dioxide nanocrystal networks and are used for further surface reactions. As compared to the conventional nanoparticle systems, the superstructure-based systems could largely enhance charge separation and had remarkably long-lived charges, thereby exhibiting greatly increased photoconductivity and photocatalytic activity.

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**Sat /12/24**

**Meeting Room No 205**

**Abstract ID: 20**

**Stable n-doped CNTs with enhanced thermoelectric properties**

Yoshiyuki NONOGUCHI, Nara Institute of Science and Technology, Japan

Carbon nanotubes (CNTs) have recently been studied for the construction of wearable thermoelectric power generators. However, the absence of air- and thermally-stable n-type CNTs has hindered the development of practical thermoelectric devices composed of P-N series circuits. Here we solve this challenge by using noncovalent bonding chemistry. We report on stable and efficient n-type nanocarbon doping based on simple salts: ordinary halide and hydroxide anions with tetraalkylammonium cations and cationic crown ether complexes with alkali ions. Thermoelectric properties measurements revealed that various ordinary salts convert p-type CNTs to air-stable n-type forms efficiently. In particular, n-type CNTs were effectively stabilized by the coordination of alkali metal-crown ether host-guest complexes. This material showed excellent n-type thermoelectric properties with a power factor exceeding 200 uW/K2, and unprecedented thermal stability in air for more than one month at 373K. This air-stable n-type conductors were implemented in the thermoelectric series circuit, enabling the powering of a commercially-available LED upon hand-blower heating.

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**Meeting Room No 205**

**Abstract ID: 21**

**Principle and application of the plasma electrochemistry: A Novel Chemical Process for the Synthesis and Assembly of Nanomaterials**

Seung Whan LEE, National Fusion Research Institute, Korea

Electrochemical reactions are typically initiated at the interface of a solid metal electrode and ionic electrolyte. A small number of experiments, dating back to more than 100 years ago, have suggested that plasmas can be used as a gaseous electrode to mediate electrochemical reactions at the surface of liquids or thin films. However, plasmas are normally operated at low pressure which limits the scope of these experiments and their applications. Recently, plasmas formed at sub-millimeter spatial scales, microplasmas, operate stably and close to non-thermally at atmospheric pressure and are a source of ions, electrons, and other electronically excited states at ambient conditions. Overall, these features make microplasmas suitable for novel electrochemical applications where gas-phase species (e.g. electrons) in the plasma can directly interact with ionic aqueous electrolytes to initiate redox reactions.

Here, I will present the fundamentals of plasma electrochemical reactions and their applications for nanomaterial synthesis and patterning. Metal cations in solution such as Ag+ and Au3+ are electrochemically reduced by the plasma to solid metal, resulting in the formation of metal nanoparticles without any chemical reducing agent. Alternatively, thin films of metal cations dispersed on a polymer are electrochemically reduced by a rastered microplasma. This has led to the development of an extracted discharge which combined with masking techniques facilitates pattern transfer at sub-micron scales. Details of these various approaches will be discussed in detail, including materials characterization and potential applications

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**Sat /12/24**

**Meeting Room No 205**

**Abstract ID: 22**

**Improvement in the thermal resistance of polymers by the addition of carbon nanotubes as a thermally stable radical scavenger**

Seisuke ATA, Advanced Industrial Science and Technology, Japan

Elastomer (rubber and TPE) is an excellent material, but its usage has been limited due to its low heat, chemical, vapor-resistance. In a high-temperature condition, elastomer decomposes due to the heat radicals generated by the bond cleavage reaction. In order to improve the thermal-resistivity of elastomer, it is necessary to stabilize or quench the radicals. Carbon nanotubes (CNTs), which are known for their excellent radical scavenging ability.

In 2004, we developed the super-growth chemical vapor deposition technique to synthesis high-purity, long and exclusively single walled CNTs. The growth efficiency of this technique is superior to other SWNT enabling industrial mass production (in ton-scale), an aspect which will soon become reality. Furthermore, the single wall carbon nanotubes synthesized using this technique (SG-SWNT) exhibits several unique properties such as high aspect ratio, high surface area, high purity and good dispersibility, making them one of the best available conductive fillers for the development of composites. Therefore, we added SG-SWNTs to fluorinated rubber which has higher thermal conductivity. The upper limit of the temperature for continuous use was increased from approximately 200 to 280 oC with the addition of the small amount of SG-SWNTs. This technology would make it possible to easily improve the heat resistivity of rubber and would expand their use in a variety of applications that were previously limited due to the issues of thermal-resistivity.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 12**

**Aluminum-based Plasmonic Nanostructures for Highly Sensitive Biosensors**

Kuang-Li LEE, Pei-Kuen WEI, Research Center for Applied Sciences, Academia Sinica, Taiwan

Nanostructure-based surface plasmon resonance (SPR) sensors are capable of real-time, label-free, and multiplexed detections for chemical and biomedical applications. Recently, the studies of nanostructure-based aluminum biosensors have attracted a large attention because aluminum is a more cost-effective plasmonic material and relatively stable. However, the intrinsic properties of aluminum metal, having a large imaginary part of the dielectric function and a longer electromagnetic field decay length, limit its sensing capability. Here we show that capped aluminum nanoslits fabricated on plastic films using hot embossing nanoimprint lithography can provide tailorable Fano resonances. The transmission spectrum was modulated by changing the ridge height of nanostructures and the deposited metal film thickness. For refractive index sensing, a period of 470 nm capped aluminum nanoslits generated a peak resonance with a bandwidth of 2.7 nm and reached a figure of merit up to 150. Its intensity sensitivity was up to 29,345 %/RIU (refractive index unit). For bio-layer detections, the surface sensitivity was 2.58 nm/nm, and intensity sensitivity for thickness was 90 %/nm. The limit of detection (LOD) of thickness reached 0.018 nm. The protein-protein interaction experiments verified the high sensitivity of the structures and LOD of concentration was 236 fg/mL. Such low-cost and high-sensitivity capped aluminum nanoslits can benefit real applications of nanostructure-based sensors.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 13**

**Photoconversion Properties of Thin Film Photovoltaics Using a Soluble Zinc Phthalocyanine**

Hitoshi MIZUNO, Takemasa TSUTSUI, Kazunori NAGANO, Ichiro HIROMITSU, Shimane University, Japan

Since the first report on heterojunction-type organic solar cells using a phthalocyanine by Tang in 1986, the phthalocyanines have been widely used for the organic solar cells owing to their long exciton diffusion length, large absorption coefficients, high charge generation efficiency and high thermal stability at room temperature. In general, the phthalocyanine-based organic solar cells can be fabricated by vacuum deposition techniques due to their poor solubility to organic solvents. Meanwhile, soluble zinc phthalocyanine-based photovoltaic cells have not yet been extensively studied because of their low crystallinity films.

In this study, we performed the characterization of the solar cells using the soluble zinc phthalocyanine, ZnPc(tert-butyl)4 (ZnPcTB). To investigate the effects of the organic solvents on the photovoltaic properties, the ZnPcTB was dissolved in dimethyl sulfoxide (DMSO), tetrahydrofuran (THF), ethyl acetate and a mixture of chloroform (CF) and chlorobenzene (CB) (CF:CB=3:1). The solar cell device consists of ITO / ZnPcTB / 3,4,9,10-perylenetetracarboxylic bis-benzimidazole (PTCBI) (50nm) / In (20nm) / Al (30nm). The ZnPcTB layer was prepared by a spin-coating method. The PTCBI, In and Al thin films were fabricated by the vacuum deposition. In the solar cell prepared by the mixture of CF and CB, higher photoconversion efficiency of 6.39×10^-4 % was obtained in comparison with other solar cells. The difference of the conversion efficiencies between the fabricated solar cells is discussed in terms of molecular aggregation and aggregation number in the films.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 14**

**High-Resolution Cathodoluminescence Scanning Transmission Electron Microscopy on Functional Plasmonic Nanopores**

Takumi SANNOMIYA, Tokyo Institute of Technology, Japan

Control of the optical properties of nano-plasmonic structures is essential for high-throughput biosensing platforms. Realization of such nano-optical devices requires optical couplings of various nanostructured elements and field confinement at the nanoscale. In particular, nanopores have recently received considerable attention because they can realize highly sensitive sensor platforms with liquid flow through configuration plus filtering function. However optical properties of such coupled nanopore/hole system have not yet fully explored or understood. Here, we present a systematic study of optically coupled plasmonic nanopores using cathodoluminescence by scanning transmission electron microscopy (CL-STEM) as well as some sensing and filtering application examples. The nanopores are fabricated by colloidal lithography and film transfer by wet etching of the sacrificial layer. With this method we are able to produce ultra-thin free-standing film structures with pores. For liquid flow-through configuration with high conductance, it is necessary to achieve such ultrathin membranes. For CL-STEM measurement, 80 kV acceleration was used to avoid possible damage due to relatively high beam current. (5nA) Even with this high current and low acceleration voltage, spatial resolution around 1 nm can be achieved thanks to the aberration corrector equipped to STEM. Depending on the electron beam position it is possible to image local optical resonances. As a simplest coupling configuration, we observed nanopore pairs which show symmetric and antisymmetric coupling. The observed symmetric coupling mode, approximated as a pair of facing dipoles, appeared at a lower energy than that of the anti-symmetric coupling mode, indicating that the facing dipoles attract each other. The anti-symmetric coupling mode splits into the inner- and outer-edge localized modes as the coupling distance decreases. These coupling behaviors cannot be fully explained as simple inverses of coupled disks. Symmetric and anti-symmetric coupling modes are also observed in a short-range ordered pore array which we use for sensing.

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**Meeting Room No 204**

**Abstract ID: 15**

**Time-resolved 3D observation of nanoscale plastic deformation in transmission electron microscopy**

Satoshi HATA, Kyushu University, Japan

Transmission electron microscopy (TEM) is a powerful tool for elucidating the relationship between material properties and nanostructures. There are some trends in advanced TEM methods. For example, electron tomography (ET), which is a three-dimensional (3D) imaging method in TEM, is an effective solution for detailed nanostructural observation of material morphologies when conventional two-dimensional (2D) observation is not satisfactory. In situ TEM, which is a real-time imaging method in TEM, is promising for directly observing how materials behave under real operative conditions such as heating, cooling, straining, magnetizing, etc. As a new TEM imaging method that combines ET and in situ, we are developing a time-resolved 3D imaging system for nanoscale plastic deformation behavior of a sample in TEM. Here, details of the system [1, 2] and its application to Sn-Pb solder alloy [2] will be reported.

This work was supported by the Japan Science Technology Agency (JST) “Development of systems and technology for advanced measurement and analysis” program.

References

[1] K. Sato, H. Miyazaki, T. Gondo, S. Miyazaki, M. Murayama and S. Hata, "Development of a novel straining holder for transmission electron microscopy compatible with single tilt-axis electron tomography", Microscopy, 64, 369–375 (2015).

[2] S. Hata, S. Miyazaki, T. Gondo, K. Kawamoto, N. Horii, K. Sato, H. Furukawa, H. Kudo, H. Miyazaki and M. Murayama, "In situ straining and time-resolved electron tomography data acquisition in transmission electron microscopy", under review.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 16**

**Anisotropic strain engineering of Si/Ge heterostructures**

Kentarou SAWANO, Tokyo City University, Japan

Ge has emerged as a promising material for both high mobility CMOS channels and photonic devices. For these applications, strain introduction and its precise control are key technologies of great importance to attain higher performances. Both tensile and compressive strain can be induced biaxially in Ge films through epitaxial growth on Si substrates. However, uniaxial strain, which is expected to additionally improve electrical and optical properties, has been impossible to be incorporated in the Ge film only via the epitaxy. We have developed selective ion implantation method, which enables us to grow SiGe buffer layers possessing uniaxial strain in micro-meter-order wide region. In this method, ions are implanted selectively on a Si substrate and subsequently a SiGe layer is grown on the Si substrate. The SiGe in the implanted area is selectively strain-relaxed and provides stress to adjacent SiGe in the unimplanted area, leading to uniaxial strain relaxation. It is difficult, however, to grow Ge on Si directly due to the large lattice mismatch. Therefore, in this study, we perform the selective ion implantation with stripe patterns on Ge substrates or Ge (SiGe) virtual substrates fabricated on Si substrates with two-step growth method. SiGe and Ge layers are grown on the implanted Ge and SiGe substrates, respectively. The selective strain relaxation only in the implanted area is demonstrated and uniaxial strained channels are obtained, which is highly expected for applications to high mobility channel MOSFETs.

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**Meeting Room No 204**

**Abstract ID: 17**

**Hydrogen adsorption on electron-doped fullerenes observed with helium atom scattering**

Masahiro SASAKI, Yoichi YAMADA, University of Tsukuba, Japan

Hydrogen is a key element for hydrogen society. However, it is known that hydrogen is quite difficult to detect by means of usual analytical methods using electrons as probe particles because the scattering cross section of hydrogen against electron is very small. In this paper, we demonstrate that helium atom scattering (HAS) is a powerful technique to observe hydrogen adsorbed on surfaces and we also present the experimental results that hydrogen is adsorbed on electron-doped fullerene, C60, molecules at room temperature and that hydrogen is desorbed by heating up to 450 K, indicating that the electron doped fullerene can be a candidate of practical hydrogen storage material.

On the basis of a theoretical study, the interaction of hydrogen to electron-doped fullerence molecule is expected to be medium between physisorption and chemisorption, which can be applicable for practical hydrogen storage. In this study the electron-doped fullerene was prepared by depositing C60 molecules on a Cu(111) surface, where the interaction between C60 and Cu(111) is so strong that many electrons are transferred from Cu(111) to C60 with re-arrangement of atoms of Cu(111).

The monolayer of C60 molecules on Cu(111) are well-arranged giving a 4x4 structure, which was observed with HAS angular distribution as well as low energy electron diffraction (LEED). We have found that the 4x4 structure in HAS angular distribution was disappeared while 4x4 LEED pattern remained upon exposing the surface to a hydrogen ambient at room temperature. And during heating the sample, the 4x4 HAS angular distribution was revived at 450 K. The results indicate this system can be used as a hydrogen storage material.

In my talk, I will also present the detailed adsorption feature of hydrogen as well as the interaction between C60 and Cu(111) substrate.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 18**

**Growth of (110)-oriented SiGe-based heterostructures for high hole mobility devices**

Keisuke ARIMOTO, Junji YAMANAKA, Kosuke O. HARA, University of Yamanashi, Japan; Noritaka USAMI, Nagoya University, Japan; Kiyokazu NAKAGAWA, University of Yamanashi, Japan

Recently, CMOS transistors based on Si(110) substrate has been extensively studied and high carrier mobility has been demonstrated on this system. According to theoretical works, combination of (110) surface and lattice strain is expected to have a particular potential in enhancing the hole mobility. This expectation has led the authors into the investigation of (110)-based strained system. Particularly, we have focused on strained-Si channel devices. Among techniques to apply stress to the Si channel layer, application of heterostructures having strain-relaxed SiGe buffer layer is a simple and practical choice. In this case, to realize preferable lattice strain, introduction of defects into SiGe layer is essential to tailor the lattice constants of each layer. Since the elastic parameters such as Poisson’s ratio and the mechanical boundary condition depend on surface orientation, defect morphology in the (110)-based heterostructure differs from that in the (001)-based systems. In this presentation, we will review our experimental investigations and discuss:

(1) The formation mechanism of defects that develop in (110)-based strained-Si/SiGe heterostructures

(2) Implication of growth conditions in crystalline morphology

(3) Influence of the defect formation on the energy band alignment and its significance in the performance of electronic device

. Theoretical background and recent results of electrical characterization which clearly reveal enhancement of hole mobility are also shown.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 19**

**Graphene-coated carbon fiber cloth for flexible electrodes of miniaturized glucose fuel cells**

Kazuki HOSHI, Nihon University, Japan; Kazuo MURAMASTU, Hisato SUMI, Incubation Alliance, Inc., Japan; Yasushiro NISHIOKA, Nihon University, Japan

In this work, we fabricated flexible electrodes for a miniaturized, simple structured, and flexible glucose biofuel cell (BFC) using a graphene-coated carbon fiber cloth (GCFC). The areas of the anode and cathode electrodes were 3x10 mm2. The anode area was coated with the enzyme glucose oxidase, and the cathode area was coated with the enzyme bilirubin oxidase. No ion-exchange film was needed because glucose oxidase selectively oxidizes glucose and bilirubin oxidase selectively reduces oxygen. The power density of the BFC with GCFC electrodes in a phosphate buffer solution of 200 mM glucose solution at room temperature was 34.3 μW/cm2 at 0.43 V. The power

density of a BFC using carbon fiber cloth (CFC) without graphene modification was 18.5 μW/cm2 at 0.13 V. The BFC with the GCFC electrode continued to function longer than 24 h with a power density higher than 5 μW/cm2. These effects were attributed to the much larger effective surface areas of the GCFC electrodes that maintain more enzymes than those of the CFC electrodes..

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 20**

**Circularly polarized near-field scanning optical microscope for characterization of nano-devices and nano-materials**

Shintaro NOMURA, University of Tsukuba, Japan

A near-field scanning optical microscope (NSOM) has been widely used for characterization of devices and materials on the nanometer scale beyond the diffraction limit. NSOMs have been providing a powerful method to clarify phenomena on the nanometer scale such as ground- and excited-states in single self-assembled quantum dots [1], excitons and biexcitons in naturally occurring quantum dots [2], and the chiral edge state [3] of a two-dimensional electron gas in magnetic field [4]. In spite of the growing needs to characterize spintronics devices, applications of NSOMs to investigate spin properties of materials have been very limited because of the difficulty in emitting or detecting circularly polarized light using an NSOM probe tip.

In this talk, I will present our results on successful development of a circularly polarized NSOM that enables us to observe circular polarization dependent properties in the nanometer scale [5,6]. We have developed an NSOM tip with an aperture with good axial symmetry and compensated the residual retardation by externally controlling the polarization of the light. I will show that our newly developed circularly polarized NSOM enables us to locally inject spin-polarized electrons in the two-dimensional gas layer that is buried several tens of nanometers below the surface of a single heterojunction.

This research was partly supported by Kakenhi, Nos. JP15H03673 and JP16H00978.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 21**

**Light Manipulation with Aluminum Plasmonic Metasurfaces**

Pin Chieh WU, Yao-Wei HUANG, Wei-Yi TSAI, National Taiwan University, Taiwan; Greg SUN, University of Massachusetts Boston, United States; Din Ping TSAI, National Taiwan University, Taiwan

The metasurfaces, an array of artificial antenna, show the abilities to control the phase as well as amplutide at subwavelength spatial region. They are promising for the development of flat optical components such as converging lenses, waveplates etc. Although a lot of meta-devices have been proposed and demonstrated, most of them are mainly operating at infrard because of the strong metallic losses of noble metals like gold and silver at visible frequencies. Aluminum plasmonics has been Here, two meta-devices working in visible light will be performed in reflection. Firstly, a meta-hologram in 2-level phase design with polarization-switchable reconstructured images is demonstrated. By introducing aluminum plasmonics, the meta-hologram is able to smoothly operated over the range of visible light. Subsequently, a aluminum plasmonic metasurface polarization generator (MPG) for the production of versatile polarizations with high polarization extinction ratio is proposed and demonstrated. Moreover, because of the lower-cost and better adhesion to diverse platforms then either gold or silver, aluminum makes our modulation mass-producible which is promising for feasible applications. Conventional holograms or polarization generators/modulators are available in the market, but their sizes are much larger and more complicated than the device proposed in this talk. Beyond people’s imagination, acquiring polarization-controllable holographic images or multi-polarization generation by a single tiny component that can greatly decrease the complexity of design and might be applied on nanotechnology and integration of photonic integrated circuits.

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**Sat /12/24**

**Meeting Room No 204**

**Abstract ID: 22**

**Who has seen a free photon?**

Hayato SAIGO, Nagahama Institute of Bio-Science and Technology, Japan

In this talk a new aspect of the interplay between mathematical-physical arguments and light-matter fusion technologies will be introduced, through an investigation on a fundamental (and seemingly naive) question: Who has seen a free photon?

Since the paper of Newton and Wigner in 1949, it has been known in mathematical physics that any position operator cannot be defined for a massless free particle with a non-zero finite spin, in sharp contrast to the cases of massive particles which can be localized. This statement is clearly in contradiction to the above familiar situations where almost all physicists and engineers have used the notion of “position of a photon” as one of the basic ingredients of theory and application of quantum mechanics. Then, who has seen a free photon?

This dilemma is resolved by introducing the "effective mass" of a photon due to the interaction with matter. The validity of this interpretation is confirmed in reference to the picture of "polariton", a basic notion in optical and solid physics. The scenario also applies to more general settings. Any kinds of boundary conditions with finite volume (like cavity) will make photons heavier and slower, even without a medium.

As a striking example, we focus on the role played nanoparticles in the context of "dressed photons" and also propose a new look at the photon-matter interaction, which will provide a brand new platform for the interplay between mathematical-physical arguments and light-matter fusion technologies.

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**Meeting Room No 202**

**Abstract ID: 12**

**High-K Dielectric and Metal Gate Materials for Low Power Consumption III-V FinFETs**

Edward Yi CHANG, Quang-Ho LUC, Huy-Binh DO, Yueh-Chin LIN, National Chiao Tung University, Taiwan.

To meet Moore’s law, the academia and industry have worked rigorously to develop advanced technologies in order to reach the ITRS roadmap standard. However, as the devices are reaching their physical limits, we are facing challenges; two most effectively ways to keep the device scaling are either using different transistor architectures or using advanced high mobility channels. Among many III-V compound semiconductors, InxGa1-xAs materials are the most promising candidates as high electron mobility channels for scaling CMOS devices to satisfy the quest of future logic applications. Besides, high-k materials, owning to its high permittivity, have also received great interests for integrating with III-V semiconductors in sub-nanometer technology regions. Unfortunately, poor quality of high-k/III-V interfaces, which degrades the gate controllability and the channel mobility, has not been overcome yet. To achieve high efficiency and low power consumption high-k/III-V MOS devices, the MOS structures should have high interface quality in conjunction with a suitable and reliable dielectric gate stack. In addition, the gate metals must have effective work functions aligned with the band edges of the channel materials, as well as a small work function variation. This talk focuses on the metal/high-k/InGaAs interface study and several new results of the InGaAs MOS devices will be presented which can be the key technologies to achieve energy saving devices for post CMOS application .

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**Sat/12/24**

**Meeting Room No 202**

**Abstract ID: 13**

**Integrated Sensor Array Chips for Simple and Rapid Diagnosis of Biologically-Significant RNA Sequences**

Hirosh AOKI, National Institue of Advanced Industrial Science and Technology (AIST), Japan.

Electrochemical gene detection methods have been developed by many researchers as alternatives to fluorescence-labelling based conventional techniques. Integration of gene sensors and its application to simultaneous detection also attract their interest in line with the growing application of conventional DNA chips. To prepare gene sensor array chips yielding reproducible diagnostic results, there have been some hurdles to overcome, for example, reproducible fabrication of substrates and electrodes, integrated immobilization of gene detection probes to the electrode surface, and so on. In this study, we have fabricated integrated microelectrode array (diameter, 300 µm, interval, 1 mm) chips based on photolithography using gold thin film evaporated on glass chips. Based on the chips, we have developed gene sensor array chips to detect multiple target genes. We achieved to demonstrate simultaneous and reproducible label-free gene detection for mRNA and miRNA sequences.

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**Sat/12/24**

**Meeting Room No 202**

**Abstract ID: 14**

**Surfactant-Polymer Templates in Morphology Modification of Precipitated Calcium Carbonate Particles**

Ketan KUPERKAR, Sardar Vallabhbhai National Institute of Technology (SVNIT), India.

Morphology study of synthesized Precipitated Calcium Carbonate (PCC) was fabricated at ambient temperature using surfactant-polymer

template: cationic surfactant cetyltrimethylammonium bromide (CTAB) with different polymers viz., polyvinyl alcohol (PVA), polyvinyl acetate (PVAc) and polyethylene glycol (PEG) also with the block copolymers F98 and F127. A systematic characterization of the modified crystals using these templates by spectral, diffraction, scattering and microscopy techniques. Results obtained provide a reasonable explanation to the influence of the polarity of the polymer on to the templated nucleation where the inclusion of such molecules within the crystal lattice of

the host growing crystal influences the overall crystal morphology. Scattering results and microscopic findings confirmed and complimented the structural changes occurying in calcium carbonate particles.

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**Meeting Room No 202**

**Abstract ID: 15**

**Migration of A Third Component Between Immiscible Polymers and Its Application to Material Design**

Masayuki YAMAGUCHI, Japan Advanced Institute of Science and Technology, Japan.

The addition of a third component in an immiscible polymer blend is often performed to obtain a high-performance polymer. When a low-molecular-weight compound is used as a third component, it is usually dissolved into polymers due to the contribution of mixing entropy, in which the content in each phase is not the same in general. A similar situation occurs when nanofillers are added in an immiscible blend, although the distribution of each phase is determined by interfacial tension. In this presentation, the interphase transfer of liquid compounds and nanofillers between immiscible polymer pairs is demonstrated, which can be controlled by the temperature and processing/mixing condition. Furthermore, its application to material design of functional polymers and high-performance polymers is exemplified.

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**Sat/12/24**

**Meeting Room No 202**

**Abstract ID: 16**

**Synthesis and Electrorheology of Polyaniline@Attapulgite Nanoparticles**

Hyoung Jin CHOI, Wen Jiao HAN, Shang Hao PIAO, Inha University, Korea.

Electrorheological (ER) fluids are electro-responsive smart suspensions, composed of dielectric particles and insulating carrier liquids, exhibiting distinctive field-induced rheological properties with a rapid and reversible phase change under an external electric field on the order of milli-seconds. Conducting polymer-inorganic composite particles have attracted considerable attention as an ER material due to their unique physical and chemical characters. Compared to the traditional method, Pickering emulsion polymerization is a feasible way of preparing polymer-inorganic composite nanoparticles without the organic surfactants or stabilizers.

In this study, we synthesized polyaniline (PANI) @attapulgite (ATP) composite nanoparticles by Pickering emulsion polymerization using ATP particles as a solid stabilizer. Surface morphology was observed by scanning electron microscope, in which rod-shaped ATP was found to wrap around the PANI nanoparticles. Chemical structure of the composite particles was confirmed by Fourier transform infrared spectroscopy, while optical microscopy showed a microstructural change of the composite nanoparticle based ER fluid dispersed in silicone oil under an applied electric field. Their ER performance was further measured by a rotational rheometer under various electric field strengths and analyzed based on the flow curve model.

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**Meeting Room No 202**

**Abstract ID: 17**

**Computational Modeling and Screening of Metal Organic Frameworks**

Jihan KIM, Korea Advanced Institute of Science and Technology, Korea

Metal organic frameworks (MOFs) are comprised of metal ions and organic linkers that can linke together in variety of different ways to form nanoporous materials. Depending on the topology and chemical environment, MOFs can be tuned to possess excellent material properties and are seen as promising materials for many different energy and enviromental related applications. In this talk, I will discuss about computational methods in which we can construct novel MOFs inside a computer that can pave the way for new applications. Moreover, some of the screening results of thousands of MOFs will be addressed in which we can utilize all of this data for variety of different purposes other than those of conventional screening (e.g. searching for the best materials for a given application).

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**Meeting Room No 202**

**Abstract ID: 18**

**Performance of High Temperature Sr(Ce0.6Zr0.4)1-xYxO3-δ Ceramic Proton Conductor**

I-Ming HUNG, Yen-Juin CHIANG, Yuan Ze University, Taiwan ; Chi-Shiung HSI, National United University, Taiwan; Jing-Chie LIN, National Central University, Taiwan

Proton-conducting oxides recently have attracted considerable attention, because of their potential applications in proton-type solid oxide fuel cells (p-SOFCs), hydrogen pumps, membrane separators and steam electrolyzes. In this study, the Sr(Ce0.6Zr0.4)1-xYxO3-δ (SCZY) perovskite structure proton-conducting ceramics are successful prepared by Ethylenediaminetetraacetic acid (EDTA)-Citric acid complex method. The effect of Y doping amount on the electrochemical properties and hydrogen flus of the SCZY in hydrogen atmosphere were investigated. SCZY samples are extremely dense after sintering at 1450 oC for 6 h. The grain size of SCZY strongly depends on the Y doping amount due the second phase of SrY2O4 on the grain boundary. The Sr(Ce0.6Zr0.4)0.85Y0.15O3-δ sample has the highest conductivity of 0.010 S cm-1 at 800 oC. The hydrogen permeation flux is as high as 0.184 mmol min-1·cm-2 at 800 oC.

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**Meeting Room No 202**

**Abstract ID: 19**

**Exposed Area Ratio Effect of Cathode Electrode on The Performance of Sediment Microbial Fuel Cells**

Chin-Tsan WANG, Department of Mechanical and Electro-Mechanical Engineering, National Ilan University; Yao-Cheng LEE, Institute of Material Science and Engineering, National Taipei University of Technology; Yun-Ting OU, Department of Mechanical and Electro-Mechanical Engineering, National Ilan University ; Yung-Chin YANG, Institute of Material Science and Engineering, National Taipei University of Technology, Taiwan.

Sediment microbial fuel cells (SMFCs) utilize voltage drop of redox potential between aerobe and anaerobe to produce electricity and degrade organic wastewater. However, the capability of dissolve oxygen on cathode limited power performance and degrade rate in SMFC. Therefore, in this study, a comb-type cathode electrode with carbon cloth embedded partly in SMFC was utilized for enhancing the power density and discussed the effect of exposing different areas of cathode electrode for improving transfer of oxygen. Results showed that the power density reached 3.77×10-2 mW/m2 by 75% of the (MA75) exposed area, which is 1.93 times of 50% of the (MA50) exposed area and 6.44 times of 0% of the (MA0) exposed area. These results indicated that the exposing area of cathode electrode had a positive effect on power performance of SMFC and would reduce impedance of cathode. These findings would offer useful information of SMFCs for the application of wastewater treatment in the future.

Keyword: Sediment microbial fuel cell, exposing area of cathode electrode, power density, impedance, transfer of oxygen

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**Sat/12/24**

**Meeting Room No 202**

**Abstract ID: 20**

**High-Density Monolayer of Metal Complex: Preparation and Catalysis**

Kenji HARA, Tokyo University of Technology, Japan

Catalyst is one the key materials to realize our sustainable society. However, we may encounter problematic cases where conventional catalyst systems cannot provide effective solutions. We thus believe that establishment of novel methods in catalyst preparation is currently necessary. Utilization of high-density monolayer of molecular metal complex is our strategy, expecting that this methodology enables facile and systematic screening of unique and efficient catalysts. This presentation describes our challenges to establish such an immature method in catalyst preparation. Preparation and catalysis of the high-density monolayers of Rh complexes with N-heterocyclic carbene, structurally compact phosphine and diisocyanide ligands on gold surface are presented. Catalytic application of high-density Pd-bisoxazoline complex prepared on single crystal silicon surface is also shown. Uniquely high catalyst turnover numbers and high chemoselectivities were observed with these catalyst systems.

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**Meeting Room No 202**

**Abstract ID: 21**

**Characteristic Studies of a PBI/H3PO4 High Temperature PEMFC under Various Conditions**

Chen-Yu CHEN, Shih-Ming HUANG, Yi-Kuang CHEN, Chinese Culture University, Taiwan

A high temperature proton exchange membrane fuel cell is considered a solution to improve the cell performance under CO-contained hydrogen and to simplify the gas purification process of a reformate fuel cell system. In this study, polybenzimidazole-based phosphoric acid-doped fuel cells are studied under simulated reformate gases of different H2, N2, CH4 and CO concentrations at different temperatures and humidities. The experimental results show that the dilution effect of N2 has a minor impact on the cell performance in absence of CO. However, the CO poisoning increases the charge transfer resistance and leads to a substantial performance drop. This work also reveals that increasing the operating temperature can effectively improve the CO tolerance by suppressing the Pt-CO binding reaction. In addition, effects of the CO concentration on the fuel cell performance and the impedance become more significant in diluted H2. As a result, the CO concentration should be maintained lower than a critical level to prevent a dramatic voltage shut-down, especially in highly diluted H2. Additionally, no improvement was observed when the gas humidity was increased. Furthermore, the tests at CH4/H2 mixtures reveal that residual methane in the reformate gases only decrease fuel cell performance slightly due to the dilution effect. Under those H2/CO/N2/CH4 mixtures in this study, the mixture composition has a minor effect on the fuel cell performance at the temperatures higher than 160 oC. As a result, it is suggested to maintain fuel cell temperatures higher than 160 oC under the reformate gases without CO cleaning processes.

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**Sat/12/24**

**Meeting Room No 202**

**Abstract ID: 22**

**Carrier formation dynamics in prototypical organic solar cells as investigated by transient absorption spectroscopy**

Yutaka MORITOMO, University of tsukuba, Japan

Sub picosecond transient absorption spectroscopy is a powerful tool used to clarify the exciton and carrier dynamics within the organic solar cells (OSCs). In this review article, we introduce a method to determine the absolute numbers of the exciton and carrier against the delay time (t) only from the photoinduced absorption (PIA) and electrochemically-induced (EIA) spectra. Application of this method to the rr-P3HT-, PTB7-, and SMDPPEH-based OSCs revealed common aspects of the carrier formation dynamics in OSCs. First, the temporal evolution of the numbers of the exciton and carrier indicates that the late decay component of exciton does not contribute to the carrier formation process. This is probably because the late component has no excess energy enough to separate into the electron and hole across the donor/acceptor (D/A) interface. Secondly, the spectroscopy revealed that the exciton-to-carrier conversion process is insensitive to temperature. This observation, together with the fast carrier formation time in OSCs, is consistent with the hot exciton picture.

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**Sun/12/25**

**Meeting Room No 204**

**Abstract ID: 23**

**Design and Fabrication of Low Power Consumption Inkjet Nanomaterials with Identification Circuit (ID) Fuse System**

Jian-Chiun LIOU, Department of electronic engineering, National Kaohsiung University of Applied Sciences(KUAS), Taiwan

In recent years, the trend of the times by using a computer and print the data is incremented. The inkjet printer is currently printing tool by most people.

Identification circuit (ID) is designed primarily upon the completion of every single print head manufacturing process, to make an identification circuit, for when the printer can be confirmed that the inkjet chip certification. This study identification circuit is in series with one end of the MOS Drain fuse, when the inkjet chip factory to be blown. This architecture is defined by blown fuse circuit, and detected 0 signal. Not being blown fuse for the passage, feedback back to the printer will detect the signal “1” as a way to confirm that the print head. Such identification circuit architecture is used to detect the amount of ink, as well as identification of inkjet chip-based authentication. The fuse element nanomaterials are tantalum aluminum (TaAl) filaments or tantalum aluminum nitride (TaAlN) filaments. Choose the identification application based on the actual printhead model and ink level. It is the lower power blown fuse. The fuse heater chip has a plurality of heater layer ink rebound protection layers. Print speed is fast. Low power consumption is also in line with green energy. Through Integrated fuse addressing and MOS fuse burn break process. Input control circuit can be increased to two group includes shift registers and latch system, so the detection signal of 8 bits. In addition, there is a design approach is to let the layout fuse circuit breaking architecture. But there drawback is that when the chip circuit after the completion of fixed. You can only correspond to a specific printer. Ink detecting circuit mask has been designed as the amount of ink. It can not be counted notes for ink level.

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**Sun/12/25**

**Meeting Room No 204**

**Abstract ID: 24**

**Interfacial Engineering of Polymer Solar Cells**

Zhicai HE, South China University of Technology, China

Polymer solar cells(PSCs) are promising solar energy conversion devices with the advantages of low cost, light weight and room-temperature solution processible. Though the power conversion efficiencies(PCE) of PSCs has been exceeding 11% recently, there are still some fundamental problems concerning the devices interfaces to be solved. In our works, we have been focusing on the working mechanism of water/alcohol soluble conjugating polymer (polyelectrolyte,PFN) interlayer and the D-A interfaces in PSCs. By combining the scanning Kelvin probe microscopy (SKPM) and electron absorption (EA), we visualized a surface potential jump upon the incorporation of the PFN interlayer, and thus proposed a interfacial dipole on the interface, which reinforced the actual built-in potential across the device as a result of the superposition. Simultaneous enhancement in the open-circuit voltage, short-circuit current density and fill factor can be achieved by simply incorporating a thin layer of alcohol/water-soluble polymer as the cathode interlayer. In our recent work , the fundamental losses in VOC of PSCs based on narrow band-gap polymers was studied. And a correlation between the D-A interface phase separation and the band tailing of the device was established. By combining the analysis on the electrical, photocurrent spectral response characteristics, the band tailing and the concomitant increase in the splitting of the electron and hole quasi-Fermi levels were found to be responsible for the VOC.

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**Sun/12/25**

**Meeting Room No 204**

**Abstract ID: 25**

**Glia and Gliotransmitters on Carbon Nano Tubes**

Bo-Eun YOON, Dankook University, Korea

Functionalized carbon nanotubes (CNTs) have shown promising biomaterials in neural system, such as CNTs-based nerve scaffolds to drive nerve regeneration. CNTs have shown to modulate neuronal growth and improve electrical conductivity of neurons. The functionalization of CNTs has improvement of their solubility, biocompatibility and alters their cellular interaction pathways. Recently, CNTs have shown to modulate morpho-functional characteristics of glia as well as neuron. Among the various types of glia, astrocytes express diverse receptors for corresponding neurotransmitters and release gliotransmitters including glutamate, ATP and GABA (γ-amino butyric acid). Gliotransmitters are primarily released from astrocytes and play important roles in glia-neuron crosstalk. This review focuses on the effects of CNTs on glial cells and we discuss functionalized CNTs can modulate morphology and gliotransmitters of glial cells. Based on exciting new findings, they look to be a promising material for use of brain disease therapy or neuroprosthetics.Write you abstract here.

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**Sun/12/25**

**Meeting Room No 204**

**Abstract ID: 26**

**Graphene Oxide Cathode of Field Emission Emitter with Square Lattice Island Array**

Yi-Tsung CHANG, National Sun Yat-Sen University, Taiwan; Shih-Hung LIN, Tunghai University, Taiwan

Graphene has attracted the attention of most scholars for its unique properties, such as high electron mobility, high thermal conductivity, low resistivity and other physical characteristics which was discovered by A.K Geim since 2004. Graphene can be widely applied such as transistor, sensor, field emission device and other research.

This study is divided into three parts: First of all, the graphene oxide is made by electrochemical exfoliation. Secondly, to make graphene oxide as square lattice island array is using screen printing method. Lastly, the field emission of graphene oxide patterns is measured in different diameter.

Graphene oxide is made from highly oriented pyrolytic graphite by electrochemical exfoliation. Before the screen printing process, graphene oxide is analyzed with Raman spectroscopy, XRD, and XPS, which makes sure the quality and purity. In the research, use the AutoCAD software to design the mask in different diameter for the screen printing. In OM and SEM images, the screen printed graphene oxide with the island patterns constructing perpendicular edge shows the best aspect ratio, and then all of them has become square lattice array emitter. When the screen-printed graphene oxide in different diameter is measured, it’s found that the best performance is the diameter of 150μm. The emission behavior of the diameter in 150μm is 1.65 V⁄μm with the maximum emission current of 20.8μA and the field enhancement factor of 15060. It's worth noting that the diameter in 100μm shows the worst emission behavior because of the screening effect.

The luminance measurement of the best condition coating the phosphor shows the maximum amount of green light with the wavelength at 562 nm and the lumens of 5.04 when the emission current is up to 20.8μA.

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**Meeting Room No 204**

**Abstract ID: 27**

**Functional Materials for Energy Conversion**

Cheuk-Lam HO, Hong Kong Baptist University, Hong Kong.

The most abundant and clean energy source on earth is solar energy to date. The energy of sunlight can be directly converted into electricity by the photovoltaic effect using a solar cell electrical device. By a smart design of molecular framework, a novel series of new functional photosensitizers have been synthesized. Their HOMO and LUMO energy level as well as their light harvesting abilities can be fine tuned by various approaches such as changing the donor, linker or acceptor moieties. Their photophysical and photovoltaic properties have been examined. The present work illuminates the potential of well-defined light-harvesting small molecules for efficient power generation in organic photovoltaics implementation.

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**Sun/12/25**

**Meeting Room No 202**

**Abstract ID: 23**

**Harmonics Generation from Mata-surface**

Kok Wai CHEAH, Shu Mei CHEN, Fatemeh HOSSEINIALAST, Hong Kong Baptist University, Hong Kong; Shaung ZHANG, University of Birmingham, Hong Kong; Gui Xin LI, Southern University of Science and Technology, China; Thomas ZENTGRAF, University of Paderborn, Germany

In our recent works, we investigate several novel metamaterial and plasmonic meta-surface designs. In particular we explore the enhancement of non-linear optics (NLO) property of the designs. The enhancement would allow fundamental study of the more exotic NLO characteristics such as Rabi-like splitting, plasmonic enhancement of NLO etc. It would also opens up potential applications such as SERS, higher harmonic generation etc.

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**Sun/12/25**

**Meeting Room No 202**

**Abstract ID: 24**

**Carbon-Based Composites for Energy Generation/Storage Systems**

Toyoko IMAE, National Taiwan University of Science and Technology, Taiwan

Focusing on global activities, consumption of fossil fuels has led to diverse environmental issues. In this view, there have been challenges to discovering sustainable, clean and environmentally-friendly fuels. Hereupon, hydrogen is an inspiring alternative fuel and energy carrier, being free from CO2 emission. The successful attaining of hydrogen production from the electrocatalytic hydrogen evolution reaction (HER) method must be keeping the clean environment. In this respect, we examined HER using electrocatalyst systems containing ~1 wt% of platinum nanoparticles (PtNPs) protected by poly(amido amine) dendrimer (Den), which were loaded on graphene oxides, carbon nanohorns (CNHs) and carbon nanotubes (CNTs) through chemical linkage. The excellent HER, durability and stability of composite electrodes are due to chemical bonding immobilization of PtNPs on carbon materials and its substantial graphitized structure. Thus, CNH/DenPtNPs and CNT/DenPtNPs with extremely low content of Pt are the promising nano-electrocatalysts with low onset potential and high cathodic current density for HER.

Supercapacitors are one of the most talented devices for energy storage. They exhibit many advantages, including high energy density, fast charge/discharge rate and excellent durability. These features enable supercapacitors to be efficiently used in hybrid electric vehicles and electronic devices. However, the energy density on the non-faradic carbon-based electric double layer capacitors (EDLCs) is not enough high, and the faradic pseudocapacitors (PC) fabricated by conductive polymers and metal oxides is not enough stable at stronger electrochemical conditions. Thus, we report the hybridization of EDLC and PC materials to cover such weakness of each system: The defect-free magnetic graphenes exfoliated via dodecylamine treatment and expanded via heat-treatment at high temperature were hybridized with conductive polyaniline. The obtained composites displayed an enhanced capacitance performance with a wide potential window, excellent charge/discharge properties and non-observed internal resistance drop.

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**Sun/12/25**

**Meeting Room No 202**

**Abstract ID: 25**

**Direct Full Visible Spectrum Emission Microrod Light-Emitting Diode**

Yuh-Jen CHENG, Research Center for Applied Sciences, Academia Sinica, Taiwan; Yun-Jing LI, National Chiao Tung University, Taiwan; Jet-Rung CHANG, Taiwan Semiconductor Manufacturing Corporation, Taiwan; Shih-Pang CHANG, Research center for Applied Sciences, Academia Sinica, Taiwan; Hao-Chung KUO, Chung-Yen CHANG, National Chiao Tung University, Taiwan

Resarch in high efficient visible color light emitting diodes (LEDs) plays an important role in the next generation lighting and display applications[1-3]. InGaN compound semiconductors have been extensively studied and are widely seen as promising materials for multiple-color lighting devices. The band gap can be potentially varied from UV (3.4 eV) to near infrared (0.7 eV). In principle, InGaN devices can cover the whole visible spectrum. Conventional GaN/InGaN multiple quantum well (MQW) LEDs are often grown on a c-plane sapphire substrate. The polar nature of this crystal surface induces a strong piezo polarization field in MQWs due to GaN-InGaN lattice mismatch, which causes electron-hole (e-h) wave function separation. This effect can seriously reduce e-h recombination efficiency especially when the In composition in InGaN QW increases for long wavelength emission. One way to solve this problem is to grow MQWs on different crystal surfaces with low or no polarization field, the so-called semipolar or nonpolar surfaces. Large area substrates of these crystal planes are however not readily available. An alternative method to access these crystal planes is by patterned 3D crystal growth. Here, we report the demonstration and study of an electrically driven microrod LED that can emit full visible spectrum. By applying patterned 3D epitaxial growth, semipolar crystal surfaces were grown from the pre-patterned microrods on a GaN substrate. InGaN MQWs were grown on these self-formed crystal facets. During the growth, the semipolar surfaces evolved from {11-20} to {10-10} planes. The InGaN MQWs grown on these two different crystal planes showed two broad emission wavelength regions together covering the full visible spectrum from 460-660 nm. This study demonstrates the potential of using 3D growth to realize a direct full visible spectrum emission LED, which can save the 25-30% phosphor down conversion energy loss in today white light LED.

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**Materials for Thermal Insulation and Thermal Management**

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Efficient energy use, sometimes simply referred to as energy-saving, involves efforts to reduce the amount of energy wasted. To minimize heat loss and improve energy utilization, materials with ultra-low thermal conductivities are becoming increasingly important under the growing demand for high performance heat management and thermal insulation. Superinsulation materials based on silica aerogel offer considerably lower thermal conductivities than that of air at ambient temperature, which offer great potential in building science. Thermal barrier coatings (TBCs) based on yittria stabilized zirconia are widely used in advanced aerospace applications as high temperature thermal insulation materials. In this seminar, I will be presenting my research activities on understanding the interfacial stability and factors controlling thermal, micro-mechanical and physical properties of these materials.

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