

# GOLDEN ACADEMY

## Message from the organizers

Dear Colleagues and Friends,

Asia Pacific Society for Materials Research 2019 Annual Meeting (APSMR 2019 Annual Meeting) will be held in Hokkaido, Japan during July 26-29 2019.

APSMR 2019 Annual Meeting is being held every year and aimed 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 APSMR 2019 Annual Meeting. Your active participation is the key to the success of this conference.



Yours Sincerely,

APSMR 2019 Annual Meeting Committee

Asia Pacific Society for Materials Science (APSMR)

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



# GOLDEN ACADEMY

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## Conference organizing committee

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### CONFERENCE CHAIRS

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Prof. Setsuko KOURA (Chiba Institute of Technology)

Prof. Noriyuki KOBAYASHI (Nagoya University)

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Ms. Yaru WU (APSMR)

Mr. Chenhuan HSU (APSMR)



# GOLDEN ACADEMY

## Conference topics

1. *Structure materials and Functional Coatings (metals, ceramics, and composites): No.106 (8-14), No.201 (19-21)*
2. *Materials for energy (saving, conversion, transfer, storage) and environment plus electrochemistry*
  - 2.1. *Photovoltaics:*
  - 2.2. *Rechargeable Batteries and Fuel Cells: No.102 (11-14), No.106 (5)*
  - 2.3. *Materials for Thermal Management and Thermal Energy Utilization: No.201 (4-6)*
  - 2.4. *Materials for Energy and Environmental Applications: No.102 (4-6), No.106 (16-21), No.202 (4-7)*
3. *Optics and Photonic Materials: No.102 (8-10), No.201 (1-3), No.202 (19-21)*
4. *Electronics, Magnetics and Nanomaterials: No.201 (16-18), No.202 (1-3)*
5. *Polymer Science and Molecular Chemistry: No.106 (1-4), No.202 (16-18), No.207 (22-24)*
- 6S. *Organic Reactions and Applications to Organic and Biomaterials (Custom-tailored session): No.202 (8-14)*
7. *Theory, Characterization and Computational Modeling of Materials: No.102 (1-3), No.207 (25-27)*

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)	Oral Presentation		
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00		Oral Presentation		
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40		Oral Presentation		
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00		Oral Presentation		
17:00 – 18:30	Conference Registration	Poster Session		
19:00 – 20:30	Conference Reception		Banquet (Japanese convivial gathering)	

# GOLDEN ACADEMY

## Presentation List (No. 102 Meeting Room)

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)	1. M.W. FU 2. R. GEMMA 3. T. MIZUGUCHI		
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00		4. N. ASAO 5. N. MIYAKAWA 6. H.W. LI 7. Reserved		
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40		8. M. KINOSHITA 9. P.H. CHEN 10. S. SHIMOMURA		
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00		11. N. YABUUCHI 12. M. SAITO 13. T. ITOH 14. Y.U. KWON 15. Reserved		
17:00 – 18:30		Poster Session		
19:00 – 20:30	Conference Reception		Banquet (Japanese convivial gathering)	

# GOLDEN ACADEMY

## Presentation List (No. 106 Meeting Room)

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)	1. S. TAMESUE 2. D. MURAKAMI 3. Y.S. KIM	16. H.L. WU 17. H.J. LIU 18. C.T. LI	
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00		4. K. TAKADA 5. K. SATO 6. J.H. JEONG 7. Reserved	19. Y.H. LEE 20. Y.H. YU 21. E. YAMAMOTO	
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40		8. J.H. KIM 9. V.B.C. TAN 10. S.I. KOMAZAKI		
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00		11. T. OHTANI 12. M. TABUCHI 13. S. ZHANG 14. N. HIYOSHI 15. Reserved		
17:00 – 18:30		Poster Session		
19:00 – 20:30	Conference Registration		Banquet (Japanese convivial gathering)	
	Conference Reception			

# GOLDEN ACADEMY

## Presentation List (No. 201 Meeting Room)

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)	1. R.H. HORNG 2. K. OKAMOTO 3. T. WATANABE	16. T. SAITO 17. S. SUZUKI 18. K. HALADA	
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00		4. Y. OSAKA 5. T. TAKEUCHI 6. H.H. PARK 7. Reserved	19. H. SAITO 20. M. ITABASHI 21. Y.G. KO	
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40				
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00				
17:00 – 18:30	Conference Registration	Poster Session		
19:00 – 20:30	Conference Reception		Banquet (Japanese convivial gathering)	

# GOLDEN ACADEMY

## Presentation List (No. 202 Meeting Room)

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)	1. H. MATSUURA 2. Y. YASUKAWA 3. H. YAMANE	16. T. KANEKO 17. N. YAMAUCHI 18. K. AOKI	
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00		4. W.C. LIN 5. Y.G. LIN 6. W.R. LIU 7. Q. LIU	19. J. TATEBAYASHI 20. M. ARAI 21. N. MIYASHITA	
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40		8. G. LI 9. S. MATSUDA 10. T. SUENOBU		
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00		11. T. MITA 12. T. BARSUKOVA 13. Y. MAWATARI 14. T. TAKAHASHI 15. Reserved		
17:00 – 18:30		Poster Session		
19:00 – 20:30	Conference Reception		Banquet (Japanese convivial gathering)	

# GOLDEN ACADEMY

## Presentation List (No. 207 Meeting Room)

	FRI, 7/26	SAT, 7/27	SUN, 7/28	MON, 7/29
9:00 – 10:20	Pre-session technical and discussion forums on international collaboration (by invitation only)			22. T. IIMORI 23. T. KANAI 24. M. AKIMOTO
10:20 – 10:30		Coffee & Tea Break		
10:30 – 12:00				25. M. HIGUCHI 26. K. HIGUCHI 27. K. UEBAYASHI
12:10 – 13:00		Lunch Break	Optional Excursion	
13:10 – 14:40				
14:40 – 14:50		Coffee & Tea Break		
14:50 – 17:00				
17:00 – 18:30	Conference Registration	Poster Session		
19:00 – 20:30	Conference Reception		Banquet (Japanese convivial gathering)	



# GOLDEN ACADEMY

## Presentations for APSMR 2019 Annual Meeting

**SATURDAY 07/27**

### **Meeting Room No 102**

1. Design and Development of Multi-Scaled Metal Forming Products Aided by Finite Element Simulation (M.W. FU)
2. CO<sub>2</sub> methanation over hydrogen storage alloys via mechanical milling -Study by atom probe tomography (APT)- (R. GEMMA)
3. Hydrogen bond analysis of confined water in nanoporous silica using molecular dynamics simulations (T. MIZUGUCHI)
4. Selective Sr adsorption from the contaminated water with layered titanate nanowires (N. ASAO)
5. Single crystal growth of bulk In-Ga-Zn-O by Pressurized Optical Floating Zone Methods and its intrinsic transport properties (N. MIYAKAWA)
6. Solid-State Hydrides for Hydrogen Storage and Rechargeable Battery (H.W. LI)
7. Reserved
8. Light-Controlling Materials with Photo-/Thermo-Sensitive Liquid Crystals (M. KINOSHITA)
9. Organic Trench Structure in Foldable Low Temperature Poly-Si Thin-Film Transistors (P.H. CHEN)
10. MBE growth of GaAsBi/GaAs quantum wells by two-substrate-temperature method (S. SHIMOMURA)

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11. Mn-based electrode materials for high-energy rechargeable Li/Na batteries (N. YABUUCHI)
12. A New Concept of Air-Electrode Catalysts by Using MnO<sub>2</sub> Nanosheets and Solid Redox Mediators for Rechargeable Li-Air Batteries (M. SAITO)
13. In Situ Raman Analysis for High Capacity Zinc Anode in Alkaline Solutions (T. ITOH)
14. Mass production of transition metal core-platinum shell nanoparticle catalysts for cathode of PEMFC (Y.U. KWON)
15. Reserved

## **Meeting Room No 106**

1. Adhesive Hydrogel Systems Utilizing Supramolecular Interactions and Macromolecular Structures (S. TAMESUE)
2. Analysis of interfacial structure at biocompatible polymer/water interface (D. MURAKAMI)
3. Biomimetic functional hydrogels with anisotropic structures (Y.S. KIM)
4. Controlled functionalization of acrylate polymers using organocatalyzed living polymerization (K. TAKADA)
5. Mechano-Electro-Chemical Design to Improve Reliability and Durability of Solid Oxide Fuel Cells (K. SATO)
6. TBA (J.H. JEONG)

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7. Reserved

8. Surface modification of ceramic and metal materials using fluorine gas (J.H. KIM)

9. Crustacean-inspired helicoidal laminates (V.B.C. TAN)

10. Damage Assessment of Structural Materials Based on Change in Hydrogen Thermal Desorption Characteristic (S.I. KOMAZAKI)

11. Nonlinear Ultrasonic Evolutions in an Austenitic Stainless Steel during Creep (T. OHTANI)

12. Strength and fracture of high Cr steel welds at high temperatures (M. TABUCHI)

13. Creep-Fatigue Life and Damage Evaluation of Ni-based Alloy 617 and Alloy 740H (S. ZHANG)

14. Development of Combined Tension-torsion and Biaxial Tension Creep Testing Machines (N. HIYOSHI)

15. Reserved

## **Meeting Room No 201**

1. Development of Thin film LEDs by Wafer Bonding and Epilayer Transferring Technologies (R.H. HORNG)

2. New Development of Plasmonics towards High-Efficiency Light-Emitting Devices (K. OKAMOTO)

3. Photopolymer Science and Technology Related to EUV Lithography at University of Hyogo (T. WATANABE)

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4. Kinetic analysis on the LiOH hydration / dehydration behavior for solar heat storage (Y. OSAKA)
5. A new, innovative finding in thermoelectric, — Colossal Seebeck effect in metallic Cu<sub>2</sub>Se — (T. TAKEUCHI)
6. Nanoporous ceramic materials: Synthesis, properties and application (H.H. PARK)
7. Reserved

## **Meeting Room No 202**

1. Electrical Characterization of Heavily Al-doped 4H-SiC for Collectors of SiC Insulated Gate Bipolar Transistors (H. MATSUURA)
2. Enhancement of magneto-optical properties through localized-surface plasmon resonance of Au nanoparticles (Y. YASUKAWA)
3. Chemical and biological sensors using magneto-optical cavity effects on magnetic stacked films (H. YAMANE)
4. 3D ToF-SIMS Imaging of Perovskite/Titania/FTO in Controlled Humid Environments (W.C. LIN)
5. In-situ studies of energy materials in operando condition using synchrotron X-ray (Y.G. LIN)
6. Surface treatment effects on Si/C composite anode for lithium ion batteries (W.R. LIU)

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7. Discovery and Fundamental Studies of high-performance lithium cobalt oxide via advanced synchrotron techniques (Q. LIU)
8. GAP Chemistry and Multi-Layer 3D Chirality (G. LI)
9. Electrochemical Analysis of Triphenylamine Derivative Using a Microelectrode and Molecular Orbital Calculation (S. MATSUDA)
10. Soft Crystal: Polymorphic Metal Complexes Affording Luminochromism (T. SUENOBU)
11. Palladium-Catalyzed Allylic Carboxylation with Carbon Dioxide (T. MITA)
12. Calix[4]arenes, bearing sterically hindered phenol fragments. Synthetic approach and potential application (T. BARSUKOVA)
13. Synthesis and characterization of helical substituted polyacetylenes toward color-tunable material (Y. MAWATARI)
14. Drug Discovery Using Automated Synthesizer & Flow Reactor and Its Social Effect in Japan (T. TAKAHASHI)
15. Reserved

## **POSTER SESSION**

- P1. Fracture Toughness and Fracture Patterns of Single Crystal Silicon in High Temperature Ranges (Y. SHIROKI)
- P2. Relationship between Tensile Strength of Ceramics to metal joint and Thermal Stress near Edge of Interface (S. MURAOKA)

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- P3. Electrolytic behavior of environmental pollutants using graphene electrodes (K. FUJISAWA)
- P4. Phosphate Separation and concentration from seawater by Electrodialysis (M. ASAH)
- P5. Electrical and electroless plating of Al using ionic liquid (K. MAKINO)
- P6. The Study of the Effect of Oxygen Ultra Fine Bubble Water on Growth of Tomato (M. KOURA)
- P7. Effect of  $\text{HCO}_3^-$  concentration on  $\text{TiO}_2$  photocatalytic sterilization (G. ISHII)
- P8. In situ transmission X-Ray microscopy studies of Li plating and stripping mechanism in high concentrated electrolyte (C.Y. WANG)
- P9. Development of Novel Poly(3-alkylthiophene)/Inorganic Semiconductor Hybrid Materials with Self-Assembled Nanostructures (P.S. YEH)
- P10. Novel Self-Healable Magnetic Nanocomposites Based on Diels-Alder Click Chemistry (W.C. KO)
- P11. Anti-solvent effect on photovoltaic performance of perovskite solar cells (S.E. CHIANG)
- P12. Investigations of double perovskite thin-film solar cells (D. THAKUR)
- P13. A highly efficient and stable semi-transparent perovskite photovoltaic cell (J.R. WU)
- P14. Effect of Ga deposition rate on GaAsSb/GaAs Quantum Dots formation (Y. OTEKI)

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- P15. Fabrication of Circular Defect Photonic Crystal Laser by Dry Etching (S. MIZOGUCHI)
- P16. High frequency characteristics analysis of photonic crystal circular defect laser (H. YE)
- P17. Influence of O<sub>2</sub> plasma treatment on the magnetic properties of Co-Pt thin films (T. SUGIMURA)
- P18. Optical electrical characteristics improvement by the transition metal addition to a ZnO film (T. KOIDE)
- P19. Water-solubilization/desolubilization of high-performance biopolyamides by binding to alkali/alkaline earth metals (Y. FUNAHASHI)
- P20. Biopolyamides of cinnamoyl photodimer derivatives with abnormal bending angles (T. NODA)
- P21. Super-thermoreistance in bio-based benzazoles from wholly-aromatic amino acids (X. ZHONG)
- P22. Particle Dispersibility and Magnetorheological Effect for Magnetic Elastomers with Ultra Sonication (M. WATANABE)
- P23. Electric Resistivity for Polyimide and Biopolyimide films (A.Y. FITRI ADILA)
- P24. Particle dispersibility and magnetorheological effect for carrageenan magnetic hydrogels (J. IKEDA)
- P25. Synthetic Studies of Polymers by Ring Opening Metathesis Polymerization (ROMP) Using Half-esters (W. SHOJI)
- P26. Synthetic Studies of (Z)- $\beta$ -Santalol (I. IHARA)

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- P27. Surface modification of cathode active material for lithium ion battery using cerium (IV) fluoride (J. SATO)
- P28. Solvatochromism and fluorescence dynamics of tetracyanoquinodimethane in solutions (Y. TORII)
- P29. Magnetic properties of SmFe<sub>3</sub>-type magnets (Y. OGAWA)
- P30. Production of SmFe<sub>12</sub>-type magnets (F. WATANABE)
- P31. Electrical properties of nitrogen doped Al<sub>2</sub>O<sub>3</sub> films by atomic layer deposition (M. KIM)
- P32. Synthesis of SnO<sub>2</sub> aerogel/reduced graphene oxide nanocomposites for the photocatalytic degradation of methyl orange (T. KIM)
- P33. Advanced surface modification by plasma electrolysis as a groundwork for multi-purpose coatings (M.P. KAMIL)
- P34. Nucleation and Growth Phenomena of MgO Layer Formed on Mg-Al-Zn Alloy via Plasma Electrolytic Oxidation (S.Y. PARK)
- P35. Formation of Conformal NiO Underlayer on Carbon for SMSI Effects on Electrocatalytic Performance of Supported Pd Nanoparticles (W. SHI)
- P36. Mass production of Fe@Pt/C Nanoparticles for Superior catalytic active Electrocatalysts for cathode of PEMFC synthesized via Sonochemical method (A.H. PARK)
- P37. Large-sized bulk single crystal growth and its characterization in pressurized optical floating zone method of InGaO<sub>3</sub>(ZnO)<sub>3</sub> (Y. KOBAYASHI)



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- P38. Measurement of in-plane compressive stress of Pd thin film prepared by magnetron sputtering method (S. NAKAHIRO)
- P39. Luminescent Crystalline Cu(I) Complexes Breathing Solvent Vapors (I. ARAHORI)
- P40. Properties of flexible PZT piezo-generator prepared by sol-gel process (S.S. PARK)
- P41. Skeletal Reinforced Silica Aerogels: A Hybrid Material for Thermal Insulation Applications (Y.J. ZHOU & K.I. LEE)
- P42. Comparison of two promising approaches to creating transparent polyethylene based hybrid silica aerogel with excellent mechanical and thermal insulation properties (D. LUO & K.I. LEE)

**SUNDAY 07/28**

**Meeting Room No 106**

16. Controlling Electrochemical Lithium Deposition and Sulfur Reduction Mechanism through Liquid Electrolytes (H.L. WU)
17. New opportunities for visible optoelectronics and green energy - the combination of metallic and wide bandgap complex oxides (H.J. LIU)
18. Structural and Functional Design of Efficient Catalysts and Mediators for Dye-Sensitized Solar Cells (C.T. LI)
19. In Situ Synthesis of Novel Poly(3-alkylthiophene)/Inorganic Semiconductor Hybrid Materials (Y.H. LEE)

# GOLDEN ACADEMY

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- 20. Novel graphene-based composite materials for counter electrodes of dye-sensitized solar cells (Y.H. YU)
- 21. Atomically Thin Oxide Nanosheets Grown at the Interfaces (E. YAMAMOTO)

## **Meeting Room No 201**

- 16. Progress of Sm-Fe-N magnets (T. SAITO)
- 17. Synthesis of Mesoporous Manganese Dioxide Nanosheets (S. SUZUKI)
- 18. Materials Technology for SDGs (K. HALADA)
- 19. Electrochemical study of tin solder wetting (H. SAITO)
- 20. Metal-Resin Dissimilar material bonded technology NMT/NAT (M. ITABASHI)
- 21. Incorporation Behavior in Plasma Coating (Y.G. KO)

## **Meeting Room No 202**

- 16. Photo-corrosive Bioplastics (T. KAKEKO)
- 17. Formation of sugar-immobilized fluorescent polymethylmethacrylate microparticles by soap-free emulsion polymerization (N. YAMAUCHI)
- 18. Large-scale Synthesis of Dendritic Photopolymers with Excellent Performance (K. AOKI)
- 19. Enhancement of Eu luminescence in GaN:Eu via introduction of nanostructures and nanocavities (J. TATEBAYASHI)
- 20. MOVPE growth and evaluation of mid-infrared range superlattice (M. ARAI)

# GOLDEN ACADEMY

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21. Study of GaInP/GaAs/GaInNAsSb triple junction solar cells: Effect of hydrogen incorporation to GaInNAsSb in MOCVD/MBE hybrid growth (N. MIYASHITA)

**MONDAY 07/29**

**Meeting Room No 207**

22. Modulation spectroscopy of functional molecular systems and polymers (T. IIMORI)

23. Tunable color of colloidal photonic crystals immobilized in soft polymers (T. KANAI)

24. Application of UV-curable nanoparticles to polymer-dispersed liquid crystals and other related composites (M. AKIMOTO)

25. Density Functional Scheme for Calculating the Fluctuation of the Electron Number in the Superconductor (M. HIGUCHI)

26. Magnetic Properties of graphene investigated by the nonperturbative MFRTB method (K. HIGUCHI)

27. Competitions on magnetic and structural phase transitions of intermetallic alloys (K. UEBAYASHI)

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# **Conference Poster Presentation Abstracts**

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 1**

## **Fracture Toughness and Fracture Patterns of Single Crystal Silicon in High Temperature Ranges**

Yudai SHIROKI, Masayoshi TATENO, Kogakuin University, Japan

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This paper provides the fracture toughness and fracture patterns on a cleavage plane (110) of the single crystal silicon in high temperature range.

Effects of a removal surface of small specimen on the fracture toughness of single crystal silicon in room temperature conditions to clarify a properly removed surface based on controlled surface flaw (CSF) method. Removing the residual stress on the surface, which indentation crack was introduced, is required on CSF method. The surface of the small specimen cut from the silicon wafer was removed by an ion shower technique after a small thin crack was introduced on the center of the small specimen. A proper removal amount of the surface related to removal conditions was considered based on the experimental results.

It experimentally provides that effects of a furnace temperature conditions on the fracture toughness and fracture patterns of the single crystal silicon.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 2**

## **Relationship between Tensile Strength of Ceramics to metal joint and Thermal Stress near Edge of Interface**

Shunsuke MURAOKA, Masayoshi TATENO, Kogakuin University, Japan

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This study provides that relationship between distributed thermal elastoplastic stresses near the edge of the interface and practical tensile strength of ceramics/metal joint system with arbitrary wedge angles. Interface wedge angles were defined as a configuration angle between interface and free surfaces of both materials. The wedge angles on ceramics and metal were described  $\phi_1$  and  $\phi_2$  respectively. The wedge angles of the metal side  $\phi_2$  were set over the range from  $27^\circ$  to  $180^\circ$ , as kept maintaining one of the ceramic side  $\phi_1 = 90^\circ$ .

Thermal elastoplastic FEM was carried out to clarify the distribution of the thermal residual stress near the edge of the interface each wedge condition using ceramics to metal joint FEM models bonded at  $780^\circ\text{C}$ . The stress singularity was confirmed near the edge of the interface on the free surfaces of ceramic side each FEM model. For  $\phi_2 \leq 90^\circ$ , the gradient of stress distribution decreases with decrease in the wedge angle. For  $\phi_2 > 90^\circ$ , the gradient was slightly changed when  $\phi_2$  approaches approximately  $\phi_2 = 150^\circ$ .

The numerical results were compared with the experimental results, which showed effects of the wedge angle on the practical tensile strength of silicon nitride to nickel joints specimens bonded at  $780^\circ\text{C}$ . Changing the wedge angle from the right wedge angle improves the tensile bonding strength, since the residual stress was decreased by changing the wedge angle for  $90^\circ \leq \phi_2 \leq 135^\circ$ . The maximum bonding strength appears at approximate  $\phi_2 = 135^\circ$ . This result corresponds with the FEM results as increasing  $\phi_2$  from  $\phi_2 = 90^\circ$  decreases the concentration intensity of the residual stress.

The dependency of the optimum interface condition on the bonding temperature was discussed based on both results of numerical and experimental in different bonding temperature condition.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 3**

## **Electrolytic behavior of environmental pollutants using graphene electrodes**

Kyohei FUJISAWA, Chiba Institute of Technology University; Masatou ISHIHARA, Yuki OKIGAWA, National Institute of Advanced Industrial Science and Technology; Setsuko KOURA, Chiba Institute of Technology University, Japan

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The electrochemical method has the advantage of being able to oxidatively decompose the persistent substance. The substance is decomposed efficiently by using a material having a high electron transfer rate. Therefore, we focused on graphene that has excellent electrical conductivity and is physically and chemically stable. Graphene is mainly studied as a device because of its characteristics, but studies on graphene electrodes have not been sufficiently researched. In this study, the possibility of using graphene as a water treatment electrode, were investigated by the decomposition behavior of the selected substance. The graphene film was formed by plasma chemical vapor deposition (CVD). It was transferred to a Si substrate and evaluated by Raman spectroscopy. Cyclic voltammetry was performed to measure the potential window of the transferred graphene film using a potentiostat/galvanostat. The pollutant, bisphenol A (BPA), used as an indicator, was electrolyzed for 5 minutes, the concentration of BPA was examined by a high-performance liquid chromatography (HPLC). It was confirmed that the graphene film was transferred to the Si substrate by Raman spectra. The potential window of the prepared graphene film was found to be 3.5 V at pH 7. It was concluded that the prepared graphene film can reduce the environmental pollutant bisphenol A to 1% of the original concentration in 5 minutes. It was concluded that bisphenol A was decomposed by the graphene film produced by the plasma CVD.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 4**

## **Phosphate Separation and concentration from seawater by Electrodialysis**

Miyako ASAH, Setsuko KOURA, Chiba Institute of Technology, Japan

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Recently, Eutrophication of seawater due to the increase of nutrients such as nitrogen and phosphorus has become a problem. On the other hand, phosphorus, which is used for fertilizers, is limited because of mineral resources, and there is concern about depletion. It will be necessary in the future to find ways to make effective use of phosphorus that has flowed into the sea. However, it is difficult to use the phosphorus in seawater, because of the quite low concentration.

In this study, separation and concentration of phosphorus in seawater was examined by using an electrodialysis apparatus with a monovalent cation selective exchange membrane and a monovalent anion selective membrane. The phosphate ion concentration of the desalted solution compartment and that of the concentrated solution compartment were measured respectively. The effect of high salinity to the concentration of phosphate ion was investigated for 0.6mol/L NaCl and 8 mmol/L PO<sub>4</sub><sup>-</sup> solution or 0.3mol/L NaCl with 8mmol/L solution. In the case of

0.3 mol/L NaCl solution, phosphate ion was moved to the concentrated compartment. On the other hand, in the case of 0.6 mol/L NaCl solution, phosphate ion wasn't moved and only NaCl moved. From this, it was found that when the salt concentration is lower than 0.3mol/L, phosphate ions can be moved and concentrated. Finally, we could understand that we need to concentrate the phosphate ion from seawater in two steps. That is, we should separate the NaCl to phosphate ion from seawater in the first step, and then we can concentrate the phosphate ion in the second step. It will be possible to concentrate the phosphate ion from seawater if these two steps are used well.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 5**

## **Electrical and electroless plating of Al using ionic liquid**

Kohei MAKINO, Setsuko KOURA, Chiba Institute of Technology, Japan

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Al is used as a wiring material in the field of semiconductors, and in the field of secondary batteries, it is attracting attention as a candidate for the next-generation battery negative electrode material that can realize high capacity. However, in the case of semiconductor wiring, the cost increases due to the use of complicated equipment, and in the case of a secondary battery, the aqueous solution system can not be used because the potential of Al is negative.

In this research, in order to solve these problems, an ionic liquid was used to deposit Al, and deposition of Al by electroless plating and electroplating was attempted without the need for complicated equipment. And, it was tried to smooth surface of Al deposited by adding an additive to the electrolytic solution of electroplating. As the substrate, Al for the secondary battery and various coated silicon substrates for the semiconductor were used. Further, a mixed solution of  $\text{AlCl}_3$  66.7 mol% EMIC 33 mol% was used as an electrolyte. Various prepared samples were measured using SEM and X-ray diffraction.

Furthermore, we could obtain some suggestion about the mechanism by performing IR measurement. The present study shows that there is a possibility that electric and electroless Al plating can be performed on various substrates, and that the additive has a smoothing effect.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 6**

## **The Study of the Effect of Oxygen Ultra Fine Bubble Water on Growth of Tomato**

Marie KOURA, Keio University; Setsuko KOURA, Chiba Institute of Technology, Japan

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Ultra fine bubbles (UFB), which are bubbles of diameter below 500nm, have several unique properties such as long lifetime in liquid and its high gas solubility into the liquid. Recent attention has been given to industrial application of UFB in several fields. In agricultural production areas, especially the plant cultivation, some studies of UFB added solution had been carried out.

In this paper, the effect of oxygen Ultra Fine Bubbles (UFB) water on the cultivation of tomatoes was studied. Oxygen UFB water was prepared by gas-liquid mixed shear method with compact generator. The dissolved oxygen concentration just after prepared oxygen UFB water was about 40 mg dm<sup>-3</sup>. In the case of hydroponic cultivation from seeds, regardless of the type of tomato, the germination rate and the growth rate were increased with oxygen UFB water. And the leaf color became dark. However, after 20 days the growth of tomato with oxygen UFB water became difficult. These results mean that oxygen UFB water effect to the germination and growth of sprout. On the other hand, oxygen UFB water shows negative effect to the growth of leaves and stems. And the effect of oxygen UFB water on soil cultivation was also studied. We investigated the effect of oxygen UFB water on soil cultivation with the obtained seedlings as a start. The starting length of seedlings was around 16cm and the stem thickness was around 5cm. 5 seedlings were grown with oxygen UFB water, and the other 5 seedlings were grown with tap water. After 1 month, the tomato leaves with oxygen UFB water showed yellow color and gradually wilted. And the number of tomatoes with oxygen UFB was lower than that of tap water. Oxygen UFB water showed negative effect to the growth of tomato for soil cultivation.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 7**

## **Effect of HCO<sub>3</sub><sup>-</sup> concentration on TiO<sub>2</sub> photocatalytic sterilization**

Genki ISHII, Chiba Institute of Technology; Nobuaki NEGISHI, Yukari MIYAZAKI, National Institute of Advanced Industrial Science and Technology; Setsuko KOURA, Chiba Institute of Technology, Japan

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Up to the present date, infections caused by bacterial contaminated drinking water have been regarded as a problem in many developing countries. The United Nations has listed “clean water and sanitation” as the sixth item of Sustainable Development Goals (SDGs) in 2015. Water treatment technology by TiO<sub>2</sub> photocatalysis is suitable for drinking water purification in developing countries because of its safety, low cost, simplicity, and availability of sunlight used as an energy source. However, actual water usually contains inorganic ions (minerals), and it is essential to evaluate the influence of minerals in water against photocatalytic sterilization for practical use of photocatalytic water purification in the future. In this study, the influence of bicarbonate ion (HCO<sub>3</sub><sup>-</sup>) abundantly present at neutral pH region of groundwater against sterilization by the TiO<sub>2</sub> ceramic photocatalyst is investigated.

In this experiment, sample water containing Escherichia coli (E.coli) and sodium bicarbonate adjusted to each concentration was circulated through TiO<sub>2</sub> ceramic photocatalyst packed glass tube by a water pump, and the decrease of E.coli by photocatalysis was counted under UV-A irradiation. The sterilization experiment was continued for 3 hours, and sampling interval was 30 minutes.

As a result, it is clarified that HCO<sub>3</sub><sup>-</sup> adversely affects photocatalytic sterilization even in a low concentration region ( $\cong$  100 mg/L) that is included in soft water. On the other hand, it is well known that calcium carbonate precipitates on a ceramic photocatalyst when water containing HCO<sub>3</sub><sup>-</sup> and Ca<sup>2+</sup> coexist is treated with a photocatalyst. We also found that the sterilization efficiency is improved when the precipitate is an aragonite crystal. However, detailed sterilization mechanism in aragonite contained system is unexplained. Anyhow this research will contribute to the SDGs6 item and will bring great evolution to the future photocatalytic sterilization field.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 8**

**In situ transmission X-Ray microscopy studies of Li plating and stripping mechanism in high concentrated electrolyte**

Chun-Yao WANG, Heng-Liang WU, National Taiwan University, Taiwan

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Sparingly solvating electrolytes such as acetonitrile-based solvate electrolyte have been proposed to improve the performance of lithium metal batteries. However, lithium metal anode is unstable in acetonitrile-based solvate electrolyte, mainly due to the formation of lithium dendrite and dead lithium during cycling. In this study, we found that acetonitrile-based electrolyte with different salt concentration results in changes in the composition of solid electrolyte interphase (SEI) layer on lithium metal and the conductivity of lithium battery cells. In addition, we report on our use of in situ transmission X-ray microscopy (TXM) to study the mechanism of lithium plating and stripping. TXM has been used to monitor the behavior of lithium plating and stripping with great spatial resolution (in nanometer scale). TXM results suggest that acetonitrile-based electrolyte with different salt concentration governs the mechanism of lithium plating and stripping. We next propose different electrolytes to enhance the capacity retention of lithium metal batteries.

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**Meeting Room No 201**

**Abstract ID: 9**

**Development of Novel Poly(3-alkylthiophene)/Inorganic Semiconductor Hybrid Materials with Self-Assembled Nanostructures**

Pin-Sheng YEH, Ying-Tien HSU; Wei-Yen SUN, Yi-Huan LEE, National Taipei University of Technology, Taiwan

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In this study, we report on a development of a novel organic/inorganic hybrid system by using an in situ synthesis method. For this fabrication,  $\pi$ -conjugated polymer poly(3-butylthiophene) (P3BT) and zinc acetate dihydrate were first mixed to form P3BT/Zn<sup>2+</sup> complexes, followed by adding a marginal solvent anisole into the solution to force the crystallization of the P3BT molecular chains. The solution crystallization process could efficiently induce one-dimensional P3BT/Zn<sup>2+</sup> nanofibrils dispersed in the solution medium. Then, the hybrid solution was drop-cast onto flat substrates, followed by heating the film samples to convert Zn<sup>2+</sup> into ZnO nanocrystals. The coaxial P3BT/ZnO nanofibrils which extended along their fiber long-axis for several hundred nanometers possessed large donor/acceptor interfaces for excitons dissociation and also offered continuous nanochannels for efficient charge transfer. Therefore, there was an efficient energy/electron transfer between the  $\pi$ -conjugated P3BT segments and ZnO nanocrystals in the hybrid system, resulting in a significant photoluminescence quenching effect. Additionally, accelerated aging experiments were further performed. We could observe that the P3BT/ZnO hybrid exhibited superior thermal stability beneficial to long-term use. We believe that the in situ synthesized P3BT/ZnO hybrid system shows potential for advanced photovoltaic applications.

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**Meeting Room No 201**

**Abstract ID: 10**

## **Novel Self-Healable Magnetic Nanocomposites Based on Diels-Alder Click Chemistry**

Wen-Chi KO, Yan-Nian ZHUANG, Chia-Wei LEE, Yi-Huan LEE, National Taipei University of Technology, Taiwan

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In this study, we developed a novel magnetic organic/inorganic nanocomposite system with self-repairable ability. First, a polycaprolactone-poly(furfuryl glycidyl ether) copolymer (PCLF) was synthesized, followed by adding iron oxide nanoparticles-decorated multiwalled carbon nanotubes (IONPs-MWCNTs) and 1,1'-(methylenedi-4,1-phenylene)bismaleimide (BMI) into PCLF to fabricate a series of hybrid samples. For the material system, the PCLF copolymer acted as a polymeric template to efficiently incorporate IONPs-MWCNTs. Simultaneously, the furan and maleimide groups served as reactive diene and dienophile sites to form Diels-Alder (DA) crosslinked networks. The DA based hybrid system with uniform distribution of IONPs-MWCNTs not only possessed superparamagnetic properties but also exhibited superior self-healing ability to repair scratch defects via a thermally induced retro-DA reaction. We believe that this nanocomposite system can be served as a smart material and show potential for advanced electromagnetic applications.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 11**

## **Anti-solvent effect on photovoltaic performance of perovskite solar cells**

Shou-En CHIANG, Sheng Hsiung CHANG, Chung Yuan Christian University, Taiwan

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In this report, the perovskite thin films were fabricated by using the one-step spin coating method with a washing enhanced nucleation (WEN) process. Toluene and iodobenzene were used as the antisolvent during the WEN process due to the low polarity which cannot dissolve the solutes of perovskite precursor and thereby resulting in the large amount of nucleation sites.

As we know that the polarity (Boiling Point) of toluene is lower (higher) than that of iodobenzene. Therefore, the formation of perovskite thin films is strongly related to the use of the different antisolvent.

Our experimental results show that the photovoltaic performance of the perovskite solar cells is related to the fundamental properties of corresponding perovskite thin films.

In addition, the surface properties of perovskite thin films also influence the contact between the hydrophilic perovskite thin film and the hydrophobic PCBM thin film (electron transport layer), which dominates the behavior in the J-V curve.

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# GOLDEN ACADEMY

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 12**

## **Investigations of double perovskite thin-film solar cells**

Diksha THAKUR, Shang Hsiung CHANG, Chung Yuan Christian University, Taiwan

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In this report, the double perovskite ( $\text{Cs}_x\text{MA}_{1-x}\text{Pb}(\text{I}_{1-x}\text{Br}_x)_3$ ) thin-film based photovoltaic cells were investigated for realizing the highly efficient and stable solar power. In order to understand the relation between the fundamental properties of double perovskite thin films and the corresponding solar cells, the x-ray diffractometer patterns, scanning electron microscopic images, water-droplet contact angle images, absorbance spectrum, and photoluminescence spectrum were used. Our experimental results show that the power conversion efficiency of double perovskite photovoltaic cells can be further improved from 10% to 14%.

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# GOLDEN ACADEMY

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 13**

## **A highly efficient and stable semi-transparent perovskite photovoltaic cell**

Jia-Ren WU, Sheng-Hsiung CHANG, Chung Yuan Christian University, Taiwan

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A highly efficient and stable semi-transparent perovskite photovoltaic cell can be achieved by using an indium tin oxide/molybdenum oxide (ITO/MoOx) bilayer as the anode electrode with a cyclopenta[2,1-b;3,4-b']dithiophene (CT) based hole-transport material(HTM), which allows bifacial illumination from both sides of the electrodes. The MoOx thin film is a wide bandgap material. And, the MoOx thin film is not only as an electron blocking layer (EBL), but also be a passivation layer which can tolerate energy bombardment during the deposition of an ITO thin film made by the radio-frequency magnetron sputtering method. The high power conversion efficiency for small cell (0.16 cm<sup>2</sup>) and module cell (11.7 cm<sup>2</sup>) are 16.38% and 14.96%, respectively.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 14**

## **Effect of Ga deposition rate on GaAsSb/GaAs Quantum Dots formation**

Yusuke OTEKI, University of Tokyo; Yasushi SHOJI, National Institute of Advanced Industrial Science and Technology; Naoya MIYASHITA, Yoshitaka OKADA, University of Tokyo, Japan

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A high conversion efficiency of the intermediate band solar cell based on increase in the photocurrent through the two-step light absorption process. In order to improve the two-step light absorption, we have focused on GaSb/GaAs type II quantum dots (QDs). This is expected to extend the lifetime of photocarriers since excited electrons and holes are spatially separated. In addition, in GaAsSb/GaAs QDs systems, the intermediate band position can be controlled by tuning As/Sb composition. However, few reports have been found on the growth of GaAsSb/GaAs QDs to date. In this work, we investigated the effect of growth rate on the QDs formation process. First, 200 nm GaAsSb thin film was fabricated on GaAs (001) substrates with simultaneous supply of Sb ( $8.0 \times 10^{-6}$  Pa) and As fluxes ( $1.0 \times 10^{-4}$  Pa) using molecular beam epitaxy. Then, the composition and lattice relaxation of the GaAsSb thin film were estimated to be GaAs<sub>0.10</sub>Sb<sub>0.90</sub> and 94.5%, respectively, from a reciprocal space mapping by high resolution X-ray diffraction measurement. Next, QDs were grown by depositing 2.3 ML GaAsSb with growth rate of 0.10, 0.20, and 0.38 ML/s, where group V fluxes were fixed to the above ones. After a first QDs layer was grown, it was capped by a 150 nm GaAs layer. Then, a second QDs layer was grown on the surface, which was subjected for atomic force microscopy observation. The QDs densities at 0.1 and 0.2 ML/s were both  $3.0 \times 10^{10}$  cm<sup>-2</sup>, whereas it decreased to  $2.3 \times 10^{10}$  cm<sup>-2</sup> at 0.38 ML/s. Furthermore, the size and the density of the coalesced giant dots tends to increase as growth rate increases. On the other hand, no giant dot was observed in the 0.10 ML/s sample, suggesting that coalescence was suppressed.

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**Meeting Room No 201**

**Abstract ID: 15**

## **Fabrication of Circular Defect Photonic Crystal Laser by Dry Etching**

Shun MIZOGUCHI, Yifan XIONG, Masato MORIFUJI, Hirotake KAJII, Akihiro MARUTA, Masahiko KONDOW, Osaka University, Japan

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We investigated deep and vertical dry etching of GaAs/AlGaAs-based epi-wafer, including InAs quantum dots (QDs). We have proposed a novel design of a current-driven photonic crystal (PhC) laser called as a circular defect (CirD) laser. Fabrication of the CirD laser requires two-dimensional PhC structure on GaAs/AlGaAs-based epi-wafer with InAs QDs as the active material. Since the target lasing wavelength of this device is about 1300 nm, the lattice constant  $a$  of the photonic crystal was set to 335 nm. The radius of the air hole  $r$  had to be  $0.3a$  or more for wide photonic band gap. The high verticality was also required for the better photon confinement. The etching was performed by inductively coupled plasma reactive ion etching using  $\text{Cl}_2$ ,  $\text{BCl}_3$ , and  $\text{CH}_4$  gas mixture. The core layer, which is the GaAs layer including InAs QDs, is difficult to be etched due to the low vapor pressure of  $\text{InCl}_3$  that is generated by InAs and  $\text{Cl}_2$ . Therefore, the air holes fabricated by dry etching process were shrunk at the core layer. In this study, we revealed that  $\text{CH}_4$  flow rate affected the verticality of the air holes. However, a collapse of the core layer occurred when the  $\text{CH}_4$  flow rate was too low. By using the dry etching process with optimized the  $\text{CH}_4$  flow rate, fabrication of the air holes with high verticality becomes possible without damage. The air holes were as deep as  $1.5 \mu\text{m}$ , and the radius under the core layer was 87 % of the radius above the core layer. We also fabricated a CirD laser structure by using dry etching, and a spectrum with a center wavelength of 1322 nm was obtained by photopumping.

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# GOLDEN ACADEMY

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**Meeting Room No 201**

**Abstract ID: 16**

## **High frequency characteristics analysis of photonic crystal circular defect laser**

Hangqiao YE, Tomoya NISHIMURA, Takuya YAMAGUCHI, Yifan XIONG, Masoato MORIFUJI, Hirotake KAJII, Masahiko KONDOW, Osaka University, Japan

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Because of the increase of the amount of information communications in recent years, devices for high-speed inter-chip or intra-chip optical communications are expected. We previously proposed a device containing photonic crystal circular defect (CirD) lasers for wavelength division multiplexing communications. By coupling 20 CirD lasers to a waveguide, it is expected to achieve huge communication capacity with 1 Tbps. However, verification of high frequency operation is still insufficient for this laser. In this study, based on the Finite-Difference Time-Domain (FDTD) simulation results, we investigate the current-output characteristics and high frequency characteristics by using two-dimensional rate equations. We reveal that excessive quality factor may reduce the relaxation oscillation frequency. When the photon lifetime is 2 ps and the quality value is about 3000, a small threshold current of 5  $\mu\text{A}$  and a high relaxation oscillation frequency can be simultaneously obtained. These support a single CirD laser to operate at the speed of 50 Gbps.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 17**

## **Influence of O<sub>2</sub> plasma treatment on the magnetic properties of Co-Pt thin films**

Tomoyuki SUGIMURA, Haruki YAMANE, Keisuke TAKEDA, Yasuyoshi ISAJI, Masanobu KOBAYASHI, Chiba Institute of Technology, Japan

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Introduction: There is a magneto-optical effect that utilizes the physical action of magnetism and light.

Magneto-optical effects include the Faraday effect and the Magnetic Kerr effect. Currently, we are researching and developing sensors using the magnetic pole Kerr effect.

In this experiment, with respect to the Co-Pt magnetic thin film expected to be used for the magneto-optical sensor, the change of the perpendicular magnetic property due to the presence or absence of the air exposure treatment of the AZO protective layer and the presence or absence of the O<sub>2</sub> plasma treatment was compared and examined.

Method: Samples were prepared using a DC magnetron sputtering apparatus. Conditions, degree of vacuum:  $5.0 \times 10^{-5}$  Pa or less, Ar gas pressure: 0.2Pa, Silicon substrate, [AZO/(Not, Atmosphere revelation, O<sub>2</sub> plasma)/Co-Pt/AZO/Ag/AZO].

The prepared samples were measured magnetic properties VSM, and the structural analysis using X-ray diffraction.

Result: The perpendicular magnetic anisotropy than a sample without a cap layer decreased by layering cap layer AZO from result of a measurement of VSM. However, it has been found that exposure between the magnetic layer and the cap layer results in the same verticality as the sample without the cap layer. In addition, I knew that the perpendicular magnetic anisotropy went up it more than atmosphere revelation when I gave O<sub>2</sub> plasma processing in a process like the atmosphere revelation.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 18**

## **Optical electrical characteristics improvement by the transition metal addition to a ZnO film**

Takumi KOIDE, Chiba Institute of Technology, Haruki YAMANE, Akita Industrial Technology Center; Masanobu Kobayashi, Chiba Institute of Technology, Japan

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Introduction: ITO is used for the displays such as TV or the PC and various touch panel as a transparent electrode. Because the indium which is the raw materials has few reserves, and there are many consumptions, stable supply is regarded as uneasiness in the future. Therefore it is cheaper, and the study of the stable substitute materials which it can supply it to is pushed forward.

It was intended that I examined the change of the optical electrical property when I added a transition metal in a base in ZnO which attracted attention as substitute materials of ITO in this study.

Method: I layered the sample which added a transition metal in ZnO at 200nm on glass substrate by sputtering. The sample which I made performed transmissivity, an addition rate, electric specific resistance, structure analysis by the X-ray diffraction. Furthermore, I performed heat-treatment (500 degrees Celsius, 1h) and performed similar measurement about a sample after the heat-treatment again.

Result: The drop of the electric specific resistance by the elemental addition was not seen in ZnO-Cr film, the ZnO-Ta film and was a similar result without depending on an experiment condition. A drop of the electric specific resistance of  $1.29 \times 10^3 \Omega$ , the cm degree was seen in the ZnO-Mn film, but the drop of the further electricity specific resistance by the change of the experiment condition was not seen. A drop of the electric specific resistance of  $23.5 \Omega$ , the cm degree was seen in the ZnO-Nb film. A drop of the electric specific resistance was seen to  $2.3 \times 10^{-2} \Omega$ , cm degree in the ZnO-Ti film, and a drop of the electricity specific resistance was seen to  $1.6 \times 10^{-2} \Omega$ , cm degree by heat-treating it. In addition, the drop of the transmissivity was not seen other than the sample which added Mn and Cr.

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**Meeting Room No 201**

**Abstract ID: 19**

## **Water-solubilization/desolubilization of high-performance biopolyamides by binding to alkali/alkaline earth metals**

Yasuyoshi FUNAHASHI, Amit KUMAR, Kenji TAKADA, Tatsuo KANEKO, Japan Advanced Institute of Science and Technology, Japan

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[Introduction] 4-Aminocinnamic acid could be reacted by photoirradiation to produce the polyamide monomers, dicarboxylic acid and diamine. By using these monomers and aliphatic dicarboxylic acid polyamides copolymer also could be synthesized. These kind of 4-aminocinnamic acid-based polyamides showed high heat-resistance and mechanical properties. However, processability of these polyamides were poor because polyamides were only dissolved to aprotic organic solvents such as N, N-dimethylformamide, dimethyl sulfoxide, N-methyl-2-pyrrolidone. From these background, two main purpose of this research had been set: 1) to synthesize and evaluate water soluble co-polyamides; 2) to prepare insolubilized polyamides using for divalent metal ion.

[Experiment] Copolyamides were synthesized using 4,4'-diamino- $\alpha$ -truxillic acid dimethyl ester, 4,4'-diacetamido- $\alpha$ -truxillic acid, and suberic acid. The obtained copolyamides were suspended into aqueous solution of MOH (M: Li, Na, K, Cs) for synthesis the water-soluble polyamides. After the treatment, solution become clear, the obtained mixture was reprecipitated into ethanol. Obtained polyamide was dissolved in water to prepare the polyamide film. K-type polyamide film was immersed in alkaline earth chloride ( $MgCl_2$ ,  $CaCl_2$ ,  $SrCl_2$ ,  $BaCl_2$ ) solution to insolubilize.

[Results and Discussion] Structure of the obtained copolyamide was confirmed by  $^1H$  NMR measurements. Obtained water-soluble polyamide films had high transparency up to 85% and yellowness index was low as 3.0. In addition, water-soluble polyamides showed no solubility for polar aprotic solvent, such as N,N-dimethylformamide, dimethyl sulfoxide, N-methyl-2-pyrrolidone, tetrahydrofuran, dichloromethane, and acetone. It was considered that polarity of the polyamides was increased by substitution with metal cation. Tensile strength of the water-soluble polyamide films was higher than the original polyamide. This result indicated that the water molecules which contained in the water-soluble polyamide films acted as the softening agent. By treating with alkaline earth chloride aqueous solution, polyamide films become water-insoluble not only water but also any other organic solvents. Thermal and mechanical properties of insolubilized polyamide films were higher than the water-soluble polyamide due to the crosslink by divalent ion.

[Acknowledgements] This work was financially supported by JST-ALCA project (JPJAL1010), Japan.

**Notes**

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 20**

## **Biopolyamides of cinnamoyl photodimer derivatives with abnormal bending angles**

Takumi NODA, Kenji TAKADA, Amit KUMAR, Tatsuo KANEKO, Japan Advanced Institute of Science and Technology, Japan

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[Introduction] Introduction of bending structure in the polymer backbone is useful method to control the properties, such as solubility, mechanical properties, and so on. Previously, High performance polyamide ( $\alpha\alpha$ -PA) which composed linear type 4-aminocinnamic acid photo-dimer. ( $\alpha$ -type truxillic acid) [1] Truxinic acids, which can also be afforded by photo-dimerization of cinnamic acids, can work as a bent structure in main chain since same functional groups are bonded on adjacent carbon atoms in cyclobutane. There are 10 stereoisomers in the truxinic acids. [2] Among them,  $\beta$ -type and  $\delta$ -type dimer have different bent angle. The aim of this research is to evaluate of structure-property relationships of  $\beta$ - and  $\delta$ -truxinic acids-based polyamides.

[Results and Discussion]  $\alpha$ -type,  $\beta$ -type and  $\delta$ -type photo-dimers were selectivity synthesized from functionalized 4-aminocinnamic acid derivatives such as 4-aminocinnamic acid hydrochloride, 4-nitrocinnamic acid methyl ester and 4-nitrocinnamic acid N-hydroxysuccinimide ester. The obtained photo-dimers were used for polyamide syntheses as diamine and diacid monomers. Moreover, molecular weight, thermal properties and solubility of the obtained polyamides were evaluated.

The bent type polyamides, which composed  $\beta$ - and  $\delta$ -type monomers, showed lower molecular weight and weight loss temperature than reported  $\alpha$ -type-based linear polyamide ( $\alpha\alpha$ -PA). The bent type polyamides has a larger exclusion volume effect than the linear type polyamide, so that entanglement of the polymer chains are inhibited. As a result, it is considered that when the entanglements of polymer chains are reduced, the mobility of the polymer chain is improved, and the thermal property is lower compared with the linear polymer ( $\alpha\alpha$ -PA)

[Acknowledgements] This work was financially supported by JST-ALCA project (JPJAL1010), and Grants-in-Aid for Scientific Research B (15H03864).

### [References]

[1] S. Tateyama, S. Masuo, P. Suvannasara, Y. Oka, A. Miyazato, K. Yasaki, T. Teerawatananond, N. Muangsin, S. Zhou, Y. Kawasaki, L. Zhu, Z. Zhou, N. Takaya, T. Kaneko, *Macromolecules* 2016, 49, 3336–3342.

[2] J. R. Mallette, J. F. Casale, *J. Chromatogr. A* 2014, 1364, 234-240.

**Notes**

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 21**

## **Super-thermoresistance in bio-based benzazoles from wholly-aromatic amino acids**

Xianzhu ZHONG, Nag ANIRUDDHA, Kenji TAKADA, Amit KUMAR, Tatsuo KANEKO, Japan  
Advanced Institute of Science and Technology, Japan

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Introduction: Development of bio-based plastic is certainly significant to establish the green sustainable society. Polybenzimidazoles (PBIs) have been attracting researchers' attention for their excellent thermal and mechanical properties since long back. In our laboratory, we have already developed poly(2,5-benzimidazole) (PBI) using bio-based aromatic monomer 3,4-diaminobenzoic acid (3,4-DABA), and poly(2,5-benzoxazole) (PBO) using biomolecule 3-amino-4-hydroxybenzoic acid (3,4-AHBA) respectively. Bio-based ABPBI and ABPBO showed excellent thermo-mechanical properties due to its rigid structure. However, both of PBO and PBI have poor solubility and processability due to a stiff structure that has low moldability. PBO and PBI are class of materials of high hardness, this is a result of dense stack of imidazole and oxazole rings in the polymer backbone, constricting the flexibility of structure, thus greatly limited the application of PBO and PBI polymers. On the other hand, polyamide is a kind of polymers of high flexibility compared with PBO and PBI owing to the amide group based configuration. Herein we prepared PBO-co-PA and PBI-co-PA copolymers, introducing amide groups to polymer backbone, which are assumed to reduce the stiffness and increase the flexibility of materials.

Results and discussion: Poly(benzoxazole-co-amide) (PBO-co-PA) copolymers were synthesized through the copolymerization of 3,4-AHBA and PABA. Thermal stabilities Td5 and Td10 of PBO-co-PA showed normal decreasing trend compared with PBO homopolymer. On the other hand, poly(benzimidazole-co-amide)s (PBI-co-PA) synthesized through the copolymerization of 3,4-DABA and 4-aminobenzoic acid (PABA), showed a peak of thermal stabilities around 15% incorporation of PA into PBI units. As a result, unexpectedly high thermal stabilities were detected comparable with inorganics and metals. The mechanism to show such a high thermal stability was discussed based on hydrogen bonding of PBI with PA units. In both experiments, the introduction of PA to the polymer backbone successfully enhanced the flexibilities of structure.

Acknowledgements: This work was financially supported by JST-CREST and SIP project "Smart-bio" (NARO), Japan.

References: (1) K. Kan, S. Tateyama, T. Kaneko, *Macromol. Res.*, 2014, 22 (7), 725-730.

(2) T. Hannori, K. Kagawa, Y. Imai, *Polym. J.* 1995, 27, 395-403.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 22**

## **Particle Dispersibility and Magnetorheological Effect for Magnetic Elastomers with Ultra Sonication**

Mayuko WATANABE, Junko IKEDA, Niigata University; Yoshihiro TAKEDA, Rigaku Corporation; Mika KAWAI, Tetsu MITSUMATA, Niigata University, Japan

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The effect of sonication time on the storage modulus and particle morphology for magnetic elastomers was investigated by dynamic viscoelastic measurements and morphological studies. An ultrasonic wave using a homogenizer was irradiated to magnetic liquids containing 70 wt% carbonyl iron, for up to 30 min before cure. SEM photographs revealed that magnetic particles were randomly dispersed in the polyurethane matrix for magnetic elastomers with sonication. A parameter showing nonlinear viscoelasticity for magnetic elastomers with sonication decreased from 0.75 to 0.4, indicating that the aggregations of magnetic particles had been destroyed by the sonication. The storage modulus at 500 mT at the linear viscoelastic regime significantly increased with the irradiation time, reaching saturation after 10 min; this suggests an increase in the number of chains of magnetic particles by sonication, due to the random dispersion of magnetic particles. At high strains, the storage modulus at 500 mT increased by 8.9 kPa by sonication, indicating the number of chains of magnetic particles which were not destroyed by increased sonication. It was also found that the storage modulus for polyurethane elastomers without magnetic particles was not varied by sonication, suggesting that the polyurethane network was not broken. The effect of sonication time on the viscoelastic properties, and on the magnetorheological response for magnetic elastomers, is discussed.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 23**

## **Electric Resistivity for Polyimide and Biopolyimide films**

Amat Yusof FITRI ADILA, Shunsuke KATO, Niigata University; Kenji TAKADA, Tatsuo KANEKO, Japan Advanced Institute of Science and Technology; Mika KAWAI, Tetsu MISTUMATA, Niigata University, Japan

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We synthesized thin films of a biopolyimide which is a copolymer of 4-aminotruxillic acid (ATA) and 1,2,3,4-cyclobutanetetracarboxylic dianhydride (CBDA) and measured the electric volume resistivity for poly(ATA-co-CBDA) films at various experimental conditions. The effects of film size, film thickness, drying time, and the electric field strength on the electric resistivity was investigated and it was compared with polyimide (PI) such as Kapton. The value of the electric resistivity for both polyimide and biopolyimide films was ranging from  $10^{15}$  to  $10^{16}$   $\Omega\text{cm}$  for all film size. The electric resistivity was also strongly depends on the film thickness and electric field strength. The critical value of the electric field for polyimide and biopolyimide films were determined to be  $5.8 \times 10^7$  V/m and  $3.2 \times 10^7$  V/m, respectively. It was also found that the humidity strongly affects the electric conductivity of the films;  $\sim 10^{16}$   $\Omega\text{cm}$  at 34% RH and  $\sim 10^{13}$   $\Omega\text{cm}$  at 60% RH for both polyimide and biopolyimide films.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 24**

## **Particle dispersibility and magnetorheological effect for carrageenan magnetic hydrogels**

Junko IKEDA, Junko TAKAHASHI, Mika KAWAI, Tetsu MITSUMATA, Niigata University, Japan

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Magnetic soft material consists of polymer gel and magnetic particles, and it demonstrates drastic increase in the elastic modulus by magnetic fields, which is called magnetorheological effect. We have cleared so far that the increase in the elastic modulus strongly depends on the dispersibility of magnetic particles within the polymer gel; that is, significant increase in the elastic modulus is observed for gels with random dispersion of magnetic particles while little increase in the modulus is observed for gels with aggregated particles. In this study, we measured the zeta potential of magnetic particles within an aqueous solution of carrageenan and investigated the dispersibility of magnetic particles within the magnetic hydrogels. In addition, the amount of adsorbed carrageenan on the magnetic particles was determined by the viscosity measurements. It was cleared that the carrageenan chains are adsorbed on the carbonyl iron particles, and this contributes to the random dispersion of particles within the gel. The effect of dispersibility of magnetic particles on the magnetorheological effect is discussed.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 25**

## **Synthetic Studies of Polymers by Ring Opening Metathesis Polymerization (ROMP) Using Half-esters**

Wataru SHOJI, Muroran Institute of Technology, Japan; Jianjun SHI, Hainan Normal University, China; Satomi NIWAYAMA, Muroran Institute of Technology, Japan

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### 1. Introduction

The development of environmentally friendly organic reactions has been of central importance, and water-mediated organic reactions are typical "green chemistry". We have been developing highly efficient selective monohydrolysis reactions of symmetric diesters in the aqueous media. [1] Half-esters, which are obtained by the selective monohydrolysis reaction, have been applied to various industrial products. Here we present our efforts toward the synthesis of a library of new polymers starting from the half-esters obtained by the above reaction.

### 2. Results and Discussion

Norbornene or norbornadiene derivations are fine precursors for ring-opening metathesis polymerization (ROMP) reactions due to the strained structures. [2] Therefore, various symmetric or non-symmetric norbornene and norbornadiene derivatives with the same or different ester groups were prepared from the corresponding half-esters. With the introduction of Grubbs' catalysts including those having high tolerance with labile functional groups, we studied the ROMP of these norbornene and norbornadiene derivatives as starting monomers for the synthesis of a library of polymers.

The experimental protocol adopted the constant ratio of  $[M]/[I] = 200$ . The ROMP produced polymers in various yields due to the difference of substituents. For comparison, other cyclic olefins having no bulky groups around the double bonds are reported as ROMP monomers. [2] Based on these data we analyzed effects of the size of substituents.

### 3. Reference

[1] Niwayama, S., Highly Efficient Selective Monohydrolysis of Symmetric Diester. *J. Org. Chem.* 2000, 65, 5834-5836

[2] Sutthira, S., et al, Recent advances in ring-opening metathesis polymerization, and application to synthesis of functional materials. *J. Polymer* 2010, 42, 905-915

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 26**

## **Synthetic Studies of (Z)- $\beta$ -Santalol**

Izuru IHARA, Muroran Institute of Technology, Japan; Hezhen WANG, Texas Tech University, U.S.A.; Satomi NIWAYAMA, Muroran Institute of Technology, Japan

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### Background

Although many studies have found some association between *Helicobacter pylori* infection and the development of gastric cancer, many aspects of this relation remain uncertain. [1] In 2005, (Z)- $\beta$ -santalol, which shows inhibitory activities against multiple species of *H. pylori*, was discovered from sandalwood in India. [2] Some total syntheses of this natural product and its derivatives have been published. [3-4] In our laboratory, we are developing a synthetic route for (Z)- $\beta$ -santalol using the highly selective monohydrolysis of symmetric and near symmetric diesters that we reported previously as the key step. [5] The starting symmetric and near symmetric diesters are typically obtained inexpensively on a large scale and the reaction conditions are environmentally friendly.

### Results

At first, the synthesis started from selective monohydrolysis of a symmetric diester having a norbornene skeleton with two endo-carbomethoxy groups. The selective monohydrolysis of this diester successfully produced the corresponding half-ester, and two substituents were independently converted. However, it was found that the intermediate synthesized from this half-ester was unstable. Therefore, we changed the route and started from the epimer of the above diester in which one carbomethoxy group was on the exo position for the purpose of hydrolysis of the exo carbomethoxy group predominantly. At present, the carboxyl group formed by this monohydrolysis reaction is selectively reduced, and continuous studies are ongoing.

[1] Uemura, N. et al. *N. Engl. J. Med.* 2001, 11, 345

[2] Ochi, T et al. *J. Nat. Prod.* 2005, 68, 819

[3] Krotz, A. et al. *Tetrahedron: Asymmetry*, 1990, 1, 537

[4] Saito, M. et al. *Tetrahedron Lett.* 1995, 36, 9003

[5] Niwayama, S. *J. Org. Chem.* 2000, 65, 5824

### Notes

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 27**

## **Surface modification of cathode active material for lithium ion battery using cerium (IV) fluoride**

Jin SATO, Jae-Ho KIM, Susumu YONEZAWA, University of Fukui, Japan

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Lithium ion batteries have been widely studied because of a large terminal voltage and a large energy density. Extensive effects have been performed to improve its electrochemical performance over decades. Among methods for improving electrochemical properties, surface modification is one of the most frequent techniques to enhance the specific capacity, rate performance, and cycling life. The modification of the surface of the cathode active material must have strongly effects on the battery performance because the electrochemical reaction takes place at the interface among the active material, carbon as the electroconductive material and the electrolyte. In our previous study, the surface modification of  $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$  using  $\text{NF}_3$  or  $\text{F}_2$  gases has been reported. Fluorinated samples indicated much better in discharge capacity and cycle ability. However, the fluorine contents on the cathode surface had limited to control using fluorinating gases. Also we found that two kinds of cerium tetrafluorides (stable  $\text{CeF}_4$  and metastable  $\text{CeF}_4$ ) are obtained by controlling the temperature in the reaction between  $\text{CeF}_3$  and  $\text{F}_2$  gas. Especially the metastable  $\text{CeF}_4$  can release the elemental fluorine with returning to  $\text{CeF}_3$ . In this study, the effects of surface modification of cathode material on the electrochemical properties were investigated using the metastable  $\text{CeF}_4$  ( $=\text{CeF}_{3+x}$ ). In order to prepare the  $\text{CeF}_{3+x}$ , the fluorination of  $\text{CeF}_3$  was performed under different fluorination conditions (①200°C②250°C③300°C in 1 atm for 1h). And the surface fluorination of  $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$  was carried out using the prepared  $\text{CeF}_{3+x}$  samples. The characterizations of samples were examined by XRD, XPS and SEM analyses. The electrochemical measurements were used by two-electrode test cell (TOM cell). The discharge capacity of samples fluorinated using  $\text{CeF}_{3+x}$  improved. Also its cyclic stability was superior to other samples fluorinated using  $\text{NF}_3$  or  $\text{F}_2$  gases.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 28**

## **Solvatochromism and fluorescence dynamics of tetracyanoquinodimethane in solutions**

Yuto TORII, Honami TAMAYA, Hideyuki NAKANO, Toshifumi IIMORI, Muroran Institute of Technology, Japan

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TCNQ is an extremely versatile and useful organic electron acceptor molecule, and is an important molecule to produce organic conductors by forming charge-transfer complexes with electron donors. However, the understanding on photoluminescence property and electronically excited state of TCNQ is still very limited. Previous investigations have shown that the fluorescence quantum yield of TCNQ is extremely low. We measured absorption and fluorescence spectra of TCNQ in various solvents and revealed that TCNQ exhibits fluorescence in nonpolar solvents. When the solvent polarity was changed, the maximum wavelength and the band shape of the absorption spectra were changed. The fluorescence excitation spectrum was measured, matching the band shape of the absorption spectrum. This result shows that the neutral monomer of TCNQ shows fluorescence. By using mixtures of hexane and dichloromethane, we investigated the influence of the polarity of solvent on fluorescence intensity. When the volume fraction of dichloromethane increased, the fluorescence intensity of TCNQ steeply decreased. It is considered that the relaxation process of the excited state of TCNQ changes with the polarity of the solvent. The excited state dynamics of TCNQ is also reported.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 29**

## **Magnetic properties of SmFe<sub>3</sub>-type magnets**

Yusuke OGAWA, Chiba Institute of Technology, Japan

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Rapidly quenched (Sm,Zr)Fe<sub>3</sub> ribbons were prepared and subsequently consolidated into bulk magnets by spark plasma sintering (SPS). The rapidly quenched SmFe<sub>3</sub> ribbon consisted of the amorphous phase. It was found that the substitution of Zr for Sm in the SmFe<sub>3</sub> ribbon deteriorated the glass-forming ability of the alloy, and that the amount of the amorphous phase decreased as the Zr content increased. (Sm,Zr)Fe<sub>3</sub> magnets were obtained by sintering the rapidly quenched (Sm,Zr)Fe<sub>3</sub> ribbons using the SPS method. Although the SmFe<sub>3</sub> magnet with the SmFe<sub>3</sub> phase alone did not show high coercivity, the (Sm,Zr)Fe<sub>3</sub> magnets exhibited high coercivity.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 30**

## **Production of SmFe<sub>12</sub>-type magnets**

Fumiya WATANABE, Chiba Institute of Technology, Japan

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Sm(Fe,Ti)<sub>12</sub> melt-spun ribbons showed low coercivity regardless of the Ti content. Although the Sm(Fe,Ti)<sub>12</sub> melt-spun ribbons contained some amorphous phase, a fully amorphous specimen was obtained only when the SmFe<sub>11</sub>Ti alloy was melt-spun. The Sm(Fe,Ti)<sub>12</sub> melt-spun ribbons were consolidated into bulk magnets by the SPS method. It was found that the SmFe<sub>12</sub> magnet consisted of the SmFe<sub>7</sub> and Fe phases and that the Sm(Fe,Ti)<sub>12</sub> magnets mostly consisted of the Sm(Fe,Ti)<sub>12</sub> phase. The SmFe<sub>11</sub>Ti magnet consisted of the Sm(Fe,Ti)<sub>12</sub> phase and exhibited the high coercivity over 5 kOe. The SmFe<sub>11</sub>Ti magnet produced by the SPS method consisted of the fine equiaxed grains and was magnetically isotropic.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 31**

## **Electrical properties of nitrogen doped Al<sub>2</sub>O<sub>3</sub> films by atomic layer deposition**

Minjae KIM, Kyung-Mun KANG, Yue WANG, Wooje HAN, Hyung-Ho PARK, Yonsei University, Korea

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High-k oxide materials for gate insulators for semiconductor power devices as well as chip metal-insulator-metal capacitance require significant properties such as low leakage current density, high-dielectric breakdown voltage, and high capacitance density. Among the high-k oxides, Al<sub>2</sub>O<sub>3</sub> is one of the most promising candidates as high-k oxide materials owing to its high permittivity (~9), almost 2 times higher than commercially available SiO<sub>2</sub>(~4), excellent thermal stability and wide energy bandgap (8.3 eV). However, the interface between Si and Al<sub>2</sub>O<sub>3</sub> generates ion diffusion and electron trapping resulted in the formation of higher leakage current than thermal oxide films. Al<sub>2</sub>O<sub>3</sub> films inherently have O-related defects such as oxygen defects and nitrogen has been known as an effective dopant for Al<sub>2</sub>O<sub>3</sub>.

The present study focused on the electrical resistivity of N-doped Al<sub>2</sub>O<sub>3</sub> thin films by atomic layer deposition using trimethylaluminum, water and ammonia as the reactants, varying the deposition temperature from 55 to 170°C. Minimum leakage current ( $5 \times 10^{-10}$  A/cm<sup>2</sup>) was obtained with N-doped Al<sub>2</sub>O<sub>3</sub> film deposited at 170°C and post-annealed at 400°C: decrease by 10 times through N-doping. This phenomenon can be explained that N-doping decreases defects and reduce the number of traps. Film thickness was measured by using ellipsometer. Surface morphologies were investigated using atomic force microscopy. X-ray photoelectron spectroscopic analysis was carried out to analyze the chemical state of the films. The electrical performance was obtained via current-voltage measurement at room temperature. Through these analyses, we can demonstrate the effect of N-doping on the structural and electrical properties of Al<sub>2</sub>O<sub>3</sub> thin films.

Acknowledgement: This work was supported by Samsung Research Funding & Incubation Center of Samsung Electronics under Project Number SRFC-TA1703-04.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 32**

**Synthesis of SnO<sub>2</sub> aerogel/reduced graphene oxide nanocomposites for the photocatalytic degradation of methyl orange**

Taehee KIM, Vinayak G. PARALE, Hae-Noo-Ree JUNG, Younghun KIM, Hyung-Ho PARK, Yonsei University, Korea

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The demand for solutions against several environmental issues has recently increased; in particular, the presence of air pollutants and organic dyes in water are global concerns. Semiconducting metal oxides such as TiO<sub>2</sub>, ZnO, and SnO<sub>2</sub> have been widely used as photocatalysts due to their ability to generate electron-hole pairs when photon energy is provided. Moreover, the economic aspects of the preparation of SnO<sub>2</sub> photocatalyst for the mass production is still challenging. The cost and compatibility should be considered in photocatalytic degradation. In present work, tin oxide aerogel/reduced graphene oxide (rGO) nanocomposites were synthesized using sol-gel method. A homogeneous dispersion of graphene oxide (GO) flakes in a tin precursor solution was captured in three-dimensionally networked SnO<sub>2</sub> aerogel matrix and successively underwent supercritical alcohol drying followed by in-situ thermal reduction of GO, resulting in SnO<sub>2</sub> aerogel/rGO nanocomposites. The chemical interaction between aerogel matrix and GO functional groups was confirmed by a peak shift in the Fourier transform infrared spectra and a change in the optical bandgap of diffuse reflectance spectra. In addition, the photocatalytic activity of these nanocomposites in the methyl orange degradation varied depending on the amount of rGO loading in the SnO<sub>2</sub> aerogel matrix; an appropriate amount of rGO was required for the highest enhancement in the photocatalytic activity of the SnO<sub>2</sub> aerogel. The proposed nanocomposites could be a useful solution against water pollutants.

Acknowledgement: This work was supported by Samsung Research Funding & Incubation Center of Samsung Electronics under Project Number SRFC-TA1703-04.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 33**

**Advanced surface modification by plasma electrolysis as a groundwork for multi-purpose coatings**

Muhammad Prislá KAMIL, Siti FATIMAH, Wail AL ZOUBI, Min Jun KIM, Young Gun KO,  
Yeungnam University, Korea

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Plasma electrolysis (PE) is a promising surface treatment to answer the ever-increasing demand of high-performing materials in real-time conditions where structural and functional requirements should be met. The key factor in creative materials design by PE is the control of destructive effects of plasma arcs, which are similar to volcanic activities in nature. This is achieved by 'soft' plasma discharges using an electrolyte containing complexing agents that governs the porosity level of PE coatings. By taking advantage of structural defects as anchor sites, smart coating strategies are developed based on a number of hybrid architectures: 1) basket-weave structure via preferential nucleation of organic compounds; and 2) nanoflower structure via  $\pi - \pi$  stacking during self-assembly. Thus, the present PE coatings can be tailored to satisfy a variety of applications such as anti-corrosion, bioimplant, solar harvester, and photocatalysis.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 34**

## **Nucleation and Growth Phenomena of MgO Layer Formed on Mg-Al-Zn Alloy via Plasma Electrolytic Oxidation**

Sun Yeob PARK, Nisa NASHRAH, Dong Keun YOON, Young Gun KO, Yeungnam University, Korea

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This study investigated the formation mechanism of the oxide layer generated by micro-arc oxidation (MAO) considering surface roughness of AZ31 Mg alloy. For this purpose, a series of MAO under alternating current in a silicate-based electrolyte were performed on two present samples with grooved and flat surfaces. The time-voltage response presented that the grooved sample reached the breakdown voltage earlier than the flat sample. This indicated the appearance of micro-discharges on the grooved sample occurred earlier than that of the flat sample since the oxide debris nucleated preferentially at the ridge areas where electrons were concentrated severely under high electrical field. The oxide layer of the grooved sample was relatively less dense than that of the flat sample. This was attributed to the fact that the oxide layer of the grooved sample was likely to grow with ease on pre-existing coating layer whereas the oxide layer of the flat sample developed conformably throughout the whole areas. Thus, the growth rate of the grooved sample was higher than that of the flat sample, which agreed well with micro-discharge activities. Such formation mechanism was proposed in relation to nucleation and growth of the oxide layer formed on the different surface structures.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 35**

## **Formation of Conformal NiO Underlayer on Carbon for SMSI Effects on Electrocatalytic Performance of Supported Pd Nanoparticles**

Wenjuan SHI, Hyun-Uk PARK, Ah-Hyeon PARK, Young-Uk KWON, Sungkyunkwan University, Korea

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Enhancing the performance of noble metal electrocatalysts is regarded as an urgent issue for the commercialization of fuel cells in the near future. In this study, we demonstrate that the electrocatalytic performance of Pd nanoparticles (NPs) supported on carbon can be enhanced by introducing NiO coating on carbon. We further demonstrate that a uniform thin layer of NiO coating on carbon support can be readily achieved by using a sonochemical reaction (ultrasound-assisted polyol synthesis, UPS) method. NiO-modified carbon (NiO/C) supports were synthesized by two different methods, atomic layer deposition (ALD) and UPS methods, and Pd NPs were formed on them. Compared with Pd NPs on carbon support, Pd NPs on NiO/C supports showed 3-5 fold enhanced electrocatalytic performance for formic acid oxidation and oxygen reduction reactions. Between the two NiO/C supports, the one synthesized by UPS method outperforms the one by ALD by up to 2 times. Detailed structural analysis data show that the NiO/C synthesized by UPS is composed of uniform and continuous thin (0.42 nm) NiO coating on the external surface of carbon while the NiO/C by ALD has thicker (1.13 nm) NiO islands to form patch-like coating on the carbon surface. The enhanced electrocatalytic performance of Pd NPs on NiO/C supports can be explained by the change of the electronic structure of strong metal-support interaction between Pd and NiO and the bifunctional mechanism enabled by the NiO surface around Pd NPs.

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**Meeting Room No 201**

**Abstract ID: 36**

**Measurement Mass production of Fe@Pt/C Nanoparticles for Superior catalytic active Electro-catalysts for cathode of PEMFC synthesized via Sonochemical method**

Ah-Hyeon PARK, Hyun-Uk PARK, Sungkyunkwan University; Jee youn HWANG, Eunjik LEE, Ji-Hoon JANG, Hyundai Motor Group, Wenjuan SHI, Young-Uk KWON, Sungkyunkwan University, Japan

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For fuel cell stack of 80kW, platinum for electrocatalyst require around 10g per fuel cell electric vehicle(FCEV). Large-scale synthesis method for catalyst is necessary in this field to reduce manpower. Ultrasound-assisted polyol synthesis(UPS) is a method for preparation of small and uniform size core-shell nanoparticles evenly distributed on the support. Platinum(II) acetylacetonate, Iron(III) acetylacetonate and carbon support were dispersed in ethylene glycol which is reducing agent and irradiated by ultrasound for 3 h to reduce to the metal nanoparticles, followed by washing and drying to obtain a powder. The structural properties of catalysts synthesized by the sonochemical method are strongly dependent on the source of metal, carbon support, chemical properties of the solvent, a temperature of the solution, and energy of sonicator, and affect catalytic activity and stability. In this research, I control the variable of UPS that affect the quality of the sample and apply the mass production of a catalyst with activity corresponding to the commercial catalyst. The characterization caused by synthesis variable was observed by analysis such as solution color visualization, X-ray diffraction(XRD), scanning electron microscope(SEM), transmission electron microscope(TEM), inductively coupled plasma atomic emission spectroscopy(ICP-AES) and electrocatalytic performance. Synthesized sample with optimized synthesis condition for mass production(145~155 °C, 30-50% amplitude, high rate of temperature change, including acid treatment) shows improved electrochemically active surface area(ECSA) and ORR catalytic activity compared to commercial Pt and small-scale synthesized sample. In MEA test, it maintains its potential during the test and demonstrates durable catalytic activity. As renewable energy conversion and storage system is one of the main challenges, FCEV is developed to solve pollution from CO2 emission and oil depletion issues. Our low-platinum nanoparticle with uniform distribution synthesized using a sonochemical method will replace precious metal catalysts used in metal-air batteries and fuel cells.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 37**

## **Large-sized bulk single crystal growth and its characterization in pressurized optical floating zone method of $\text{InGaO}_3(\text{ZnO})_3$**

Yuki KOBAYASHI, Daiki KATO, Naoki KASE, Tokyo University of Science, Japan; Noboru KIMIZUKA, Universidad de Sonora, Mexico; Nobuaki MIYAKAKA, Tokyo University of Science, Japan

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Transparent conducting oxides (TCOs) have received considerable attention as materials for transparent electrodes, high performance thin film transistors (TFTs) for liquid displays and organic light-emitting diodes. One such example  $(\text{InGaO}_3)_m(\text{ZnO})_n$  ( $m, n = \text{natural number}$ ; hereafter referred to as IGZO- $mn$ ) are promising channel materials for TFTs, due to their high-mobility, and high optical transparency.

The transport properties of the IGZO- $mn$  family have been extensively studied. However, most studies have been conducted on polycrystalline samples, single crystal thin films and amorphous thin films. Thus, studies of single crystal which are important for deep understanding of fundamental properties are delayed, and the fundamental properties are not completely obvious.

However, we could establish a reliable method for the single crystal growth of IGZO-11 (space group  $R\bar{3}m$ , No. 166) and reported its optical and electrical transport properties of IGZO-11 [1]. Conductivity along the  $c$ -axis ( $\sigma_c$ ) of IGZO-11 is smaller than that of  $\sigma_{ab}$ , and the anisotropic ratio

$\sigma_{ab}/\sigma_c$  increases with lower  $\sigma_{ab}$ . To clarify this mechanism, we focus on IGZO-13. Because IGZO-13 is same space group as IGZO-11 but IGZO-13 has two more ZnO layers in the unit cell than IGZO-11. So, the origin of anisotropic electrical conduction will be clarified by comparing the anisotropic ratios between IGZO-11 and IGZO-13. In this study, single crystals of IGZO-13 have been successfully grown using the same optical floating zone method employed for IGZO-11 crystal growth.

XRF data shown good stoichiometric composition ( $\text{In}:\text{Ga}:\text{Zn} = 19.1:21.1:59.8$ ), and XRD data shown clearly (0 0 l) peaks of IGZO-13. In this conference, we will report about there electrical conductivity, Seebeck coefficient, and optical band gap in IGZO-11 and IGZO-13, and their data will be compared.

[1] Y. Tanaka, K. Wada, Y. Kobayashi et al., CrystEngComm, 2019,21, 2985-2993

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 38**

**Measurement of in-plane compressive stress of Pd thin film prepared by magnetron sputtering method**

Shuntaro NAKAHIRO, Ryota GEMMA, Tokai University Japan.

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In recent years, attempts have been made to shift to hydrogen society due to the increasing trend of CO<sub>2</sub> emissions. In order to realize this, elucidation of the mechanism of hydrogen embrittlement is required. It has been reported that the vacancy-hydrogen interaction is greatly related to the mechanism of hydrogen embrittlement. Furthermore, in thin films, it has been also confirmed that the compressive stresses incorporate when hydrogen is loaded. Therefore, the impact of compressive stress at hydrogen uptake is also considered to be closely related to the hydrogen embrittlement mechanism. Both of stress and defects are important factors to understand hydrogen embrittlement. In this research, we aimed to study relationships between hydrogen and vacancies and first evaluated internal stresses in Pd thin film prepared by DC magnetron sputtering.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 39**

## **Luminescent Crystalline Cu(I) Complexes Breathing Solvent Vapors**

Ikuya ARAHORI, Tomoyashi SUENOBU, Mitsuharu SUUKI, Ken-ichi NAKAYAMA, Norimitsu TOHNAI, Osaka University; Hidetaka KASAI, Eiji NISHIBORI, University of TSUKUBA, Japan.

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Recently, environmental response-type materials that exhibit various functionalities according to the external stimuli such as light, heat, and chemical exposure have attracted much attention. In particular, chromic phenomena have long been regarded as attractive functions, where color or luminescence color is reversibly changed by external stimuli. Consequently, those materials could visualize invisible external stimuli by their own color change and, thus, play a role in sensor, memory, switching materials, and so on.

For example, vapoluminochromism, in which the emission color reversibly changes in response to organic solvent vapors, has mainly been observed in platinum(II) and gold(I) complexes with metallic interactions and flexible framework structures. However, the earth-abundant metal complexes might be preferable for their extensive and practical use in the future.

A planar trinuclear copper(I) complex (**1**) exhibits highly efficient solid-state orange emission attributed to the excimer formation between two complexes due to Cu-Cu interactions in the excited state at room temperature. The orange luminescence of **1** was found to turn to green by exposure to the vapor of organic solvents at room temperature, while it returned to orange by removing the vapor. The color changes can repeatedly and reversibly occur in fast response to the absence and presence of the vapor like breathing. We have clarified the difference between the crystal structures of **1** in the absence and presence of the solvent vapor by using single-crystal X-ray diffractions, in-situ powder X-ray diffractions, and in-situ XAFS analyses. Furthermore, the green-emissive state of **1** exhibiting a smaller Stokes shift than the orange-emissive state was found to decay with considerably large non-radiative deactivation rate determined by time-resolved spectroscopies. Therefore, the difference in the emission color of **1** could be attributed to the difference in the excited state structure, that is consistent with the result of the in-situ crystal structure analyses of **1**.

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**Meeting Room No 201**

**Abstract ID: 40**

## **Properties of flexible PZT piezo-generator prepared by sol-gel process**

Sang-Shik PARK, Min-Ho LEE, Rudder WU, Kyungpook, Korea

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In recent years, many researchers have explored the viability of various energy harvesters to power small-scale, wearable and portable electronic devices. We report a high-performance flexible piezoelectric generator that was based on  $\text{PbZr}_{0.53}\text{Ti}_{0.47}\text{O}_3$  (PZT) perovskite materials and Al etched foil as substrates for flexibility and large specific surface area. Etched Al foils shows the specification such as thickness:  $\sim 125 \mu\text{m}$ , pit density:  $\sim 2.0 \times 10^7 \text{ cm}^{-2}$ , pit diameter:  $1\text{--}2 \mu\text{m}$ , and pit length:  $20\text{--}50 \mu\text{m}$ . The PZT sol (0.5~1.0M) precursors were prepared by mixing zirconium (IV) propoxide,  $(\text{Zr}(\text{OCH}_2\text{CH}_2\text{CH}_3)_4)$ , Titanium (IV) isopropoxide,  $(\text{Ti}[\text{OCH}(\text{CH}_3)_2]_4)$ , and Lead (II) acetate trihydrate,  $(\text{Pb}(\text{CH}_3\text{CO}_2)_2 \cdot 3\text{H}_2\text{O})$ . The thickness of the PZT layer on Al foils increases with the PZT sol concentration due to the high viscosity of the sol. Elemental mapping results by TEM-EDS showed uniform distributions of Pb, Zr, Ti and O elements. The thickness of PZT layer in surface and etch pit showed  $1\text{--}5 \mu\text{m}$  and  $100\text{--}300\text{nm}$  according to process condition, respectively. The dielectric properties of PZT layer exhibited a specific capacitance  $\sim 10 \text{ nF/cm}^2$  and a dissipation factor of 0.02 at 1 kHz. The PZT layers exhibited a low leakage current density of  $\sim 10^{-6} \text{ A/cm}^2$  at a high applied electric field of 30 kV/cm. The prepared piezo-generator exhibited better output performance in bending than in pressing condition.

The output performance in bending condition improved output performance by  $\sim 4.5 \text{ V}$  after poling. This was sufficient to instantly light a commercial light-emitting diode (LED).

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# GOLDEN ACADEMY

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 41**

## **Skeletal Reinforced Silica Aerogels: A Hybrid Material for Thermal Insulation Applications**

Yi Jun ZHOU, Kuan-I LEE, Rudder WU, National Institute for Materials Science Tokyo University of Science, Japan

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Silica aerogels have drawn multiple industries' attention in the past few years for possessing a wide range of scientific and technological applications due to their unique properties such as their flame retardancy, hydrophobicity, high surface area, and low thermal conductivity. The two common ways to synthesize aerogels from wet gels are normally either through supercritical pore fluid extraction or by ambient pressure drying. The latter represents a less expensive, less hazardous, and more accessible method for many probable hybrid products fabrications. The present work investigates the thermal insulation capabilities of silica aerogels reinforced with monolithic polyurethane memory foam, glass wool, and polyester fibers all synthesized through ambient pressure drying process. The purpose is to minimize the thermal conductivity of widely employed insulation materials using different skeletons for nanoporous aerogel particles to be held on. The investigation allows quantification of the hybrid materials' conductivity, contact angle, and density.

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**Sat/07/27**

**Meeting Room No 201**

**Abstract ID: 42**

**Development Comparison of two promising approaches to creating transparent polyethylene based hybrid silica aerogel with excellent mechanical and thermal insulation properties**

Yizhou LUO (Daniel), Eric LEE, Rudder WU, National Institute for Materials Science, Japan

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Silica based aerogel is a ultra-low density material with extremely low thermal conductivity. It has a microporous silicon based solid structure filled with mostly gas. Its unique properties make it an excellent thermal insulation material. With further research there is a significant potential to replace traditional insulation materials in the building and construction sector and the industrial sector. The main barriers to its more widespread use are its high cost and poor mechanical properties.

The challenge exists to improve the mechanical properties of silica based aerogels and decrease costs while maintaining low density and low thermal conductivity. This study compares the properties of aerogels synthesized using unique variations of two recently published methods for obtaining silica based aerogels with outstanding mechanical and thermal insulation properties from pre-polymerized vinyl trimethoxy silane (VTMS) precursor.

One method formed hybrid aerogels with particulate structures strengthened through aging while the other method formed hybrid aerogels with a continuous structure formed by a spinodal decomposition mechanism. The low cost ambient pressure drying (APD) method will be used in the synthesis of both samples as one of the aims is to lower cost.

Transparent aerogel with low density, excellent mechanical and thermal properties will be synthesized using both methods and APD. The analysis looks into the process parameters which can produce aerogel with the best balance of mechanical and thermal insulation properties with cost and scalability as major considerations.

The present work intends to provide helpful data and insight for researchers seeking a lower cost and faster method to create aerogels with excellent properties.

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