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University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

CONFERENCE ABSTRACTS

2018 3rd International Conference on Design, Materials and Manufacturing (ICDMM 2018)

2018 3rd International Conference on Material Engineering and Smart Materials (ICMESM 2018)

University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

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CONTENT

University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

WELCOME

University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

Dear professors and distinguished delegates,

Welcome to 2018 3rd International Conference on Design, Materials and Manufacturing and 2018 3rd International Conference on Material Engineering and Smart Materials in Okinawa, Japan!

We wish to express our sincere appreciation to all individuals and organizations who have contributed to the conference. Special thanks are extended to our colleagues in the technical program committee for their thorough review of all the submissions, which is vital to the success of the conference, and also to the members in the organizing committee who had dedicated their time and efforts in planning, promoting, organizing and helping the conference. Our special thanks also go to the invited speakers as well as all the authors for contributing their latest researches to the conference.

This conference program is highlighted by three keynote speakers: Prof. Jesus Toribio, University of Salamanca, Spain; Prof. Ömer Aydan, University of the Ryukyus, Japan; and Prof. Nao-aki Noda, Kyushu Institute of Technology, Japan.

Oral presentations are divided into six parallel sessions. One best presentation will be selected from each session, evaluated for: Originality, Applicability, Technical Merit, Visual Aids, and English Delivery. We wish you all the best of luck with your presentations!

We believe that by this excellent conference, you can get more opportunity for further communication with researchers and practitioners with the common interest in improving Material Engineering, Smart Materials, Design, Materials and Manufacturing related techniques.

We wish you a pleasant and memorable experience at this conference as well as in Okinawa, Japan.

Yours sincerely,
Conference Organizing Committee
Okinawa, Japan

NOTE & TIPS

University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

Notes:

- You are welcome to register at any working time during the conference.
- Please kindly keep your Paper ID in mind so that the staff can quickly locate your registration information onsite.
- Certificate of Listener can be collected in front of the registration counter. Certificate of Presentation will be awarded after your presentation by the session chair.
- One *Best Presentation* will be selected from each parallel session and the author of best presentation will be announced and awarded when the session is over.
- Your punctual arrival and active involvement in each session will be highly appreciated.
- Please kindly make your own arrangements for accommodations.
- Please keep all your belongings (laptop and camera etc.) with you in the public places, buses, metro.

Warm Tips for Oral Presentation:

- Get your presentation PPT or PDF files prepared.
- Regular oral presentation: 15 minutes (including Q&A).
- Laptop (with MS-Office & Adobe Reader), projector & screen, laser sticks will be provided by the conference organizer.

VENUE

University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

Engineering Faculty Building

University of the Ryukyus, Okinawa, Japan

Add.: 1 Senbaru, Nishihara-cho, Nakagami-gun, Okinawa, Japan
http://www.u-ryukyu.ac.jp/en/

Access from Naha Airport/City to University of the Ryukyus
http://gspd.jim.u-ryukyu.ac.jp/gakusaibu/kokusai/english-accessmap/?lang=en

Monorail

Naha airport - Shuri station (27 min.), then take taxi Shuri station – University of the Ryukyus (20 min.) or take bus No. 94 (30-40 min.)

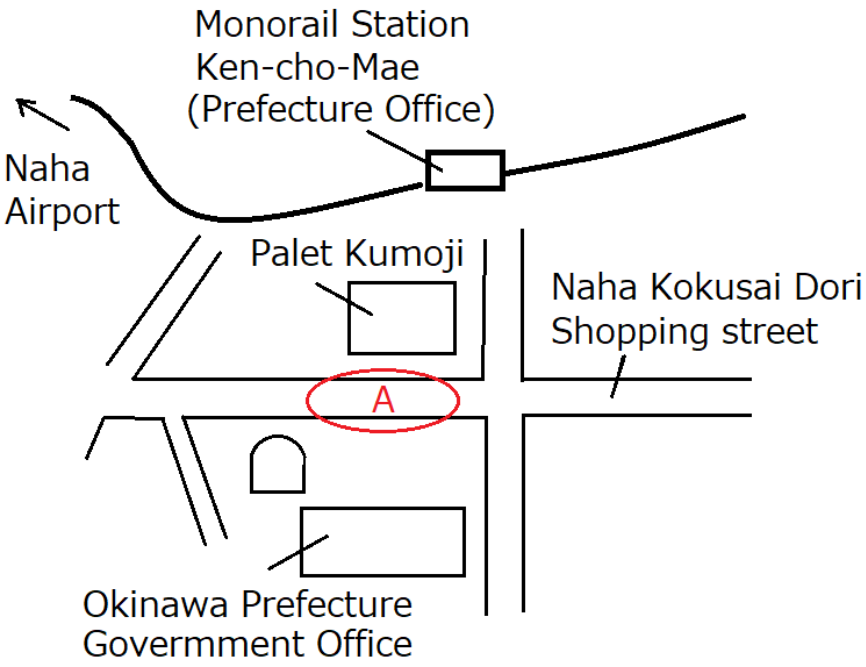
Express bus

Bus No. 111, 113, 123
Naha airport –- Naha bus terminal - - - (high way) –Kochi bus stop – Entrance of University of the Ryukyus (Ryu-DAI-IRIGUTI) (45min.) - Then take walk about 15 min.
Bus No. 98
Naha city - University of the Ryukyus (terminal = final bus station) (40-50 min.)
Bus No. 97Naha city – University of the Ryukyus (terminal = final bus station) (40-50 min.)

VENUE

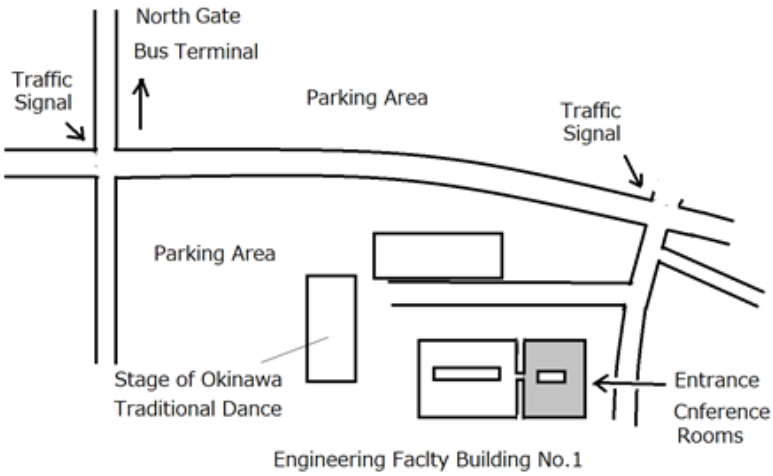
University of the Ryukyus, Okinawa, Japan | August 11-13, 2018

Free Chartered Bus



A free bus will be provided and it leaves from the location A to University of the Ryukyus at 7: 40 on August 12, and at 8:00 on August 13 (for participants for academic visit only).

North Gate is nearest to Engineering Faculty Building.



AGENDA

University of the Ryukyus, Okinawa, Japan |August 11-13, 2018

< Aug. 11, 2018, Saturday >

Engineering Faculty Building No.1

Lounge (1st floor)	
10:00-17:00	Onsite Registration & Conference Materials Collection

< Aug. 12, 2018, Sunday > Morning

Engineering Faculty Building No.1

Room 1-221 (2nd floor)		
09:00-09:10	**Opening Remarks**	**Prof. Chobin Makabe** University of the Ryukyus, Japan
09:10-09:50	**Keynote Speech I**	**Prof. Ömer Aydan** University of the Ryukyus, Japan
		Speech Title: Some Thoughts on Risk of Natural Disasters in Ryukyu Archipelago
09:50-10:30	Coffee Break & Group Photo	
10:30-11:10	**Keynote Speech II**	**Prof. Jesus Toribio** University of Salamanca, Spain
		Speech Title: Fatigue & Fracture Crack Paths Generated by Manufacturing-Induced Microstructural & Strength Anisotropy in Cold Drawn Pearlitic Steels: A Tribute to Fray Luis de León in the 800th Anniversary of the University of Salamanc
11:10-11:50	**Plenary Speech**	**Prof. Nao-aki Noda** Kyushu Institute of Technology, Japan
		Speech Title: Anti-Loosening Performance and Fatigue Life Improvement for Bolt-Nut Connections Having Slight Pitch Difference

AGENDA

University of the Ryukyus, Okinawa, Japan |August 11-13, 2018

Lunch @ 2nd floor of the Engineering Faculty Building No.2
<11:50--13:30>

< Aug. 12, 2018, Sunday > Afternoon

Engineering Faculty Building No.1

13:30-15:30	**Session I - Metals and Alloys** 8 presentations	Room 1-222
	DM013 , DM017, DM029-A, DM036, DM037, DM044-A, ES015, ES035-A	
	Session II - Design and Manufacturing Engineering 7 presentations	Room 1-322
	DM002, DM006, DM057-A, DM062, DM052, DM015 DM025-A	
	Session III - Building Materials and Structures 8 presentations	Room 1-221
	ES002, ES025, ES003, ES042, DM053, DM032, ES037-A, ES004	
	Poster Session	Room 1-122
	ES019-A, ES039-A, ES041-A, ES043-A, ES047-A, DM005, DM016, DM041-A, DM042-A, DM043-A, DM045-A, DM046-A, DM050-A, DM055, ES048-A, ES049-A, DM023-A, DM059, DM064-A, DM065-A, DM066-A, DM067-A	
 **Coffee Break <15:30--15:45>**		
15:45-18:15	**Session IV- Composite Materials and Solid Mechanics** 10 presentations	Room 1-222
	DM004, DM010-A, DM020-A, ES046-A, DM051, DM022, DM018, DM033, DM101, ES050-A	
	Session V- Functional Materials and Devices 10 presentations	Room 1-322

	ES010, DM061, ES030-A, ES029-A, ES034, ES011-A, DM028, ES006-A, ES013-A, ES031	
	Session VI - Material Chemistry and Chemical Engineering 10 presentations	Room 1-221
	ES017-A, DM019, DM047-A, ES040, DM056, DM058, , ES016-A, ES038-A, DM060, DM024-A	
18:15-18:45	**Okinawa Traditional Dance**	

Prof. Tomohisha Wada, Dean of Faculty of Engineering, University of the Ryukyus will pay a tribute to all the participants of this conference and Prof. Aydan will lead of a toast before dinner.

Dinner @ 2nd floor of the Engineering Faculty Building No.2
<18:45-20:00>

<Aug. 13, 2018, Monday>

Academic Visit 09:20 AM - 11:30 AM * Participants need to sign up in advance.	
09:20-10:00	Lab 1. Disaster Prevention Research Center for Island Regions
10:00-10:30	Lab 2. Corrosion in Metals and Structures
10:30-11:00	Lab 3. Strength of Materials and Metal Fatigue
11:00-11:25	Manufacturing Laboratory (Teaching Group of Manufacturing)

Note: The visit is optional and will charge an additional 30 USD. Sign up is needed before July 20th.

KEYNOTE

Prof. Jesus Toribio, University of Salamanca, Spain

Professor Jesus Toribio graduated in Civil Engineering in 1982 and then in Mathematics in 1986. In 1987 he was awarded his PhD in the Polytechnic University of Madrid (UPM) and turned into Associate Professor in that Institution. In 1992 he became Full Professor and Head of the Materials Science Department of the University of La Coruña (at the age of 32, thus being the youngest Full Professor in the area of Materials Science in Spain). In 2000 he moved to the University of Salamanca (USAL) where is currently Full Professor of Materials Science and Head of the Fracture and Structural Integrity Research group (FSIRG) of that Institution.

His research work is mainly concerned with fatigue and fracture mechanics, environmentally assisted cracking, stress corrosion cracking and hydrogen embrittlement / degradation / damage of metals and alloys (mainly cold drawn pearlitic steel wires for civil engineering and austenitic stainless steels for nuclear engineering and energy applications), covering theoretical, computational and experimental aspects. He actively participates in International Conferences, very often being member of the International Advisory Committee, organising Special Sessions / Symposia, being Session Chairman or delivering Plenary / Keynote / Invited Lectures. Professor Dr. Jesus Toribio has published more than 500 scientific papers, most of them in international books and journals.

He is the Chairman of the Technical Committee 10 (TC10): Environmentally Assisted Cracking of the European Structural Integrity Society (ESIS) and has been Director (2013-2017) of the International Congress of Fracture-The World Academy of Structural Integrity (ICF-WASI), being responsible of launching the Ibero-American Academy of Structural Integrity (IA2SI). Prof. Toribio has been awarded a variety of scientific research prizes and awards including: (i) UPM Young Scientist Award of the Polytechnic University of Madrid; (ii) METROTEC Award for the best Technological Research Project; (iii) Honour Medal of the Spanish Group of Fracture (GEF/SEIE) in recognition of his research achievements in the field of fracture mechanics; (iv) Fellow of the Wessex Institute of Technology (WIT) in recognition of leadership and outstanding work in engineering sciences, (v) Top Reviewer 2011 in recognition of an outstanding contribution to the quality of the Elsevier International Journal Engineering Fracture Mechanics, (vi) Fellow of the European Structural Society (ESIS Fellow) for his outstanding contributions to the art, science, teaching or practice of fracture mechanics and his service to the society; (vii) Honorary Member of the Italian Group of Fracture (IGF) in acknowledgement and appreciation of his outstanding achievements in the

research field of fracture mechanics (viii) Best Paper and Presentation Award in the International Conference on Energy Materials and Applications (ICEMA 2017) held in 2017 in Hiroshima, Japan, with a paper entitled: Numerical Simulation of Hydrogen Diffusion in the Pressure Vessel Wall of a WWER-440 Reactor.

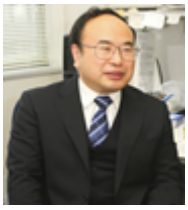
KEYNOTE

University of the Ryukyus, Okinawa, Japan |August 11-13, 2018

Prof. Ömer Aydan, University of the Ryukyus, Japan

Born in 1955, Professor Aydan studied Mining Engineering at the Technical University of Istanbul, Turkey (B.Sc., 1979), Rock Mechanics and Excavation Engineering at the University of Newcastle upon Tyne, UK (M.Sc., 1982), and finally received his Ph.D. in Geotechnical Engineering from Nagoya University, Japan in 1989. Prof. Aydan worked at Nagoya University as a research associate (1987-1991), and then at the department of Marine Civil Engineering at Tokai University, first as Assistant Professor (1991-1993), then as Associate Professor (1993-2001), and finally as Professor (2001-2010). He then became Professor of the Institute of Ocean Research and Development at Tokai University, and is currently Professor at the University of Ryukyus, Department of Civil Engineering & Architecture, Nishihara, Okinawa, Japan. He has furthermore played an active role on numerous ISRM, JSCE, JGS, SRI and Rock Mech. National Group of Japan committees, and has organized several national and international symposia and conferences. Professor Aydan has received the 1998 Matsumae Scientific Contribution Award, the 2007 Erguvanh Engineering Geology Best Paper Award, the 2011 Excellent Contributions Award from the International Association for Computer Methods in Geomechanics and Advances, the 2011 Best Paper Award from the Indian Society for Rock Mechanics and Tunnelling Technology and was awarded the 2013 Best Paper Award at the 13th Japan Symposium on Rock Mechanics and 6th Japan-Korea Joint Symposium on Rock Engineering. He was also made Honorary Professor in Earth Science by Pamukkale University in 2008 and received the 2005 Technology Award, the 2012 Frontier Award and the 2015 Best Paper Award from the Japan National Group of Rock Mechanics.

PLENARY



Prof. Nao-aki Noda, Kyushu Institute of Technology, Japan

Prof. Nao-aki Noda is a professor at Department of Mechanical and Control Engineering, Kyushu Institute of Technology, Japan. He is also a staff of JSMS Kyushu Branch, Japan.
Prof. Noda received his Master and Doctor Degree from Kyushu Institute of Technology and Kyushu University respectively in 1981 and 1984. He is a Guest Professor of several universities, including East China Jiaotong University, Shandong University and Henan University of Science and Technology.

Prof. Noda's research focuses on Machine material/material mechanics, including Stress Analysis, Mechanics of Solids, Elasticity, Fracture Mechanics, Strength of Material, Body Force Method, Finite Element Method, Nemerical Analysis. He has published numerous papers and books, and got the Award for the Best Presentation in Asian Conference on Engineering Education in 2014, JSMS Award for Academic Contribution, The Japan Society of Meterial Science in 2010, Sokeizai Industry Technology Award, The Materials Process Technology Center in 2010. He was a Fellow of the Japan Society of Mechanical Engineers in 2012 and 2015. Prof. Noda also actively participated in many conferences and symposia.

< Aug. 12, 2018, Sunday >

Engineering Faculty Building No.1

Opening Remarks & Speeches Time: 09:00-11:50 **Room 1-221 (2nd floor)**	
09:00-09:10	Opening Remarks **Prof. Chobin Makabe** University of the Ryukyus, Japan
09:10-09:50	*Some Thoughts on Risk of Natural Disasters in Ryukyu Archipelago* **Prof. Ömer Aydan** University of the Ryukyus, Japan **Abstract**: Ryukyu Archipelago is situated on Ryukyu Arc and consists of a 6 major islands together with 55 islands of various sizes. Compared to the other parts of Japan, the documented seismic history of Ryukyu Archipelago is not well known. However, there are huge tsunami boulders, which definitely imply mega earthquakes in the vicinity of Ryukyu Archipelago. Furthermore, The archipelago experiences great typhoons every year compared with other parts of Japan. The Ryukyu limestone formation overlaying Shimajiri formation consisting of mudstone, sandstone and tuff cover a huge area in many islands of the archipelago. While large scale sinkholes and cliff failures observed in association with Ryukyu limestone formation, large scale landslides are commonly observed in Shimajiri formation as geotechnical disasters. It is shown that the risk of mega earthquakes, mega-tsunamis, large-scale geotechnical disasters are quite high in addition to super-typhoons in Ryukyu Archipelago.
 Coffee Break & Group Photo 09:50---10:30	
10:30-11:10	*Fatigue & Fracture Crack Paths Generated by Manufacturing-Induced Microstructural & Strength Anisotropy in Cold Drawn Pearlitic Steels: A Tribute to Fray Luis de León in the 800th Anniversary of the University of Salamanca* **Prof. Jesus Toribio** University of Salamanca, Spain **Abstract**: This paper studies fatigue & fracture crack paths generated by manufacturing-induced microstructural & strength anisotropy in heavily cold drawn pearlitic steel wires that are made by progressive (multi-step) cold drawing of a previously hot rolled pearlitic steel bar to produce commercial high-strength prestressing steel wires to be used in prestressed concrete structures. The paper deals

	with anisotropic fatigue & fracture behavior of progressively cold drawn pearlitic steels on the basis of their microstructural evolution during manufacturing by multi-step cold drawing that produces slenderizing and orientation of the pearlitic colonies, together with densification and orientation of the Fe/Fe3C lamellae, reviewing previous research by the author and co-workers on fracture behavior in inert and aggressive environments in the presence of crack and notches, with focus on hydrogen embrittlement as an important particular phenomenon (including many names such as hydrogen assisted cracking, hydrogen assisted fracture or hydrogen degradation). Results demonstrate the key role of manufacturing-induced microstructural anisotropy (orientation of the two microstructural levels of pearlitic colonies and ferrite/cementite lamellae as a consequence of the progressive/repetitive cold drawing) in the fatigue & fracture crack paths, thereby producing crack path deflection/deviation/branching with mixed-mode propagation, with the associated anisotropy of fatigue & fracture resistance and its linked anisotropic fatigue & fracture behavior (it means strength anisotropy with regard to fatigue, fracture, environmentally assisted cracking and hydrogen embrittlement), allowing the definition of a directional toughness depending on the specific crack path with its defined crack propagation direction/angle.
11:10-11:50	*Anti-Loosening Performance and Fatigue Life Improvement for Bolt-Nut Connections Having Slight Pitch Difference* **Prof. Nao-aki Noda** Kyushu Institute of Technology, Japan **Abstract**: In wide industrial fields, the bolt-nut joint is widely used as an important machine element to connect mechanical and structural components. To ensure the safety of structures, anti-loosening performance and enough fatigue strength are always required for bolt-nut connections with low cost. A lot of previous studies deal with the anti-loosening performance by developing newly bolt-nut connections and several studies contribute toward improving fatigue strength. This paper focuses on the pitch differences between the bolt and nut to realize both anti-loosing and high strength. In this study, therefore, several pitch differences are considered in experiment and analysis. A three-dimensional FEM simulation is applied to the nut tightening process to obtain the relationship between the torque and the bolt axial force. To obtain the anti-loosening performance without losing tightening force, the most desirable pitch difference is discussed. It is found that the tightening force can be predicted by FEM simulation since both results are in good agreement. From crack initiation and propagation process observed at bolt threads, fatigue life improvement mechanism is studied with the aid of the finite element analysis. To improve the fatigue strength efficiently, a lager root radius at the bolt-nut threads is introduced. Then, the combined effects on the slight pitch difference and the larger root radius are considered experimentally and analytically. The results show that the fatigue life of the bolt joints is significantly improved by introducing the suitable pitch difference and enlarging the root radius.

Lunch @ 2nd floor of the Engineering Faculty Building No.2
<11:50--13:30>

< Aug. 12, 2018, Sunday >

Engineering Faculty Building No.1

	Session I : Metals and Alloys Time: 13:30-15:30 Room 1-222 (2nd floor) Chair: **Assoc. Prof. Yuzo Nakamura** **Kagoshima University, Japan**
DM013 13:30-13:45	Effect of Cooling Time on Microstructure and Properties of 2507 Super Duplex Stainless Steel Welding Heat-Affect Zone **Yuqing Zhou**, Dening Zou, Kexin Li, Wei Zhang, Rong Liu, Ying Han Xi'an University of Architecture and Technology, China **Abstract:** The welding thermal simulation of 2507 Super Duplex Stainless Steel (SDSS) was investigated using Gleeble-3800 thermo-mechanical simulator. The morphology evolution of austenite and ferrite under different t8/5 and t12/8 were observed and compared. The impact tests and pitting corrosion tests under different t8/5 and t12/8 were conducted. The results showed that the austenite content increased and the austenitic morphology changed from allotriomorphic structure to strip or coarse-blocky structures with the increase of t8/5 and t12/8. The effect of t12/8 on the microstructure of welding Heat Affect Zone (HAZ) was more distinct than that of t8/5. The impact toughness of HAZ with the increase of t12/8 was improved due to higher austenite content, while that with the increase of t8/5 was slightly decreased due to the formation of intermediate phase, such as σ phase. The corrosion tests showed that the pitting resistance of HAZ was improved with the increase of t8/5 and t12/8, while the effect of t12/8 was especially evident.
DM017 13:45-14:00	Effect of Cl- Concentration on Pitting Corrosion Property of Maraging Hardened Stainless Steel Based on Pourbaix Diagram **Xin Zhang**, Dening Zou, Yuqing Zhou, Xuan Na, Wei Zhang, and Ying Han Xi'an University of Architecture and Technology, China **Abstract:** The corrosion behavior of maraging hardened stainless steel (MHSS) in different Cl- medium was investigated by thermodynamics simulation and

	electrochemical experiments. The simulation results show that the thermodynamic stability zone decreases with the increase of the concentration of Cl-. Some of chromium transformed into Cr(OH)2+ and adsorbed on the surface of stainless steel, and others generated Cr2O3 protecting the matrix. Mo reacted with O2 to form MoO42- adsorbed on the surface of the material, which inhibited the destruction of Cl-. The electrochemical experiments indicate that the concentration of Cl- is in the range of 2%-7%. The pitting potential and self-corrosion potential of MHSS decreased linearly with the increase of ion concentration, and the pitting corrosion resistance of MHSS decreased. When the self-corrosion current increases from 1.9888 μA to 2.6524 μA, the corrosion tendency of the material enhances.
DM029-A 14:00-14:15	Microstructure and Fatigue strength of Cu-6Ni-1.5Si alloy **Takashi Iwamura**, Masahiro Goto, Takaei Yamamoto, Junichi Kitamura and Terutoshi Yakushiji Oita University, Japan **Abstract:** Age hardening Cu-Ni-Si alloys have been widely used in electrical/electronic components. In spite of the comparatively early discovery of the age hardening effect in this alloy system, relatively little work has been published on mechanical properties of the alloys, in general, and its fatigue characteristics, in particular. For the actual structural applications, the fatigue characteristics should be clarified for safe design and maintenance of components. To develop Cu-Ni-Si system alloy for improving the fatigue resistance, a fatigue mechanism, such as crack initiation and propagation, should be clarified. The fracture surfaces of Cu-Ni-Si alloys analyzed by a scanning electron microscope (SEM) have showed intergranular facets, leading to a hypothesis that grain boundaries (GBs) were an origin of fatigue crack. Up to now, however, there was no clear evidence for crack nucleation at the GBs. The strengthening of Cu-Ni-Si alloys are attributed to nano-size-Ni2Si intermetallic compounds precipitated in the copper matrix due to aging. During subsequent aging, however, large heterogeneous precipitates are formed, in addition, some parts of matrix are transformed into discontinuous precipitate (DP) phases. At a later stage of aging, the matrix is fully covered by DP phases which bring a detrimental effect on mechanical properties. However, there are few studies on the effect of large heterogeneous precipitates and scattered DP phases on fatigue behavior. The present work was performed in an attempt to obtain a better understanding on fatigue damage of precipitate strengthened Cu-Ni-Si alloy. In this regard, clear evidence of the crack initiation from GBs and the role of DP phase on fatigue of fatigue cracks was shown.
DM036 14:15-14:30	Effects of Hydrogen and Weld Defect on Tensile Properties of SUH660 and SUS316L Welded Joints **Masanobu Kubota**, Xuesong Cui, Ryosuke Komoda, Hiroshi Wakabayashi and Yasuhisa Tanaka International Institute for Carbon-Neutral Energy Research (WPI-I2CNER), Kyushu University, Japan

	Abstract: The effect of hydrogen on the tensile properties of the SUH660 and SUS316L different materials welded joints was characterized in conjunction with the joint shape and weld defects. The butt welded joint specimen without weld defect fractured at the SUS316L base material, and did not cause hydrogen embrittlement (HE). However, the failure position of the spigot-lap welded joint specimen moved from the SUS316L base material to the weld part when hydrogen charging was applied. This resulted in a significant reduction of the elongation. It was presumed that the HE was induced by the stress concentration due to the weld shape. The weld defect induced HE in both joints. The weld defect was produced by incomplete penetration. It also caused incomplete mixing of the weld metal. Consequently, filler nickel segregated around the weld defect, then HE occurred.
DM037 14:30-14:45	Three Dimensional Fractography of Extruded Age-hardened Al Alloys subjected to Fatigue Tests **Yuzo Nakamura**, Ryuichi Iwamoto, Yuta Kurigeno, Hiroki Kamibayashi, Kohji Kariya and Norio Kawagoishi Kagoshima University, Japan **Abstract:** Observation of fracture surface in metal fatigue is one of the most significant procedures to get insight into the cause and mechanism of crack initiation and propagation. In the present study, age-hardened 2017-T4 and 7075-T6 Al alloys having the extrusion texture were fatigue tested in low and high humidities, and their fracture surfaces were examined using a three dimensional (3D) surface analyzer. In addition to the microscopic observations conducted, it is shown that these 3D analyses provide important information on the difference in crack propagation depending on the stress level and environment.
DM044-A 14:45-15:00	Corrosion of Ti-Al-Nb-Cr-Si-C-(W) Alloys in Ar/0.2%SO2 Gas **Dong Bok Lee**, Xiao Xiao and Min Jung Kim Sungkyunkwan University, South Korea **Abstract:** Intermetallics such as titanium-aluminides are considered as potential substitutes to conventional metallic alloys for aerospace, automobile and gas turbine industries because of their low density, high melting point and high specific strength at elevated temperatures. In order to utilize the TiAl alloys as high temperature structural components, their corrosion characteristics in a variety of corrosive environments should be investigated. However, the sulfidation of TiAl alloys has not been studied thoroughly. In this study, Ti–Al–Nb–Cr–Si–C(-W) intermetallics with a fully lamellar structure were cast and heat-treated for microstructural control. They were corroded in 1 atm of flowing Ar/0.2%SO_2-mixed gas at 800-1100^{o}C for up to 100 hr. Corroded alloys were examined using SEM, XRD, EPMA, and TEM. The sulfidation experiments were carried out in a gas mixture of 99.8% Ar-0.2% SO_2–mixed gas at 800, 900, 1000 and 1100^{o}C. During corrosion experiments, thin scales

	were formed on the alloys. The multilayered scales consisted of an outer layer of pure TiO_2 and an inner layer of a mixture of TiO_2 and Al_2O_3. Chromium, and niobium accumulated below the lower part of the intermediate Al_2O_3-rich layer. Sulfur was strongly segregated at the scale-matrix interface.
ES015 15:00-15:15	Effect of alloy composition on microstructure and martensitic transformation temperature of Zr-Cu system shape memory Alloy **Hiroo Tokunaga** and Takuya Kunishi National Institute of Technology, Kagoshima College, Japan **Abstract**: Zr-Cu binary and Zr-Cu-Al ternary alloys with different alloy composition were fabricated by arc melting method. The microstructures and martensitic transformation temperatures of fabricated alloys were investigated by means of a X-ray diffraction and differential scanning calorimetry. As the results, it was found that the intermetallic compound ZrCu martensitic phase was formed in near equiatomic Zr-Cu binary alloy. On the other hand, both the ZrCu martensitic and parent phases were formed in Zr-Cu-Al ternary alloy. Also, it was confirmed that the martensitic transformation temperature of the ZrCu decreases with addition of Al. Therefore, it was found that addition of Al to equiatomic Zr-Cu alloy is effective to control the microstructure and martensitic transformation temperature.
ES035-A 15:15-15:30	Effect of mechanical alloying on characteristics and properties of tungsten-baed ODS alloys **Chun-Liang Chen** and Yong Zeng National Dong Hwa University, Taiwan **Abstract:** Tungsten-based ODS alloys are considered as promising materials for the future fusion devices, in particular for the divertor and other first wall components. The microstructure and the mechanical properties of the material are dependent on the amount of Ti present in the alloy. In this study, W-Ti-Y2O3 alloys with varied Ti contents between 1 wt.% and 10 wt.% fabricated by mechanical alloying were investigated. The effect of Ti on the phase formation and mechanical properties of W-Ti-Y2O3 alloys has been examined. The results suggest that the alloys containing low Ti content exhibit homogeneous microstructure with a uniform distribution of fine titanium oxide particles and tungsten carbides, leading to a significant increase in hardness and elastic modulus of alloys. In addition, high-energy ball milling can facilitate a solid-state reaction between Y2O3 particles and the tungsten-titanium matrix and the subsequent sintering processing promotes the formation of stable nano-Ti2Y2O7 oxide particles, which greatly increase the mechanical properties at elevated temperature and enhance irradiation resistance.

ABSTRACT

Session II : Design and Manufacturing Engineering

Time: 13:30-15:15

Room 1-322 (3rd floor)

Chair: **Assoc. Prof. Francisco Pérez-Arribas**

Univeridad Politécnica de Madrid, Spain

DM002 13:30-13:45	A Study for New Balance Sports Products to Analysis and Design **Huang Yu-Che** and Huang Tai-Shen Chaoyang University of Technology, Taiwan **Abstract:** In recent years, under the influence of globalization, more and more different needs have created different sports products. In general, they are mainly used for cardio training and muscular endurance training, and their products for human balance training are few. Balance training has always been one of the most important exercises, but most exercise training is often overlooked. In this study, we searched for sports product patents and related literature that improve balance training and determined the direction of innovative design based on the different patent categories. Based on the results of the analysis, we have redesigned a model that can effectively provide innovative sports products with different angular misalignments and different displacements. In this research, we search, analyze and summarize the related patents and further identify the methods of innovative design to accomplish the required technologies for this design. The relevant design of this study is to use SolidWorks to draw 3D models for motion simulation and size checking. Then use the ANSYS11.0 command module to analyze the body structure of the force situation, to determine the strength and safety. Finally, make the original. Finally, this study hopes to provide a design reference for future sports product design engineers through this design process.
DM006 13:45-14:00	Computer-Aided Design of Developable Surfaces: designing with developable surfaces **Francisco Pérez-Arribas**, Leonardo Fernández-Jambrina Univeridad Politécnica de Madrid, Spain **Abstract:** The use of developable surfaces in design addresses engineering needs because they can be easily manufactured without stretching or tearing, or without the use of heat treatment. In addition, they also require the minimum strain energy of flexure. This paper presents study cases of ship hulls that are of direct application on shipyards, although the method could be implemented in other fields, such as architecture or furniture design. Our approach is to create a developable B-spline surface between two boundary curves. Between each pair of these curves or directrix lines, the generatrix lines or rulings are created and a quasi-developable B-spline surface containing the rulings is defined. In engineering practice, quasi-developable surfaces can be considered as strictly developable ones, since a tolerance depending on the materials is used. The rulings are obtained by a searching technique based on the

	warp angle that depends on the material. The creation of a lofting B-spline surface containing the rulings enables the interchange between most common engineering softwares that work with NURBS (Non Uniform Rational B-Spline) surfaces by the use of IGES or STEP standard data exchange files. B-spline curves and surfaces are widely used today in practically all the design softwares. An example of ship hulls entirely created with developable surfaces are presented.
DM057-A 14:00-14:15	Innovative Design Method of Incremental Profile Ring Rolling Process for Manufacturing Seamless Ring with Arbitrarily Shaped Profiles Sungcheol Park, Byungmin Kim and **Kyunghun Lee** Korea Maritime and Ocean University, South Korea **Abstract:** The purpose of this study is to develop an innovative design method of incremental profile ring rolling process for manufacturing seamless ring with arbitrarily shaped profiles. First, an advanced feasible forming condition based on the plastic penetrating condition, constant growth velocity condition (CGVC) of the ring outer diameter and mathematical correlations among the main roll, mandrel and axial roll sets is proposed. Second, a hydraulic control method of centering rolls for establishing a successful radial-axial ring rolling process is also proposed using the parameter design of the linkage assembly and beam bending theory. Finally, a design method for intermediate rolls based on the uniform volume distributions element technique (UVDET) and the extremum rolling ratio is developed. The effectiveness of proposed design method is verified by finite element analysis and profile ring rolling experiments using AISI 1035 steel alloys, and it is shown that this method can be lead to the successful ring shapes and the highest dimensional precision.
DM062 14:15-14:30	Ratio of Cutting Force Components in Turning **Oleg Ryabov**, Seisuke Kano, Hiroyuki Sawada and Jonny Herwan National Institute of Advanced Industrial Science & Technology, Japan **Abstract:** Turning of cast iron and steel is monitored with the help of three-dimensional force and vibration sensors. It is shown the ratios of force components have the similar trends despite of material characteristics. Moreover, the normalized values of dynamic force components (variation of force signals) are the same in a wide variation of cutting condition. These results are discussed and confirmed by a mechanical model of work-tool interaction during the cutting process.
DM052 14:30-14:45	The Application of AR Technology to Spatial Skills Learning in Carpentry Training I-Jui Lee, **Ting-Chun Hsu**, Ten-Li Chen, and Meng-Cong Zheng National Taipei University of Technology, Taiwan **Abstract:** Furniture carpentry requires plentiful cognitive judgements of views and capability of spatial understanding. For beginners, the idea of spatial geometry in mortice-tenon structure is often hard to comprehend, and being restricted by traditional 2D graphic, lacking basic 3D spatial concept. Yet augmented reality (AR) has

	already been proven to be capable of geometry training and enhancing conceptual manifestations of 3D space. Through combination of solid controller and virtual 3D subject of AR, dual feedbacks in both senses of touch and vision, this study aims at enhancing beginners' spatial skills in the making of furniture carpentry and further the improvement of carpentry skills. After experiments of each phase, evaluations are done through questionnaires and experts' observations on furniture works. It has proven that AR technique can truly and efficiently solve the perspective problems in complicated and implicit structure and spatial obstacles in furniture carpentry learning for beginners.
DM015 14:45-15:00	Performance Evaluation of Different Electrode Geometries in Electric Discharge Drilling of MMCs Sabindra Kachhap, **Abhishek Singh**, and Sanoj Kumar National Institute Of Technology Patna, India **Abstract:** Electric discharge drilling (EDD) is a hybrid machining process, which has been assembled with Z axis numerical control electric discharge machining (ZNC-EDM) setup. EDD process is basically a hole making process used for electrical conductive materials such as super alloys, metal matrix composites (MMCs) etc. It is difficult to machine these materials. The present discussion will attempt to highlight the recent developments in the field of drilling of MMCs. In this study, electric discharge drilling has been carried out on MMC. Al based MMC (Al6063/10%SiC) is used as a workpiece material and copper is used as an electrode tool material. Five different electrode geometries viz. conical, solid slotted, hollow, hemispherical and hollow slotted tool have been used for comparative analysis on machining. The effect of input variables such as discharge current, pulse on time, pulse off time, tool speed of the output responses such as material removal rate (MRR) and tool wear rate (TWR) during the machining of MMC were investigated. Some other constant parameters were also used such as flushing pressure, spark gap and voltage gap etc.
DM025-A 15:00-15:15	Nucleation-growth and kinetics behavior of SiC coatings from methyltrichlorosilane in H2 **Lintao Jia**, Mengqian Wang, Aijun Li, Yuqing Peng and Fangzhou Zhang Shanghai University, China **Abstract:** Silicon carbide fiber-reinforced silicon carbide ceramic matrix composites (SiC/SiC) exhibit excellent physio-chemical properties, such as high strength and toughness, high capabilities of chemical resistance at high temperature. The densification process of SiC fiber performs is controlled by the growth and kinetics behavior of SiC matrix. The chemical vapor deposition (CVD) growth and kinetics characteristics of SiC from methyltrichlorosilane (MTS) and H2 were investigated at various temperatures from 900℃ to 1100℃.The equilibrium gas-phase calculation was used to analyze the deposition characteristics of SiC. Furthermore, the deposition reactor was simplified as a plug flow to analyze the difference of the deposition rates

	along the reactor length. The results showed that the various deposition features and micro-morphologies on the SiC fiber surface were observed. The intrinsic deposition rates at various temperatures indicated that the deposition rates were nearly a first-order function of the temperatures. Additionally, the temperature boundary line of the kinetic control regions was determined as a function of the reactor length. The temperature affected the reaction process by influencing the gas phase compositions. The nucleation-growth mechanism of SiC coating was investigated using the synergistic effect between the temperature field distribution and the pyrolysis process of MTS. High-resolution X-ray diffraction was employed to identify the quality characteristics of the coatings. The results showed that the obtained layers were β-SiC with the preferred orientation of (111) plane and various average grain size. Scanning electron microscope (SEM) was used to characterize the changes of the nucleation-growth morphologies. According to the SEM result, the Volmer-Weber island growth mode was observed. Moreover, the changes of secondary electron microscopy of the β-SiC coatings surface induced by electron-bombardment of SEM at high magnification were successfully observed. Therefore, the semi-solid microstructure was determined. Furthermore, the energy dispersive spectrometer (EDS) was done to analyze the composition of the semi-solid. A relatively amount of C, Si, O, and Cl was found. Finally, we proved that the five-step droplet nucleation-growth mechanism of β-SiC existed in this experiment.

Session III : Building Materials and Structures Time: 13:30-15:30 Room 1-221 (2nd floor) Chair: TBA	
ES002 13:30-13:45	Composite High-rise Structures: Structural Health Monitoring (SHM) and Case Studies Koorosh Gharehbaghi, Maged Goergy, **Farshid Rahmani** RMIT University, Australia **Abstract:** High-rise construction usually alludes to a multi-storey structure approximately between forty to hundred and twenty meters tall (approximately twelve to forty storeys); whereas composite materials are those made from two or more constituents generally with significantly different physical or chemical compositions. The focus in this paper is in-particular on high-rise construction and whether or not composite materials' structural integrity, and hence longterm sustainability, is comparable to that of a traditional building. Composites possess different characteristics from those common to traditional materials. The purpose of producing composite materials is to produce matters, which are stronger, lighter, and commonly less expensive compared to traditional substance. Generally, in construction, the composite materials typically include geo-polymers and others. More importantly, these composite materials require to bear a variety of demanding conditions, including

	high winds and seismic conditions, which are important design factors for high rise structures. A particular benefit of composite materials for high rise construction, is their overall ability to maintain structural integrity despite their lack of conventional construction material's composition. Systematically, composite materials are usually used for high-rise buildings, in order to strengthen the overall structural integrity. This paper will discuss the utilization of composite materials in construction, particularly for high rise structures and in doing so also provides some case studies to support the ever increasing utilization of composite materials.
ES025 13:45-14:00	Sustainability Assessment of Smart Materials in Building **Jungwon Yoon** University of Seoul, South Korea **Abstract:** Smart Materials are discussed in architecture to transfer the state-of-the-art technology and expand the horizon of building performance. Although the effects of smart material applications in building design are discussed in literature and publications from the context of an autonomous responsive system and an environment-control device, the notion of sustainability assessment of smart materials is not comprehensively discussed yet. Researches on the energy simulation, life cycle cost assessment, thermal behavior evaluation, and daylight assessment have been developed for some specific materials. However, the sustainable performance of building is evaluated with criteria of region-based building sustainability assessment tools. Although smart materials in building may contribute to energy demand reduction and be considered as innovative technology with multiple values, currently available sustainability assessment tools would not allow the adequate evaluation of smart materials in buildings. Therefore, this research reviews the possibility to evaluate smart materials in major sustainability assessment tools – BREEAM, LEED, and CASBEE and propose the assessment criteria to embrace a smart material application in architecture as an opportunistic smart approach toward sustainability of buildings.
ES003 14:00-14:15	Practicalities and developments of high-rise composite structures: case studies Koorosh Gharehbaghi and **Farshid Rahmani** RMIT University, Australia **Abstract:** Composite materials are those made from two or more constituent materials generally with significantly different physical or chemical compositions; thus producing a material with characteristics different from the individual components. Moreover these individual components remain separate and distinct within the finished material's internal structure. The purpose of this mechanism is to produce materials, which are stronger, lighter, or less expensive when compared to traditional materials. In construction and engineering projects the composite materials typically include, concrete, Fiber-reinforced polymer and Geo-polymer among others. These composite materials are generally used for buildings, bridges, and other structures such as walls, floors, and platforms. All of these materials need to be able to handle various demanding environments such as high winds and seismic conditions. This paper will

	discuss the utilization of composite materials in Construction project and also provides number of field studies to support the ever-increasing utilization of composite structures in Building and Construction projects.
ES042 14:15-14:30	Characteristics of Flexural Behavior of Reinforced Concrete Member Substituted Heavyweight Waste glass as Fine aggregate **So Yeong Choi**, San Kim and Eun Ik Yang Gangneung-Wonju National University, South Korea **Abstract:** The progress of civilization has been led to the increase of industrial products, the amount of waste is increasing, and its disposal has become a problem. And, the huge amount of expended concrete has led to the dissipation of natural aggregate. To deal with these problems, many researches have been executed to use a variety of industrial waste as aggregate in concrete materials. So, in this paper, the flexural behavior with substitution ratio of heavyweight waste glass were compared and evaluated in reinforced concrete members. From the results, initial cracking load, yielding load and flexural rigidity less affected by substitution ratio of heavyweight waste glass. However, the ductility of the RC member was significantly affected when all of the fine aggregate is replaced by the heavyweight waste glass.
DM053 14:30-14:45	Analytical Study on the Flexural Behavior of Reinforced Concrete Beam with Mineral Admixture under Calcium Leaching Degradation **Il Sun Kim**, Yoon Suk Choi, Chan Kyu Lee and Eun Ik Yang Gangenung-Wonju National University, South Korea **Abstract:** Calcium leaching degradation could be happened in reinforcement concrete member due to the contact with pure water in underground condition. Thus, it is needed to evaluate the resistance of calcium leaching for concrete mixed with mineral admixtures. So, in this paper, to evaluate the flexural behavior in RC member with mineral admixture under calcium leaching degradation, we investigated the effect of calcium leaching using the non-linear finite-element program. From the results, the load capacity and flexible rigidity of a degraded RC member decrease when the degradation level increases with leaching period. And, regardless of the type of mineral admixtures, finite-element -method analysis effectively showed the characteristics of calcium leaching damaged RC beam.
DM032 14:45-15:00	Effects of crack density on wettability and mechanical properties of hard chrome coatings **Suwat Ploypech**, Martin Metzner, Claudia Beatriz dos Santos, Petch Jearanaisilawong and Yuttanant Boonyongmaneerat Chulalongkorn University, Thailand **Abstract:** Hard chrome is an important coating used widely in the industry, yet the understanding of the relationship of their plating process, developed surface crack, and corresponding properties are not fully established. This research investigates the development of surface crack of hard chrome through the variations of chromic acid

	concentration, catalyst content, and plating temperature, and subsequently examines how crack density contributes to wettability and mechanical properties in dry and lubricated environments. The study reveals that an increase of crack density in the low-to-medium crack range (150 – 400 crack/cm) is generated by the decrease of the chromic acid to catalyst volume ratio, and with the increase of temperature. These process parameter adjustments lead to reductions of cathodic current efficiency, and hydrogen gas development which could ultimately generate stress in the deposits. An increase of crack density contributes to the marked improvement of wettability with decrement of the contact angle from 8.5o to 4.2o. Hardness is also found to increase from 720 to 830 HV. Furthermore, crack density increments also result in the reduction of the coatings' wear rate in a non-lubricated condition by several folds. Hardness of the coating and the presence of cracks appear to largely influence the improvement of the wear resistance.
ES037-A 15:00-15:15	Al2O3/AlGaN/GaN metal-oxide-semiconductor high-electron mobility transistor **Lin Yu-Shyan** and Wang Heng-Wei National Dong Hwa University **Abstract**: An AlGaN/GaN metal-oxide-semiconductor high electron mobility transistor (MOS-HEMT) that employs a Al2O3 dielectric layer is studied. Furthermore, the effects of postdeposition annealing on the electrical properties of the MOSHEMTs are investigated. Improvements in the quality of the sputtered Al2O3 is achieved after rapid thermal annealing. In this study, the HEMT structures were grown on silicon substrates by metal organic chemical vapor deposition. A buffer was followed by an undoped GaN layer, a 1.5 nm AlN, and a 20-nm-thick, undoped Al0.25Ga0.75N layer. The studied devices consist of two gates, each of length 1 um and width 100 um, yielding a total gate periphery of 200 um. The process steps were lithographically defined using a contact aligner. First, Cl2-based inductively coupled plasma etching defines mesas. Then, ohmic contacts were deposited by thermal evaporation, followed by a rapid thermal anneal. Then, Ni/Au Schottky gate metal is deposited by thermal evaporation and liftoff. Furthermore, for the fabrication of the MOS-HEMT, a 20 nm sputter deposition Al2O3 layer was deposited before the gate metal. The dimensions of the gate were 1x125 um. A metal–oxide–semiconductor high electron mobility transistor (MOS-HEMT) that employs a Al2O3 dielectric layer is investigated herein. The gate leakage current of the annealed MOS-HEMT is significantly smaller than that of the conventional HEMT. Furthermore, capacitance-voltage (C-V) measurements are carried out using a computer controlled Hewlett-Packard 4284 LCR meter. The dielectric constant for the annealed Al2O3 dielectric is extracted to be about 10. The MOS-HEMT reaches a peak extrinsic transconductance of around 138 mS/mm. The maximum current density and extrinsic transconductance of the MOS-HEMT are larger than those of the HEMT. The cutoff frequency values of 8.6 and 14.3 GHz were

	measured for the conventional HEMT and annealed MOS-HEMT, respectively. Furthermore, the maximum oscillation frequency values are 10 and 17.1 GHz for the HEMT and annealed MOS-HEMT, respectively. Our experimental results demonstrate that the use of annealed Al2O3 as a gate oxide and surface passivation on AlGaN/GaN HEMTs produces lower leakage currents, increased reverse breakdown voltage, increased three-terminal breakdown voltage and improved high-frequency characteristics. These encouraging data demonstrate the viability of the studied MOS-HEMT for high-frequency and high-temperature applications.
ES004 15:15-15:30	Deterioration of Transportation Infrastructures: Corrosion of Reinforcements in Concrete Structures Koorosh Gharehbaghi and **Farshid Rahmani** RMIT University, Australia **Abstract:** The considerable network of transportation infrastructures such as highways, rails, and so forth are key providers to economic growth and productivity of countries. Consecutively, Reinforced Concrete (RC) is the predominant construction materials in constructing many of these infrastructures. RC is a unique construction material which allows flexible design layouts and offers safe bending and torsion to satisfy design requirements. However, being exposed to harsh environment and contamination such as salts, acid rain, distilled water, carbonation, sulphur and so on are the reasons for deterioration, thus significantly impacting the performance of these structures. Furthermore, the deterioration of these structures is not only a safety issue, but also an economic concern. Moreover, deterioration of concrete infrastructures can be attributed to many factors from structural deficiency to corrosion of reinforcement and thermal expansion due to fire damage. Accordingly, this paper will review the corrosion of reinforcements in concrete transportation Structures, and in doing so it will also examine some of the novel deterioration models to prolong concrete transportation structures. First, second, and third level headings Introduction. All manuscripts must be in English. Please keep a second copy of your manuscript in your office (just in case anything gets lost in the mail). When receiving the manuscript, we assume that the corresponding authors grant us the copyright to use the manuscript for the book or journal in question. Should authors use tables or figures from other Publications, they must ask the corresponding publishers to grant them the right to publish this material in their paper.

Coffee Break <15:30--15:45>

Session IV : Composite Materials and Solid Mechanics

Time: 15:45-18:15

Room 1-222 (2nd floor)

Chair: **Prof. Nao-aki Noda**

Kyushu Institute of Technology, Japan

DM004
15:45-16:00

Effect of Fiber Direction and Stress Ratio on Fatigue Property in Carbon Fiber Reinforced Epoxy Composites

Md. Shafiul Ferdous, **S. M. Moshiar Rahman**, Chobin Makabe
University of the Ryukyus, Japan

Abstract: The fatigue limit and crack growth behavior of slit specimens of carbon fiber reinforced epoxy composites were investigated. The fatigue limit was defined by the maximum stress amplitude that the specimen endured 106 times repeated stress when S-N curve was used. The highest fatigue limit was obtained when all the fiber directions were parallel to the load axis. The fatigue limits were evaluated in the cases of composites using alternately parallel and perpendicular to the load axis and compared with the result of the specimen having all the carbon fiber orientations were parallel to the load axis. When the measured value of the fatigue limit was lower, shear damage to the epoxy resin and peeling of fiber from epoxy resin occurred clearly. According to those results, it was expected that the fatigue limit of smooth specimens of carbon composites with long fibers can be evaluated from the results of the slit specimens.

DM010-A
16:00-16:15

Fracture toughness evaluation of TiB reinforced TiB composites fabricated by spark plasma sintering

Kazuya Sakayanagi, **Hiroki Kurita** and Noriharu Yodoshi
Tohoku University, Japan

Abstract: TiB whisker reinforced Ti matrix (Ti−TiB) composites, with a high specific tensile strength are expected as aerospace materials. It has been reported that Ti−TiB composites have low fracture elongation in previous studies, however we demonstrated both of a good tensile strength and elongation of TiB whisker reinforced Ti-6Al-4V alloy matrix (Ti6Al4V−TiB) composites fabricated by spark plasma sintering, with a homogeneous dispersion of TiB whiskers. Therefore, we seemed that these Ti6Al4V−TiB composites have also a good fracture toughness. In this study, we evaluated the fracture toughness of these Ti6Al4V−TiB composites, which have a homogeneous dispersion of TiB whiskers, a three-dimensional random orientation of TiB whiskers and an intimate Ti-6Al-4V/TiB interface. We employed the 3 fracture toughness test methods, compact tension test, four-point bending test, and small punch test. TiB volume fraction in Ti6Al4V−TiB composites was controlled between 0 and 12.5 vol %. The microstructure and the fracture behavior of Ti6Al4V−TiB composites by scanning electron microscope (SEM). The fracture toughness of Ti6Al4V−TiB composites was lower than the one of Ti-6Al-4V alloy, which was fabricated in same process (; Ti6Al4V−0 vol% TiB composite) due to the presence of

	brittle TiB whiskers. It was observed that TiB whiskers were firstly cracked and the crack propagated inside TiB whiskers during fracture toughness test. This result implies that the direction of crack propagation is dominated that the direction of TiB whisker orientation. Consequently, it is likely that the control of TiB whisker orientation can improve the fracture toughness of Ti–TiB composites.
DM020-A 16:15-16:30	Mechanical properties of plastic composite material using mortar powders **Yasuyuki Kanda** University of the Ryukyus, Japan **Abstract:** Large quantities of waste concrete, an industrial by-product, are generated in the demolition of buildings. Concrete is a composite material composed of mortar and coarse aggregate. Many effective uses of coarse aggregate have been reported in the in literature. By contrast, there is few reports on the effective use of mortar. Currently, in many cases, mortar in waste concrete is applied to a roadbed material. Mortar is fabricated using fine aggregate and cement. Thus, the chemical composition of mortar includes ceramic material components such as silica and alumina. Therefore, milled mortar powder can be used as reinforcement particles in composite materials. For contributing to the effective use of mortar from waste concrete, in this study, we fabricated a plastic composite material by using mortar powder, and the mechanical properties of this composite material were investigated by performing a three-point bending test. First, mortar powder was obtained by pot-milling mortar prepared using a 50 wt.% water/cement mixture. Next, the composite material was prepared by forming a mixture of polyethylene and mortar powder to compression molding. The results of the three-point bending test show that the flexural strength and flexural modulus of the composite material increased with increasing content of mortar powder. Therefore, mortar powder can be effectively used as reinforcing particles in composite materials.
ES046-A 16:30-16:45	Characterizing Thermal Conductivity Of Graphene Nannocomposites Using Ema And Mmt Model **Jia-Lin Tsa**i and Po-Ying Tseng National Chiao Tung University, Taiwan **Abstract:** In this study,effective medium approximation model (EMA)and modified Mori-Tanaka model (MMT)were employed to characterize the thermal conductivity of grapheme nano composites. The two model predictions were then compared with theex perimental data. Results illustrate the typical results for the model predictions and experimental data. It is indicated that predictions based on MMT model are higher than those obtained from EMA model. The difference is substantial when the graphene loading increases. Moreover, the experimental data are located somewhere between the two model predictions. Thus, the two analytical models respectively play the upper bond and lower bond solutions for the thermal conductivity of graphene nano composites.
	The Synergistic Effects of Multi-filler Addition on the Mechanical and

ABSTRACT

DM051 16:45-17:00	Thermo-mechanical Properties of Phenolic Resins **Pattarakamon Chaiwan** and Jantrawan Pumchusak Chiang Mai University, Thailand **Abstract:** The effects of the carbon fiber (CF), carbon black (CB) and nanosilica (SiO_2) on the mechanical properties of the phenolic resin (PF) were studied and the optimum composition was selected for the preparation of quaternary composites (CF/CB/SiO_2 phenolic composites). The incorporation of poly (acrylonitrile-co-butadiene) rubber (NBR) to strengthen the quaternary composites were also studied. The morphological, mechanical and thermo-mechanical properties of unmodified and NBR modified-quaternary phenolic composites were investigated. The phenolic compounds were mixed by ball milling and the phenolic composites were fabricated by hot compression molding. Scanning electron microscopy images of NBR modified - quaternary phenolic composites show the high fracture surface roughness. The results show that the addition of 5 wt% NBR in the quaternary composites offer the highest tensile strength and Young's modulus which are significantly improved by 176% and 235%, respectively, and they also offer the high flexural strength, impact strength and flexural modulus which are improved by 79%, 29% and 12%, respectively, compared to neat PF. The glass transition temperature (T_g) of unmodified and NBR modified-quaternary phenolic composites are higher than that of neat PF (107.3 °C). The increase of NBR content does not deteriorate T_g of the quaternary phenolic composites. This study provides a new pathway for making advanced phenolic composites.
DM022 17:00-17:15	Synthesis of Graphene Oxide Grafted With Epoxidized Natural Rubber Via Aminosilane Linkage **Pollawat Charoeythornkhajhornchai** and Anongnat Somwangthanaroj Burapha University, Thailand **Abstract:** Graphene oxide was synthesized from graphite by Hummer method and connected with (3-aminopropyl) triethoxysilane to form graphene oxide-aminosilane (GO-Si) linkage. The solution was centrifuged and washed with acetone to remove unreacted aminosilane before grafting with epoxidized natural rubber (ENR). ENR dissolved in toluene solution was mixed with GO-Si particle and dried at room temperature. Then, it was grafted to form graphene oxide grated with ENR via aminosilane linkage (GO-Si-ENR) by heat treatment. GO-Si-ENR was washed in toluene to remove unconnected ENR molecule. The synthesized GO particle in each step was characterized by Fourier transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). The possible reaction mechanism was proposed in this research. The aim of this synthesis is to improve natural rubber - graphene interfacial interaction thus the dispersion of GO and GO-Si-ENR particle in natural rubber matrix by solvent mixing process was observed by transmission electron microscopy (TEM).

ABSTRACT

DM018 17:15-17:30	Evaluation of fatigue strength of butt joint by intensity of singular stress field Tatsujiro Miyazaki, **Takeru Matsuda** and Kaito Naka University of the Ryukyus, Japan **Abstract:** In this study, the fatigue fracture criterion of the adhesively bonded joint is discussed. The singular stress field is formed at the interface end in the butt joint and causes the debonding fracture. The singular stress field is represented with the intensity of singular stress field (ISSF). The static debonding strength of the adhesively bonded joints is expressed with a constant value of critical ISSF. The rotating-bending fatigue tests are carried out on the butt joints of 15mm in diameter with four different adhesive thicknesses of 109 - 159m, 209 - 265m, 393 - 432m and 795 - 841m. The evaluation method by the ISSF is applied to the experimental results. It is found that the fatigue strength of the butt joint can be expressed with the constant value of critical ISSF.
DM033 17:30-17:45	Hexahedral-based Smoothed Finite Element Method using volumetric-deviatoric Split for Contact Problem **Kai Oshiro**, Hiroka Miyakubo, Masaki Fujikawa and Chobin Makabe University of the Ryukyus, Japan **Abstract:** A first-order hexahedral (H6)-element-based smoothed finite element method (S-FEM) with a volumetric-deviatoric split for nearly incompressible materials was developed for highly accurate deformation analysis of large-strain problems. In the proposed method, the isovolumetric part of the deformation gradient $\bar{F}$ at the integration point is derived from F based on the beta finite element method (i.e., an S-FEM), whereas the volumetric part of the deformation gradient is derived from F on the basis of the standard FEM with reduced integration elements. This method targets H6 elements that are automatically generated from tetrahedral elements, which makes it quite practical. This is because the FE mesh can be created automatically even if the targeted object has a complex shape. This method eliminates the phenomena of volumetric and shear locking, and reduces pressure oscillations. The proposed method was implemented in the commercial FE software Abaqus and applied to the large-deformation contact problem to verify its effectiveness.
DM101 17:45-18:00	Three-Dimensional Finite Element Analysis during Tightening of Bolt-Nut Connection Having Slight Pitch Difference **Nao-Aki Noda**, Xi Liu, Yoshikazu Sano, Yunting Huang, and Yasushi Takase Kyushu Institute of Technology, Japan **Abstract:** In a wide industrial field, the bolt-nut joint is unitized as an important machine element although anti-loosening performance is always required. In this paper, the effect of a slight pitch difference between bolt and nut is studied. The prevailing torque required for the nut rotation is analyzed before the nut touches the

	clamped body as well as the tightening torque after the nut touches the clamped body. The results show that a large pitch difference may provide large prevailing torque that causes an anti-loosening effect although a very large pitch difference may deteriorate the bolt tightening force even under a certain tightening torque. By taking into account the anti-loosening and clamping abilities, the most desirable pitch difference is proposed to improve anti-loosening.
ES050-A 18:00-18:15	Bio-photoelectrochemical Hybrid Device Integrating Microbial Electrodes with Perovskite-based Photoelectrodes for Solar Fuel Generation Chun Hong Mak, Rugeng Liu and **Hsien- Yi Hsu** City University of Hong Kong, Hong Kong **Abstract:** The microbial fuel cell (MFC) is integrated with the photoelectrochemical cell (PEC), employing the plasma surface technique as the performance booster for perovskite-based photoelectrodes and bioelectrodes, to construct the novel Bio-photoelectrochemical Hybrid Device (BPEC) for the application in the field of energy and environment. Here, we focus on the invention of a novel integrated perovskite photo-bioelectrochemical system concentrated on solar fuel production. The interdisciplinary approach in bio-material and non-bio-materials is a possible alternative for a sustainable, clean, safe and efficient energy generation in the future, addressing the global warming, greenhouse gases and environmental issue nowadays.

Session V : Functional Materials and Devices Time: 15:45-18:15 Room 1-322 (3rd floor) Chair: **Prof. Chuen-Lin Tien** **Feng Chia University, Taiwan**	
ES010 15:45-16:00	Thermochromic properties of vanadium oxide films prepared by R-HIPIMS using closed-loop controlled with plasma emission monitoring **Chien-Jen Tang**, Wei-Hsuan Hsu and Ching-Tang Li Department of Photonics, Feng Chia University, Taiwan **Abstract:** The vanadium dioxide films were deposited by reactive high-power impulse magnetron sputtering for different plasma emission intensity at the substrate temperature of 310 °C. The setpoint of plasma emission intensity was controlled by a PID controller with plasma-emission-monitoring. The vanadium dioxide films characteristics were measured by optical spectrophotometer, X-ray diffraction and electrical source meter.
DM061 16:00-16:15	Characteristic, Microstructure and Properties of Dense Hydroxyapatite Ceramic from Cockle shell for Biomaterials **Tiwasawat Sirisoam**, Cherdsak Saelee, Sakdiphon Thiansem and Sittiporn

	Punyanitya Chiang Mai University, Thailand **Abstract:** Dense hydroxyapatite ceramic can be fabricated from hydroxyapatite (HA) powder —prepared from cockle shells. The shell powder was treated at 900°C and co-precipitated with PO_4^{3-} in $NH_4H_2PO_4$ solution at Ca/P ratio of 1.67 in order to synthesize the HA powder. HA discs were formed by a hydraulic press machine and sintered at temperature of 1250°C for 2 h in an electric furnace which helps to dense ceramic. The results from FTIR analysis identified the functional groups of HA powder that has the ion stretching vibration around 3574, 2002 cm^{-1} for hydroxyl group (OH^-), 1451 cm^{-1} for carbonate (CO_3^{2-}), and phosphate groups (PO_4^{3-}) were also observed around 1045 and 560 cm^{-1} respectively. XRD measurement showed that the ceramic contains hydroxyapatite crystals with β-tricalcium phosphate and calcium oxide as the secondary phase. Morphological evaluations by SEM measurement shows that the HA particles were agglomerated and showed the fractured surface of dense HA when sintered at 1300°C. Grain size ranges from 0.5–1 mm, with an apparent porosity of about 50% of the total area and the pore size ranges from 1–10 mm. Mechanical property measurements show that the dense ceramic contains bending strength of 135 MPa, which is close to the strength of human's cortical bone (162 MPa).
ES030-A 16:15-16:30	Influence of nanolaminate Thickness on Residual Stress and Surface Roughness of Al2O3/ZnO Multilayer Thin Films Grown by Atomic Layer Deposition **Chuen-Lin Tien**, Hong-Yi Lin, Shih-Hsiang Lai and Chien-Jen Tang Feng Chia University, Taiwan **Abstract:** In this work, we studied the influence of nanolaminate thickness on the residual stress and surface roughness of (Al2O3/ZnO)x multilayer thin films prepared by atomic layer deposition technique. The different bilayer stacks of (Al2O3/ZnO)x (grown cycles x= 8, 10, 13, 19) were deposited on B270 glass substrates by atomic layer deposition technique at a low temperature of 60 degrees Celsius. The thickness of both Al2O3 and ZnO nano-film was approximately 2 nm. The residual stress and surface roughness of (Al2O3/ZnO)x nanolaminates were evaluated by different non-contact measurement instruments. The residual stress in Al2O3, ZnO monolayer and Al2O3/ZnO nanolaminates were measured by a homemade Twyman-Green interferometer with fast Fourier transform (FFT) algorithm. Surface roughness were characterized by a homemade Linnik mircoscope interferometer based on FFT with a Gaussian filter. The results show that the compressive stress in Al2O3 and ZnO monolayer was -1.340±0.457 GPa and -2.145±0.978 GPa, respectively. As increasing the bilayers stack of (Al2O3/ZnO)x nanolaminates in the power range of 8 to 19 cycles, the tensile stresses in Al2O3/ZnO nanolaminate thin films were decreased from 0.390±0.072 GPa to 0.213±0.020 GPa, and the root-mean-square (RMS) surface roughness was increased from 1.22±0.11 nm to 2.24±0.15 nm. The results demonstrate that the residual stress can be modulated by varying the nanolaminate thickness. The

	compressive stress in ZnO nano-film combined with Al2O3 monolayer as bilayers stack can be converted into a tensile stress in (Al2O3/ZnO)x nanolaminate films. By increasing the bilayers stack or the nanolaminate thickness, the tensile stress in (Al2O3/ZnO)x nanolaminate films was reduced. But the RMS surface roughness was increased with increasing the (Al2O3/ZnO)x nanolaminate thickness. These results reveal that (Al2O3/ZnO)x nanolaminate films will be opening the possibility for new optical and photoelectric applications. a mixture of polyethylene and mortar powder to compression molding. The results of the three-point bending test show that the flexural strength and flexural modulus of the composite material increased with increasing content of mortar powder. Therefore, mortar powder can be effectively used as reinforcing particles in composite materials.
ES029-A 16:30-16:45	Modulated precursor ink for one-step deposition in perovskite solar cells Shao-Yu Hsing, Syue-Yi Jhan and **Chih-Liang Wang** National Chung Hsing University, Taiwan **Abstract:** Photovoltaic material is known as one of smart materials having the feature of converting the light into the electricity under the illumination. The emergence of the perovskite solar cell utilizing a hybrid organic-inorganic perovskite absorber with high absorption coefficient, long diffusion length, and tunable bandgap has been attracted much attention recently due to its conversion efficiency exceeding 20% in a short of period. However, the device performance and stability strongly depend on the quality of perovskite film, easily affected by the deposition methods and preparation parameters. One of the promising perovskite deposition methods is one-step deposition, employed with a spin-coated precursor film simultaneously dropped by an antisolvent during the midway coating, to attain a desirable high conversion efficiency. Unfortunately, this antisolvent process is easily interfered with its relevant process factors that remain unclear, leading to the difficulty in repeatedly obtaining a required high quality perovskite morphology. Accordingly, in this presentation, a series of perovskite precursor inks composed of lead iodide (PbI2) and methylammonium iodide (MAI) dissolved in the solution of gamma-butyrolactone (GBL) and dimethyl sulfoxide (DMSO) followed by different preheated temperatures (RT, 80 oC and 100 oC) are adopted for the preparation of methylammonium lead halides (MAPbI3) film via one-step deposition with toluene as an antisolvent. The morphology of resultant perovskite film such as the density of pore, the compactness of film and the size of grain is found to be related with different preheated temperatures of precursor inks and spin coating parameters. The fourier-transform infrared spectroscopy (FTIR), contact angles anlysis, thermogravimetric analysis (TGA) are performed in order to provide a better understanding with the influence of preheated temperatures on the property of precursor ink that could potentially take effect during the antisolvent process. Furthermore, the X-ray diffraction (XRD) is carried out to analyze the crystallization of the resultant perovskites prepared by different preheated temperatures of precursor inks. The I-V measurement of perovskite devices is tested

	under AM 1.5G illumination and more details of related device performance will be discussed as well in the presentation.
ES034 16:45-17:00	Development of New Glass Phosphor for Multimodal Artifact Metrics Applicable for Ceramics **Masaki Fujikawa**, Mariko Hara and Shingo Fuchi Kogakuin University, Japan **Abstract:** Multi-modal artifact metrics, an anti-counterfeiting technique, was created based on the concept of multi-modal biometrics and can improve the certainty of authenticity and difficulty of counterfeiting as it gives more than one characteristic information to the artifact. In order to give two optical feature information (hue and emission intensity) into the ceramic products, we develop a new type of glass phosphor. This is a novel approach, since up-conversion phosphors with different color hue and emission intensity at each observation point on the material by optical excitation have never been reported. By welding a small amount of phosphor powder onto the surface of the ceramics, the certainty of authenticity and difficulty of counterfeiting would be enhanced than an existing method we proposed. Based on our experiment, we found appropriate blending ratio of two types of rare earth oxides for making glass phosphor with above-mentioned emission characteristics. These characteristics could be seen in other glass phosphor created by different base material glass with same blending ratio.
ES011-A 17:00-17:15	Artificial Domain Structure in Relaxor-Ferroelectric Material Induced by Sample Preparations **Jongchul Jeon**, Kyung-Mook Lim and Kyou-Hyun Kim Korea Institute for Rare Metal, Korea Institute of Industrial Technology, South Korea **Abstract:** Polarization rotation in Pb(Mg1/3Nb2/3)O3-xPbTiO3 (PMN-PT) has been widely discussed in the structural aspect in order to reveal the giant piezoelectric properties in relaxor-based ferroelectric materials. It has been reported that monoclinic (M) phases existing in morphotropic phase boundary (MPB) region act as a structural bridge to enhance the polarization rotation from rhombohedral phase ($P^{\rightarrow}$ R=[111]) to tetragonal phase($P^{\rightarrow}$ T=[001]). Therefore, proving existence of M phases is considered as the key to understand the polarization rotation mechanism. A large body of structural investigation has been carried out investigating the evidences of M phases existing in MPB region using various analytic tools such as x-ray diffraction (XRD), polarized optical microscope (POM), neutron diffraction and transmission electron microscope (TEM). For the structural investigation, conventional sample preparation procedures are in general followed by mechanical polishing and chemical etching regardless of used analytic tools. PMN-PT, however, is a piezoelectric material which is sensitive to the external force so that the original domain structure of PMN-PT can be changed during the conventional sample preparation procedures, leading to mislead the mechanism of

	polarization rotation in PMN-PT. Thus, in this study, we investigated the effect of sample preparation procedures on the domain structure of PMN-PT. In order to induce the artificial domain structure, The PMN-31%PT sample was first annealed and then the external force was intentionally applied to the PMN-PT sample by mechanical polishing and Ar-ion milling. Microstructural study shows that the mechanical polishing and Ar-ion milling both give the different domain structure from the original domain structure in the annealed PMN-PT sample. Details of domain structure is further studied using TEM with the help of quantitative symmetry measurement of CBED pattern. The experimental results show that the artificially induced domain structure is similar to that of poled PMN-31%PT along [001]C direction.
DM028 17:15-17:30	Design, fabrication and analysis of a novel membrane dielectric elastomer in-plane actuator **Yun-Hua Zhao**, Qiu-Hua Gao, Qi-Chang He and Wen-Ming Zhang Shanghai Jiao Tong University, China **Abstract:** The emerging field of soft robots offers the prospective of applying soft actuators as artificial muscles, replacing traditional actuators based on hard materials. Dielectric elastomers (DE), one class of electro-active polymers, represents an attractive technology for the realization of mechatronic actuators, due to their light weight, high energy efficiency and scalability. This work aims at investigating and characterizing a novel design of membrane DE in-plane actuator by magnetic mechanism. A nonlinear dynamic model of the dielectric elastomer actuator (DEA) is established and corresponding material parameters are identified. Natural frequency and response speed of DEAs are studied. It demonstrates that larger stretch and higher response speed can be realized by the proposed DEA.
ES006-A 17:30-17:45	Synaptic Plasticity and Learning Behaviors Mimicked in Single Inorganic Synapses of HfO2-based bilayer memristors **Aidong Li**, Laiguo Wang, Chang Liu, Yanqiang Cao and Di Wu Nanjing University, China **Abstract**: Synapse is the smallest unit of learning and memory of human brain, and the bionic simulation of synaptic learning is considered as an important route to realize artificial neural network. Ordinary electron devices use a number of transistors and capacitors to realize artificial synapse, causing high energy dissipation at high density and the limitation of software program running. The new memristor system is now known as the most close to the synaptic device because of its nonlinear transfer characteristics similar to the neural synapse. In this work, new memristor systems of HfO2-based bilayer memristors, such as Pt/HfOx/ZnOx/TiN, Pt/AlOx/HfOx/TiN, and Pt/HfO2/HfOx/TiN, were fabricated by atomic layer deposition. The synaptic plasticity and learning behaviors of bilayer memristive system were investigated deeply. Multilevel resistance states were obtained by varying the programming voltage amplitudes during the pulse cycling. The cell conductance could be continuously

	increased or decreased from cycle to cycle, and about 3×103 endurance cycles were obtained. Essential synaptic plasticity and learning behaviors were emulated using this memristor, including short-term plasticity (STP), long-term plasticity (LTP), spike-timing-dependent plasticity and spike-rate-dependent plasticity. And the STP-to-LTP transition can be observed through repeated "stimulation" training. Important time constants were extracted from these synaptic modifications, which are associated with brain learning and memory functions. The memristive switching mechanism for bilayer memristors and the role of oxygen vacancies in such memristive behaviors are also discussed. The metal oxide bilayer structures memristors may be promising electronic synapse devices for the emerging neuromorphic computation system.
ES013-A 17:45-18:00	Photoinduced Strain In Ferroelectric Based Devices **Loïc Guillemot**, Sylvia Matzen, Thomas Maroutian, Guillaume Agnus, Dafiné Ravelosona, Philippe Lecoeur, Sheena Patel, Oleg Shpyrko, Eric Fullerton, Haidan Wen, Anthony Dichiara and Roopali Kukreja Paris Saclay University, France **Abstract:** Ferroelectric materials, for their thermodynamically stable and switchable polarization states, are good candidates for photostrictive actuators when illuminated with above bandgap energy. Their internal electric field can efficiently separate the photoinduced charges and in combination with their inverse piezoelectric property, can lead to a structural deformation of the lattice. In the last few years, ultrafast pump-probe measurements have been realized on ferroelectric thin films (BiFeO3[1] and PbTiO3[2]), to better understand photoinduced strain. However, these films were in the as-grown polarization state, so the contribution of the ferroelectric polarization could not be extensively investigated. In this work, the induced deformation of a Pb(ZrxTi1-x)O3 (PZT) thin film after a UV pulse by time-resolved X-ray diffraction was studied. PZT layers were grown by pulsed laser deposition. The films were integrated within a capacitive device, having two electrodes allowing an in-situ manipulation of the polarization state. We studied the ultrafast photoinduced strain of PZT under UV excitation as a function of the applied electric field. By considering the competition between the different components of the total electric field present in the sample, a model was proposed denoting the polarization's contribution on the photostriction. In order to further control the photoinduced strain in devices, various approaches were studied, such as increasing the remnant polarization, increasing the UV depth penetration and developing asymmetric electrodes known to act on the ferroelectric polarization.
ES031 18:00-18:15	A Multifunctional Ankle Foot Orthosis Utilizing a Magnetorheological Actuator **Yuan Zhou** and Lu Liu City University of Hong Kong **Abstract:** The intelligent material, so-called magnetorheological (MR) fluid, is used in

	the design of an ankle foot orthosis. This paper presents the configuration of a multifunctional ankle foot orthosis that is equipped with a novel MR actuator. At first, the structure of the orthosis is introduced. Then, according to the mounting position of the actuator, the MR actuator is conceived by designing the structure and magnetic circuit. The actuator has three working modes, assistant, resistant and free modes. Finally, the manual power consumptions of two conditions, gait with and without the orthosis, are investigated; electricity consumptions of two cases, orthosis with and without the MR actuator, are compared.

Session VI : Materials Chemistry and Chemical Engineering

Time: 15:45-18:15

Room 1-221 (2nd floor)

Chair: **Prof. Ömer Aydan**

University of the Ryukyus, Japan

ES017-A 15:45-16:00	Photocatalytic Degradation of Rhodamine B by Cu(II)-doped Nanosheet-based Hierarchical ZnO Neethu Sebastian and **Wan-Chin Yu** National Taipei University of Technology, Taiwan **Abstract:** Abstract. ZnO hierarchical nanostructure consisting of nanosheets were synthesized by a direct precipitation method. The effects of Cu(II) doping on their structures and photocatalytic activity were investigated. Scanning electron microscopy shows that the as-synthesized hierarchical ZnO nanostructures were micron-sized spheres (2-5 [illegible] did not have a significant effect on the morphology. When Cu(II) doping was increased to 7 mol%, the nanosheets became loosely packed, although the overall spherical shape was preserved. The photocatalytic activities of the as-synthesized ZnO nanostructures were assessed by studying the degradation of the organic dye Rhodamine B (RhB) under UV light irradiation. In addition to the amount of Cu(II) doping, the effect of various parameters on the degradation of RhB were investigated, including the catalyst dosage, dye concentration, and the pH of the dye solution. Results show that proper Cu(II) doping can enhance the photocatalytic activity of the ZnO hierarchical nanostructures. At a dosage of 0.5 g/L ZnO, nearly 100% degradation of RhB was achieved in 3 h by the 2 mol% Cu(II) doped ZnO, much more effective than the undoped counterpart (38% degradation). Furthermore, the photocatalytic activity of our ZnO nanostructure was maintained even after five successive cycles. Over-doping (10 mol%) with Cu(II), however, could have negative effect. Our experimental results provide better understanding of the correlation between the degradation of RhB and Cu-doped ZnO hierarchical nanostructures.
DM019	Evaluation of mechanical properties of dimpled PET fiber fabricated by

16:00-16:15	electrospinning method Kazuto Tanaka, **Ryota Kawasaki**, Tsutao Katayama and Yusuke Morita Doshisha University, Japan **Abstract**: Insufficient endothelialization of stent grafts tends to cause a problem of thrombosis formation. Because the structure of nanofibers, generally defined as fibers with a diameter below 1 μm, resembles the structure of an extracellular matrix, nanofibers are applied to scaffolds for regenerative medicine. Using nanofibers as the covering material of the stent graft can be expected to solve the problem of the stent graft. Previous studies have shown that a porous scaffold offers better surfaces to anchor and culture endothelial cells than a nonporous scaffold. Therefore, fibers with nano-order dimples are expected to promote endothelialization. As a method of forming the dimple shape on the surface of the PET fiber, there is a method utilizing a difference in the volatilization rate of the solvent in the high humidity environment in the electrospinning method. For practical application of the stent graft to artificial blood vessels, the mechanical properties of the dimpled PET fiber should be clarified. In this study, the mechanical properties of single nanofibers and nonwoven fabrics of PET fibers with dimples on their surface were evaluated by tensile test. By forming the dimple shape on the fiber surface, the tensile strength of single PET fibers with dimples was 90 % lower than that of single PET fibers with a smooth surface. In the fabrication process of nonwoven fabric, the addition of EG delayed the volatilization of the PET solution, and the fibers adhered to each other. The bonding between the fibers contributed to the tensile strength of the nonwoven fabric.
DM047-A 16:15-16:30	Preparation of catechol-anchored polymer crosslinked to dopamine-conjugated Pluronic for temperature sensitive and adhesive hydrogels **Sang Gyu Roh**, Eun Jeong Kim and Sung Young Park Korea National University of Transportation, South Korea **Abstract:** A research on hydrogel with specific properties, such as thermo responsiveness, injectability, and strong tissue adhesion, has caught wide attentions particularly for medical applications. The thermo-responsive and injectable adhesive hydrogel was prepared by utilizing adhesive mussel-inspired catechol moieties between catechol-anchored polymers (C-q-PDMB) and dopamine-functionalized Pluronic (PDP). This tissue adhesive material was achieved by synthesizing the C-q-PDMB via quarternization reaction of 2-chloro-3, 4'-dihydroxyacetophenone (CCDP) into poly (dimethylaminoethyl methacrylate)-co-(t-butylmethacrylate) (PDMB), which followed by cross-linking reaction with PDP to form PDP/C-q-PDMB hydrogel. The mixture showed temperature sensitive behavior, good gel stability and excellent adhesive properties. In room temperature condition, the PDP/C-q-PDMB form was appeared as a viscous solution, which can be transformed into a gel state when the temperature was increased. The PDP/C-q-PDMB hydrogel also demonstrated a more stable structure

	compared to pure pluronic in aqueous state. By optimizing mixture ratio between PDP and C-q-PDMB (14:8 wt%), a hydrogel form was easily acquired when exposed at body temperature in less than 10 s, and demonstrated a good gel stability. Furthermore, this hydrogel provides biocompatibility and strong adhesive behavior based on cytotoxicity assay and universal testing machine. Thus, this hydrogel offers astonishing properties which can be used for various medical applications, such as drug delivery and tissue engineering.
ES040 16:30-16:45	Linear and Hyperbranched Copolymers of PEG-Based Acrylates and Methacrylic Acid as pH-Responsive Hydrophobic Drug Carriers Eduardo Jr. Atayde, **Reynaldo Carlos Montalbo** and Susan Arco Natural Sciences Research Institute, University of the Philippines - Diliman, Philippines **Abstract:** The oral administration of pharmaceuticals is typically preferred over other methods due to its non-intrusiveness and convenience of administration. However, the varying chemical environments of the gastro-intestinal tract pose a challenge in ensuring the stability and inertness of a drug compound until it reaches its target. Polymers that are responsive to pH changes have potential as smart materials for the controlled oral administration of pharmaceuticals. In this study, linear and hyperbranched copolymers of methacrylic acid (MAA) and poly(ethylene glycol) methyl ether methacrylate (PEGMEMA) were synthesized by RAFT polymerization. High molecular weight polymers were produced with PDI values close to 1.0. These smart materials underwent phase changes at pH 5.15-5.6. This property enabled the amphiphilicity of the copolymers to be switched on or off. By doing so in *in vitro* drug release studies with ibuprofen as the model hydrophobic drug, the copolymers were able to inhibit drug release in simulated stomach conditions to up to 13% while enhancing drug release in simulated intestinal conditions to up to 75% within 6 hours. These indicate that copolymers based on MAA and PEGMEMA have potential as smart materials for drug delivery applications.
DM056 16:45-17:00	Effects of Reaction Temperature and Electrolyte Concentration on Interfacial Reactions between Graphite and Propylene Carbonate-Based Solutions **Soon-Ki Jeong** Soonchunhyang University, South Korea **Abstract:** The effects of temperature and electrolyte concentration on the reaction of graphite electrodes in propylene carbonate (PC)-based solutions were investigated. In the case of natural graphite, it was confirmed that the reaction leading to the insertion of lithium ions into the graphite, which does not proceed at 25 °C in a solution with a concentration of 0.85 mol kg^{-1}, proceeds by lowering the reaction temperature to –15 °C. The temperature at which lithium ions were inserted increased as the concentration increased. That is, lithium ions were electrochemically inserted into the interior of the natural graphite at 5 °C in a solution of 1.63 mol kg^{-1} and at 15 °C in a solution of 2.45 mol kg^{-1}, indicating that the temperature and the electrolyte concentration greatly

	affect the properties of the solid electrolyte interphase produced by the decomposition of the PC-based electrolyte. Similar and slightly different electrochemical behavior was observed for synthetic graphite in terms of changes in temperature and the electrolyte concentration factor. In synthetic graphite, the temperature at which lithium ions were inserted was lower than in natural graphite: –25 °C and 5 °C in solutions of 0.85 mol kg^{-1} and 2.45 mol kg^{-1}, respectively.
DM058 17:00-17:15	Effect of Mixing of Carbon Support from Sawdust and Sugarcane Bagasse by Hydrothermal Carbonization for Synthesis of Molybdenum Disulfide (MoS2) Catalyst **Peerawith Sumtong**, Vituruch Goodwin, Nuwong Chollacoop and Apiluck Eiad-Ua King Mongkut's Institute of Technology Ladkrabang, Thailand **Abstract:** Molybdenum disulfide (MoS_2) catalyst on carbon support from varying ratio of sawdust and sugarcane bagasse has been successfully synthesized by hydrothermal carbonization and calcination process. Hydrothermal carbonization of lignocellulosic structure into carbon support is investigated at 200 ^{o}C for 24 hr and calcination at 600 ^{o}C for 2 hr. The precursor of MoS_2 catalyst is prepared using thiourea (CH_4N_2S) and ammonium molybdate tetrahydrate ($(NH_4)_6Mo_7O_{24}\cdot 4H_2O$) loaded on carbon support. The lignocellulosic structure as hemicellulose and cellulose is changed at high temperature via hydrothermal carbonization and calcination. The distribution of molybdenum disulfide on carbon support is varied based on morphology and functional group of carbon support. The morphology and functional group were analyzed using Scanning Electron Microscope (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). It shows that carbon support at equal ratio (1:1) of sawdust and sugarcane bagasse is an optimum ratio with high distribution of molybdenum disulfide catalyst on carbon support.
ES016-A 17:15-17:30	Synaptic Plasticity and Learning Behaviors Mimicked in Single Inorganic Synapses of HfO2-based bilayer memristors **Aidong Li,** Laiguo Wang, Chang Liu, Yanqiang Cao and Di Wu Nanjing University, China **Abstract:** Three dimensional mesoporous structures composed of ZnO nanocrystals (approximately 20 nm in size) were synthesized by an eco-friendly aqueous solution method and explored as the photoanode materials for dye-sensitized solar cells (DSSCs). These submicron-sized hierarchical structures can be used to improve the power conversion efficiency of DSSCs, because they have the capability to boost optical absorption through enhanced light scattering, while providing alarge interfacial surface area for dye adsorption. The morphology of the ZnO hierarchical structures was modulated by the introduction of small amounts of aluminum nitrate into the reaction mixture. In the absence of aluminum nitrate, a flowerlike structure with 5-6 petals radiating from a central core was obtained. The overall dimension of the flower-like assembly was approximately 500-600 nm. When 1-10 mol% of aluminum nitrate was

	introduced into the reaction mixture, the growth of the flower petals was inhibited. Instead, the central core was surrounded by nanocrystallite aggregates of varied sizes, and the amount of the nanocrystallite aggregates appeared to increase with increasing amount of aluminum nitrate. The powder X-ray diffraction and EDS results demonstrate that all the as-prepared hierarchical structures are composed of pure ZnO. The as-prepared ZnO mesoporous structures were constructed into DSSC photoanodes using a low-temperature (150°C) thermal treatment process and the N719 dye. The ZnO hierarchical structures produced the best photovoltaic performance was those prepared in the presence of 3-5 mol % of aluminum nitrate. The highest power conversion efficiency achieved was 4.17%, a significant improvement compared with the 3.41% efficiency of the reference device fabricated with commercial ZnO nanoparticles. The enhancement in the power conversion efficiency could be attributed to the greatly improved photocurrent (JSC) of the hierarchical structure-based devices.
ES038-A 17:30-17:45	Green Fabrication, 3D Hot-Junctions, and Immobilization of Gold Nanoparticles on Two-Dimensional Silicate Nanosheets as High-Efficiency SERS Substrates **Chih-Wei Chiu**, Yen-Chen Lee and Chun Hsiao National Dong Hwa University **Abstract**: In this study, we observed a high-efficiency surface-enhanced Raman scattering (SERS) substrate composed of gold nanoparticles (AuNPs) onto two-dimensional silicate nanosheets as inorganic stabilizer synthesized by sodium citrate reducing (Figure1) [1–3]. The use of various dimensions of silicate sheets to stabilize the AuNPs, such as laponite, Na+-MMT, mica, that forming the narrow particle diameter range between 25–30 nm was successfully confirmed by transmission electron microscopy (TEM) measurement. In addition, the SERS substrate could be applied to biological, environmental, and food safety that measured by small molecules included adenine of DNA, direct blue of dye, paraquat of pesticide and the sensitivity was improved with an enhancement factor (EF) of 7 × 105 and detection limit concentration of 10-9 M. The highly sensitive SERS substrates with 3D hot-junctions formations with AuNPs and two-dimensional silicate nanosheets that allow the detection of organic molecules with high efficiency. Therefore, the AuNPs/nanosheets nanohybrids as SERS substrates have great potential in biosensor technology because of its high-efficiency and simple fabrication and they are expected to apply in the rapid detection of environment friendly.
DM060 17:45-18:00	Synthesis, Characterization and Properties of Forsterite Refractory Produced from Thai Talc and Magnesite **Surapattanapong Kullatham** and Sakdiphon Thiansem Chiang Mai University, Thailand **Abstract:** This paper reports the synthesis, characterizations, microstructure and properties of forsterite powder produced in Thailand from talc and magnesite as raw materials by using mechanical activation with subsequent calcination. The synthesis

	forsterite powder were mixed by using talc and magnesite at 1:5 mole ratio. The maximum milling time was 24 h in a planetary zirconia ball mill. Afterward, the mixtures were calcined in an electric furnace for 1 h at 900, 1000, 1100, 1200 and 1300°C respectively. The synthesized powder was characterized by X-ray diffraction (XRD), X-ray fluorescence (XRF), scanning electron microscopy (SEM) and physical properties. Results of the physical properties of synthesized forsterite showed an increased in density as the calcining temperature increased. In contrast, porosity was decreased with an increase of the calcining temperature. Therefore, forsterite that was calcined at 1300°C provided the best results which were 2.96 g/cm^3 of true density and 15.41% of true porosity. Results of XRD of synthesized powder indicated that the forsterite crystallization was constant for which sharpen appeared after 5 h of mechanical activation. Fraction of forsterite was appeared after being calcined at 1000°C for 1 h with an increasing of calcination temperature, the fraction of forsterite phase increased. Based on the mentioned characteristics, the forsterite produced from Thai talc and magnesite exhibited properties of an insulator and can potentially be used as refractory devices.
ES031 18:00-18:15	Preparation of Boron Nitride Coating from BCl3-NH3-H2-N2 Precursor by Chemical Vapor Deposition **Mengqian Wang**, Lintao Jia, Aijun Li and Yuqing Peng Shanghai University, China **Abstract:** As an ideal interface coatings material for continuous fiber-reinforced ceramic matrix composites (CFRCMCs), the chemical vapor deposition (CVD) of boron nitride (BN) occurred in a vertical hot-wall apparatus using BCl3-NH3-H2-N2 precursors system. The surface deposition rate was studied under various temperatures (923K~1123K), pressures (3KPa~12KPa) and residence times (0.5s~4s). The effect of process parameters on the deposition characteristics was analyzed. The deposition rate of boron nitride increases with the increase of deposition temperature. At a certain temperature, the deposition rate of boron nitride in the deposition area gradually decreases along the gas flow direction, indicating the gradual consumption of gas components in the gas flow direction. With the increase of system pressure, the deposition rate of BN first increases and then decreases, and the deposition process changes from surface reaction control to mass transfer control. The relationship between BN deposition rate and residence time varies at different deposition locations. The deposition is the process of adsorption-saturation adsorption-growth-gas phase nucleation control, and the adsorption process can be described by a Langmuir-Hinshelwood kinetics model with a second-order surface reaction. The BN coating on the surface of silicon carbide fiber is relatively smooth and dense, the main component are BN and oxidation product B2O3, the BN is amorphous before heat treatment, the crystallization degree of BN increases after heat treatment at 1200 ℃, and the BN is transformed to the hexagonal morphology. The deposition process of BN was discussed, and the deposition mechanism of BN is leading by several intermediate

	gases products, mainly Cl2BNH2 and ClB(NH2)2. The reaction terms of related gas phase species in deposition process were proposed.

Dinner @ 2nd floor of the Engineering Faculty Building No.2
<18:45-20:00>

Poster Session Time: 13:30-15:30 Room 1-122 (1st floor)	
ES019-A	Properties of Cement-Based Materials Used in Geological Repository **J.G. Jang** and S.M. Park Incheon National University, South Korea **Abstract:** Cement-based materials are an essential component in the construction of radioactive waste repositories. In particular, countries that have operated nuclear power plants are now expected to initiate disposal of high-level radioactive wastes in near future. On one hand, cement-based materials are appreciated to be used as a core material to construct engineered barrier system for geological repositories, on the other hand, cement-based materials are a material whose physicochemical properties can be changed by the natural environment over time. For instance, a neutralization caused by carbonation reaction of cement hydrates is a typical deteriorating phenomenon which governs the durability performance of a cement-based material. For this reason, studies have been actively conducted to clarify such deterioration phenomena, and to enhance the performance of cement-based materials. This study presents an overview on the properties of various types of cement-based materials such as blended Portland cement, low-alkali cement and alkali-activated cement, which are studied or currently being developed for use in geological repositories. Furthermore, this study reports a result of an experimental work conducted by the authors to investigate the weathering effect on physicochemical properties and radionuclide retention of a cement-based material.
ES039-A	A Size Effect on Heating Performance of Multi-walled Carbon Nanotube Cement Composite **Sunghoon Park**, Jongkyeong Seong and Wonseok Chung Kyunghee university, South Korea **Abstract:** Recently, the multi-walled carbon nano tube (CNT) is used for functionalization of cement-based materials. MWCNTs can be combined with cement composite to improve their thermal properties and electrical conductivity. In this study,

	various sizes of MWCNT cement composites are manufactured to study size effect on heating performance. MWCNT was mixed 0.1wt% to cement weight. The cross sections of all specimens are the same as 40×40 mm2, length was 80, 120, 160, 200mm respectively. MWCNT cement composite installed stainless steel mesh was connected to DC power supply. The heating test was implemented by supplying a voltage of 100V to the specimen. Thermocouple was installed to measure internal temperature of specimen through a static data logger. The internal temperature change of the specimen was measured at various points. The surface temperature and distribution patterns were investigated by using a thermal imager. As a result, the internal temperature change of the 80mm length specimen was 79.2ºC. It was the largest temperature change in the test group. Temperature change of the 120, 160 and 200mm length specimens were 77.2, 71.0 and 68.3ºC respectively. In test results, the length of the specimen and the heating performance were in inverse proportion when same voltage was supplied to the same electrode interval.
ES041-A	Characteristics of smart window device using nano coating technology Park Jaesoung, Hwang Doyun and **Park Sungeun** Gumi Electronics&amp & Information Technology Research Institute, South Korea **Abstract:** Smart window can be applied to various fields such as display and industrial exterior materials. In particular, devices using electrochromic materials can incorporate nano-fusion technology such as nanoparticle and nano processing control through nano coating technology. Electrochromic devices can be fabricated by using glass or film substrate materials. In this study, materials that can reversibly change the optical characteristics of materials are deposited by oxidation and reduction reactions of electrochromic materials, Is a thin film electrolyte coating study that prevents performance deterioration due to deterioration phenomenon. The electrochromic device is characterized in that its optical properties can be reversibly changed by injection and extraction of charges induced by an external voltage. The principle of the electrochromic material is briefly described. When electrons and Li + or H + are injected into the electrochromic layer (WO, MoO, Nb2O5, etc.), which is a typical reducing coloring material, (V2O5, NiO, IrO2, MnO, etc.), when Li + or H + and electrons are released, they are discolored. In this study, we study the optical characteristics of Ta2O5 thin films deposited with WO, which is a reducing coloring material to which electrons are injected, and investigate the discoloration and response speed of thin films depending on the thickness and voltage.
ES043-A	Evaluation on Applicability of Industrial Waste as Aggregate of Concrete **Eun Ik Yang**, Won Jun Lee and Hyo Eun Choi Gangneung-Wonju National University,South Korea **Abstract:** In order to solve the problem of natural aggregate exhaustion, several types of industrial waste have been studied for recycling of construction materials. In general, steel slag has been used as aggregate in concrete, however, steel slag has a

	problem of causing volume expansion by F-CaO. Therefore, in this study, the expansion properties are compared with aging period to solve the problem of the steel slag expansion. And, fresh and hardened properties of concrete were evaluated. According to the test results, the expansion of the steel slag decreased regardless of the types of steel slag during aging period. And, the Electronic Arc Furnace Oxidizing Slag (EAF) had the better reduction in expanding than the Converter Slag (CS). Also, it is showed that the water aging period of the steel slag had no effect on the air contents, slump, compressive strength and density of concrete.
ES047-A	Controlling Electric Potential for Ultrafast Lithium-ion Batteries Won Jun Chang and **Won Il Park** Hanyang University, South Korea **Abstract:** Despite significant advancement in the development of higher-capacity anode materials, problems associated with the unstable evolution of a solid-electrolyte interphase (SEI) remain, and become more detrimental with increasing cycling rates. Considering that the SEI develops on the active anode surface before lithiation starts, most previous research focused on the novel hybrid design to prevent direct contact between electrolyte and anode materials. However, since the Li ion/etchant-permeable shell cannot permanently prevent permeation of electrolyte, these works gave rise to a dispute concerning the permeation of electrolyte and SEI development on the anode surface. Here, we propose a new approach that prevents the formation of an SEI layer by engineering the electric potential across the electrolyte/anode interface. The NiSiNWs@GrμTs were tested as a proof of concept for the proposed strategy and demonstrated unprecedentedly excellent performance during 2000 cycles at 20C with a high specific capacity (over 700 mAh/g, corresponding to 84% of the initial capacity). Moreover, the NiSiNWs@GrμT anodes showed superior rate capabilities with a capacity retention higher than 88% at 80C (vs. the capacity at 1C). To the best of our knowledge, there is no report demonstrating a capacity higher than ours (~780-800 mAh/g) at a cycling rate higher than 40-80C.
DM005	Li-doped ZnO Piezoelectric Sensor for Touchscreen Applications **Chun-Cheng Lin** R.O.C. Air Force Academy, Taiwan **Abstract:** Piezoelectric sensors based on highly (002)-oriented Li-doped zinc oxide (LZO) thin films are fabricated on Pt/Ti/SiO2/Si substrates using a radio frequency (RF) magnetron sputtering technique with DC-bias voltages ranging from 0 ~ 25 V. The DC-bias voltage modifies the microstructure and thickness uniformity of the LZO films, and therefore changes their piezoelectric properties. The optimal value of the piezoelectric coefficient is obtained for a DC-bias of 20 V. The observation results suggest that the superior piezoelectric property is the result of an improved crystallization of the LZO film rather than a greater thickness uniformity. The feasibility

	of the optimal LZO-based piezoelectric sensor for touchscreen applications is demonstrated by means of a simple experiment.
DM016	Variable Stiffness Structures utilizing Pneumatic Artificial muscles **Ning Feng**, Jingze Wang and Yingli Chang Pingdingshan University, China **Abstract:** Pneumatic artificial muscles (PAMs) can offer excellent force-to-weight ratios and act as shape-changing actuator under injecting the actuation fluid into their bladders. PAMs could be easily utilized for morphing structures due to their millimeter-scale diameter. The pressurized PAM can serve not only as artificial muscle actuator which obtains contraction deformation capability but also as a spring system with variable stiffness. In this study, the stiffness behaviors of pressurized PAMs and a variable stiffness structure are investigated. By taking advantage of the designed PAMs which was conducted by the non-linear quasi-static model, significant changes in the spring stiffness can be achieved by air pressure control. A case study is presented to explore the potential behavior of a structure with circular permutation PAMs. The structure used in this case consists of sixteen PAMs with circular homogeneous distribution and a circular supporter with sixteen slide way runners. The stiffness of presented structure can vary flexibly in wide range through controlling the air pressure levels and slide deformation respectively.
DM041-A	The effect of mixing ordered mesoporous carbon with zinc indium sulfide as an anode material for lithium ion battery **Gyuseong Lee**, Jungho Lee, Min Ji Kim and Ji Man Kim Sungkyunkwan University, South Korea **Abstract**: Lithium ion batteries (LIB) are efficacious electrochemical energy storage device due to their high energy density, long life cycle, and no memory effect. [1] Graphite is the most commonly used anode for LIB because of its stability and low volume expansion. However, graphite has critical disadvantage, low theoretical capacity. To overcome this limitation, the development of high-capacity anode material is indispensable. Layered ternary chalcogenide system, Zinc Indium Sulfide (ZnIn2S4) exhibits two polymorphs based on cubic and hexagonal lattices. When zinc indium sulfide with hexagonal lattices act as an anode material in lithium ion battery, it shows interesting features. In2S3 has layered structure with proven high theoretical capacity and ZnS has reversible lithium insertion/desertion with good stability. [2] From these features, ZnIn2S4 could be a good anode material for LIB. Also, carbon-based materials have been widely introduced due to its excellent conductivity. On the other hand, ordered mesoporous carbons are good candidates for heterogeneous energy storage composites due to its regular structure and large surface area which could facilitate higher material utilization for electrochemical redox reactions. Zinc indium sulfide will be mixed with ordered mesoporous carbon and show enhanced electrical conductivity.

	In this work, ZnIn2S4/C nanocomposites are synthesized with CMK-3 and tested for anode material in lithium ion battery. Characterization methods are X-ray diffraction, Nitrogen sorption, SEM, and various electrochemical investigations. We anticipate that these materials may show good cycle ability, stability, and high rate performance.
DM042-A	Cathode materials for Li-S battery: P-doped Meso-Microporous Core-Shell carbon **Min Ji Kim**, Jin Seo Park, Gyuseong Lee and Ji Man Kim Sungkyunkwan University, South Korea **Abstract:** The rechargeable batteries are in high demand to address increasing electric devices market. Li-ion battery is most widely used because of its high energy density and lightness, but the practical application for electric vehicles and energy storage systems is hindered due to its low capacity. To develop alternative batteries which can show higher capacity, various studies are under way. Among them, the promising one is Li-S battery. Li-S battery has attracted much attention as the next-generation battery because it has high capacity and use low-cost active materials compared to conventional Li-ion battery. However the active material, sulfur dissolves as polysulfides intermediates while charging and discharging. This makes the capacity decrease and followed by poor cycle performance. So we tried to develop new cathode materials that can block the elution of polysulfides by synthesizing ordered mesoporous carbon material coated with microporous carbon layer, named as P-doped meso-microporous core-shell carbon (P-MMCS). In our study, ordered mesoporous carbon was synthesized by nanocasting method using SBA-15 as hard template. Then, microporous carbons were coated by reflux and we controlled the amount of phosphoric acid. After that, calcination was done at 900℃ and the silica template was removed by using hydrofluoric acid. The as-synthesized ordered mesoporous carbons were characterized by X-ray diffraction (XRD), nitrogen-sorption isotherm and scanning electron microscope (SEM). Also further electrochemical analysis was done, too.
DM043-A	Effect of Ni-Ce/SMS catalyst on the activity in dry reforming of methane **Jungho Lee**, Jin Seo Park, Gyuseong Lee and Ji Man Kim Sungkyunkwan University, South Korea **Abstract:** The dry reforming of methane (DRM; CO2 + CH4 → 2CO + 2H2) is attracting attention as a reaction to generate valuable syngas (a mixture of hydrogen and carbon monoxide) using greenhouse gases, as an increase in concern for reduction and utilization of greenhouse gases. Nickel is most widely used as a catalyst for reforming, but the high reaction temperature of DRM causes aggregation of the nickel particles and severe coke formation on the catalysts leading to deactivation. In this study, we prevented the sintering and coking by impregnating nickel oxide precursor and several promoters into spherical mesoporous silica (SMS) support to reduce the size of the nickel nanoparticles through nanocasting method. It has been known that small nickel nanoparticles are advantageous to reduce coke formation. Furthermore, promoters with high oxygen

	mobility, such as ceria and zirconia, have great influence on the amount of coke. Reduction was carried out before the catalytic tests and full conversion of CH4 and CO2 was obtained below 700 ℃. The synthesized catalytic properties were analyzed by X-ray diffraction (XRD), nitrogen adsorption and desorption isotherms (BET), scanning electron microscope (SEM), transmission electron microscopy (TEM), hydrogen temperature programmed oxidation (TPR), temperature programmed oxidation (TPO), and Raman spectroscopy.
DM045-A	Highly dispersed tungsten oxide supported on ordered mesoporous rod-SBA-15: An active catalyst for glycerol acetalization **Jin Seo Park**, Jungho Lee, Min Ji Kim and Ji Man Kim Sungkyunkwan University, South Korea **Abstract:** Biodiesel has gained a considerable attention in recent years due to global warming and decrease of the fossil fuel reserves. The production of biodiesel involves transesterification of vegetable oil with methanol to afford biodiesel and glycerol, produced as byproduct. Due to the high contamination of crude oil, this glycerol cannot be used in food nor pharmaceutical industries. Glycerol can be transformed into diverse derivatives by various catalytic processes. Among them, acetalization of glycerol with ketones has been reported to yield five and six membered acetal. The products of glycerol acetalization have been widely used as fuel additives, cents in cosmetic industries and basis for surfactants. In this research, glycerol conversion with acetone has been studied using mesoporous WO3/rod-type SBA-15 (WO3/R-SBA-15) as a catalyst. A series of catalysts with varying WO3 loadings (5~20 wt%) were prepared by incipient wetness impregnation method using tungsten precursor. The catalysts were physicochemically characterized with X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), N2 adsorption-desorption analysis, NH3 temperature-programmed desorption (NH3-TPD), and pyridine-adsorbed Fourier transform infrared spectroscopy (py-FTIR). In the catalytic acetalization experiment, variant molar ratios of glycerol to acetone were fed, and WO3/R-SBA-15 catalyst was added. Among the catalysts, 15 wt% WO3/R-SBA-15 was found to be the most active catalyst in acetalization reaction at 50 ℃. The catalyst exhibited 97% conversion with 97% selectivity for the five-membered (1,3-dioxolane) cyclic product. The excellent performance of the catalyst is mainly due to their high specific surface areas, high pore volumes and strong surface acid properties. These results suggest that WO3/R-SBA-15 catalyst is highly active catalyst for the acetalization of glycerol.
DM046-A	Thermo-responsive polymer based on Poly-N-Isopropylacrylamide grafted into Pluronic for injectable hydrogel **Hyun Jeong Won**, Seul Gi Kim and Sung Young Park Korea National University of Transportation, South Korea **Abstract**: A temperature-sensitive polymer hydrogel was prepared by a radical-induced

	grafted polymerization technique using successive reaction of N-isopropylacrylamide (NIPAAm) which initiated by t-butylperoxybenzoate followed by attachment into Pluronic backbone. The thermal properties of Pluronic-g-poly(NIPAAm) were analyzed using differential scanning calorimetry (DSC) and showed distinguish shifting. For confirming about critical behaviors of the graft copolymer solutions, cloud point measurement were conducted which showed typical graft copolymer transmittance-temperature curves. Moreover, the copolymerization hydrogel demonstrated sol-gel transition which rely on the degree of polymerization of the grafted poly(NIPAAm) into Pluronic backbone. Particular thermo-reversible gelation properties of the thermo-responsive hydrogel was observed through the analysis of dynamic modulus of the injectable hydrogel in aqueous solution. The different content of poly(NIPAAM) also exhibited hydrophobic and hydrophilic balance and become a parameter for controlling the transition and the stability of the polymer whether in solution or in gel state. The hydrogel form change along with the temperature which become main factor for the mechanical properties of Pluronic-g-poly(NIPAAm). At 15oC, soft rigid polymer was formed due to loosely packed micelle and unsteady hydrophobic interaction, however, it became an elastic solid at 37oC which explain the sol-gel transition. Finally, Pluronic-g-poly(NIPAAm) was shown an attractive application for drug delivery and tissue engineering due to adjustable sol-gel transition.
DM050-A	Development of Infrared Thermal Imaging Instrument for Wind Turbine Health Monitoring **Yu Chuan Lin**, Long Jeng Lee, Roger Lien and Ming Fu Chen Instrument Technology Research Center, National Applied Research Laboratories, Taiwan **Abstract:** The purpose of this study is to develop structural health monitoring system for a large wind turbine. Structural health monitoring is critical to improve the reliability wind turbine. A high-resolution infrared thermal imager with a Newtonian telescope is integrated to monitor the operating state of wind turbine. Compared with traditional sensor monitoring system, such as Fiber Bragg Grating (FBG) and Electric Strain Gauge (ESG), Infrared thermography (IRT) is proper to the health monitoring for wind turbine, because the IRT shows the temperature gradient of wind turbine surface area instead of just at a few single points of traditional methods. The study result shows that differences in the temperature gradient at blade of the root and the tip indicate abnormal conditions may occur. Moreover, IRT is a suitable remote technique for detecting abnormal conditions on wind turbines at an early stage. The reliable IRT health monitoring technique can be applied to the offshore wind turbine, building and bridge deformation monitoring for further advanced usage.
DM055	Catalytic transfer hydrogenation for production of γ -Valerolactone from methyl levulinate on bimetal oxide catalysts **Apiluck Eiad-ua**, Worapak Tanwongwan, Wasawat Kraithong and Sanchai Kuboon King Mongkut's Institute of Technology Ladkrabang, Thailand

	Abstract: γ-Valerolactone (GVL) is an organic compound which shows its great potential in energy and polymer application. Previously, Raney-nickel was employed as an effective catalyst for producing GVL from various levulinate esters. However, high temperature required for synthesis of Raney-nickel (about 1000ºC) and its complex pretreatment and storage steps are main drawbacks of this catalyst. In this study, GVL can be produced via catalytic transfer hydrogenation from methyl levulinate on bimetallic oxide catalysts which using instead Raney-nickel. These bimetallic oxide catalysts are prepared at lower temperature and not required to pretreatment before its use. Among different bimetallic oxide systems, nickel-copper oxide catalyst shows the best catalytic performance with 100% methyl levulinate conversion and more than 95% GVL yield. The study of catalyst support effect indicates that support materials were significantly effect to catalytic behavior of nickel-copper oxide catalysts.
ES048-A	Waterborne polyurethane modified with poly(ethylene glycol) macromer for waterproof breathable coating **Jisung Hwang** and Han Mo Jeong University of Ulsan, South Korea **Abstract:** Waterborne polyurethane (WPU) was modified with poly(ethylene glycol) (PEG) macromer, containing a terminal acrylic group to be polymerized by a radical mechanism, to endow breathability. The water vapor permeability (WVP) of WPU was effectively improved by the modification to introduce other polymer chains with PEG brushes in the WPU network. Other problems resulting from the introduction of the PEG segment were minimized by this new approach. The modified WPU exhibited a good balance of WVP and water resistance. In addition, the decline of tensile properties and tackiness generation by the introduced PEG segment were moderate. The modified WPU exhibited a temperature-responsive WVP due to the crystallinity of the PEG segment.
ES049-A	Properties of UV-Cured Waterborne Polyurethane Having Poly(ethylene glycol) Side Chains for Waterproof Breathable Coating **Min Seok Jeong** and Han Mo Jeong University of Ulsan, South Korea **Abstract**: A polyurethane prepolymer having a poly (ethylene glycol) (PEG) segment as a side chain was prepared with a PEG macromer having two hydroxyl groups at one end of the PEG chain. The ends of this prepolymer were capped with 2- hydroxyethyl acrylate to prepare a UV-curable waterproof breathable waterborne polyurethane, and the performance, such as water vapor permeability and water resistance, and thermal, mechanical and physical properties of the WPU was evaluated. That is, the effect of crosslinking degree or filler reinforcement was investigated by adding pentaerythritol tetraacrylate or hydrophobic silica (Aerosil R711) having vinyl groups on its surface as a post-crosslinking agent or a reinforcing agent. In addition, the effect of replacing a part

	of HEA with 1,4-butanediol or ethylenediamine to strengthen the hard segment domain while reducing the degree of cross-linking was investigated.
DM023-A	A Simple Method for Detecting Fatigue Crack Initiation **Kaito Naka**, Shusaku Kinjo, Chobin Makabe University of the Ryukyus, Japan **Abstract**: Many failure accident of machine equipment has been related to metal fatigue. So, it is important to detect a fatigue crack initiation during a machine operation. In the present study, a simple method of detecting fatigue crack initiation is proposed. In many cases, fatigue crack initiated at weak part of machine equipment. The crack initiation can be detected by inspecting of physical property of thin film pasted at such weak part.
DM059	A Study on the Evaluation Indexes of Wear Process of Electroplated CBN Grinding Wheel **Fang Quan**, Zhitong Chen, Qiantong Li and Huan Ye Beihang University, China **Abstract:** The wear process of electroplated CBN grinding wheel is difficult to predict and control because of the lack of unified evaluation index of wear degree. This paper investigates the service life cycle of electroplated CBN grinding wheel in grinding of nickel-based superalloy GH4169. The evolution of topography of grinding wheel, diameter of grinding wheel, grinding force and surface roughness are tracked in the wear process. Using the analytic hierarchy process (AHP), the optimal evaluation index of service life of electroplated CBN grinding wheel is proposed.
DM064-A	Photoluminescence emission of multi-shell InP Green quantum dot color filter with Blue OLED light source **Sang-Won Kim**, Wonhyeok Park and Byoungdeog Choi Sungkyunkwan University, South Korea **Abstract:** Full color display using Blue PHOLED with quantum dot color filter which can be a next generation QLED display technology is a strong demand for display application. In this study, we report the InP quantum dots photoluminescence property emitted by energy absorption from electroluminescence of the blue PHOLED light source. Blue PHOLED which have the structure of Indium Tin Oxide (ITO) / PDL / HAT-CN (5nm) / TCTA (30nm) / TCTA:FIrpic (8%) (30nm) / TmPyPB (30nm) / LiF (1nm) / Al (100nm) has been fabricated. As shown in Fig.1.InP QD layer is fabricated using solution-based spin-coating process. After curing spin-coated QD layer ITO anode is deposited by DC spurttering process on the top of QD layer. InP QD layer is located between glass substrate and ITO transparent electrode. As shown in Fig. 2, Electroluminescence energy from Blue PHOLED are transferred to QD and then photoluminescence emission of the InP quantum dots are emitted. Blue color peak with a 470nm wavelength intensity is reduced as Green color peak with a 550nm

	wavelength intensity are increased. It means electroluminescence energy with Blue OLED can be transferred to multi-shell InP quantum dots and then, induce photoluminescence from quantum dots effectively.
DM065-A	Measurement of exciton profile using red phosphorescent dopant with Ir- based in organic light emitting diodes **In-Seon Lee**, Won-Hyeok Park, Sang-Won Kim, and Dong-Pil Park Sungkyunkwan University, South Korea **Abstract:** $Ir(piq)_3$, used as a red phosphorescent dopant, was investigated to find the region where most exciton is formed. As shown in Fig. 1, the reference device is fabricated with a structure of ITO/ HAT-CN(5nm) / NPB(40nm) / CBP:$Ir(ppy)_3$ 6% (20 nm) / CBP:$Ir(ppy)_3$ 12% (10 nm) / TPBi(10nm) / LiF(1nm) / Al. Since the triplet(T_1) level(2.0eV) of $Ir(piq)_3$ is lower than the T_1 level(2.42eV) of $Ir(ppy)_3$, used as a green phosphorescent dopant, and the emission wavelength of $Ir(ppy)_3$ and the absorption wavelength of $Ir(piq)_3$ region is overlapped, exciton of $Ir(ppy)_3$ has easy access to the $Ir(piq)_3$. Located exciton can be profiled through red emission peak. Emitting Layer(EML) region is divided into 6 regions from 1 to 6. 2nm-thick of $Ir(piq)_3$ as a profile material is deposited in selected region of EML, as specified in Fig. 1. The finding demonstrated that red peaks were strongly emitted region 4, 3, 5, 6, 1 and 2 in order, as shown in Fig. 2. Particularly, in the EML region 4, holes and electrons are strongly injected because of direct injection effect through the energy level of dopant. As a result, EML-1 region is always only in Hole-Excess condition. The EML-2 region can secure the maximum emission efficiency when the optimized doping concentration and the controlled number of holes in EML-2 region.
DM066-A	Change of device characteristics vary with location of Hole Blocking Layer **MinJoon Kim**, Wonhyeok Park, Sangwon Kim, and Dongpil Park Sungkyunkwan University, South Korea **Abstract:** Experiment was investigated to observe the characteristics of the Organic Light Emitting Diode(OLED) device vary with the position of the Hole Blocking Layer(HBL). The OLED devices were fabricated with a structure of ITO/HAT-CN (5nm)/NPB (40nm)/TPBi (10nm)/CBP:$ir(ppy)_3$,6%wt (20nm)/TPBi (5nm)/Alq_3 (20nm)/LiF (0.8nm)/Al (100nm). EML is a double host structure using two materials. CBP, which has similar hole and electron mobility, is used as the first host material. TPBi is used as a second host material and HBL in order to prevent holes having high mobility. Each 10nm TPBi host is inserted into the device at the bottom(A), middle(B), and top(C) of the EML. As shown in Figure.2 and Figure.3, The lowest value of the current efficiency and the current density were measured when the TPBi host is near the bottom. This is because the holes are not smoothly moved into the EML. When the TPBi host is located at the bottom, it is difficult to move the hole to the EML due to the high HOMO level difference between NPB (5.5 eV) and TPBi (6.8 eV). Since TPBi's hole mobility is 10

	times faster than electron mobility, the charge balance of holes and electrons matches well as the TPBi host is inserted behind the EML. As a result, the current efficiency and current density of the device C with the TPBi host inserted after the EML showed the best performance.
DM067-A	Optoelectronic Characteristics of Functionalized Graphene Oxide as a Hole Injection Layer in Phosphorescence OLED **Taehyeon Yang**, Won-Hyeok Park, Sang-Won Kim and Dong-Pil Park Sungkyunkwan University, South Korea **Abstract:** The solution processed graphene oxide(GO) was coated on ITO patterned glass substrate and used for hole injection layer(HIL) of PHOLED device. The GO is used as a HIL in the device and is expected to affect the optical performance of the device in relation to hole injection. GO could be coated easily on substrate because of that GO particles can readily disperse and stable colloid in water. Thus, GO can be used for polymer light emitting diodes and organic photovoltaic devices, via solution process. The reference device was fabricated with a structure of ITO/NPB (50nm)/TCTA (10nm)/CBP:Ir(ppy)$_3$ (4% wt.) (30nm)/TPBi (10nm)/Bphen (30nm)/LiF (1nm)/Al (100nm) while the test device included 5nm of HAT-CN or GO as HIL between ITO anode and NPB, as shown in Fig. 1. Because of that solution-processed 2nm GO film has relevant work function(4.98eV, whereas 10nm GO film has 4.86eV), hole injection barrier would be 0.2eV small to be suitable for using as HIL. The device with HAT-CN as HIL exhibits higher current density than that of GO HIL device, but higher current efficiency and higher emission intensity was measured from the device with GO as HIL. The result could be that the highest current efficiency of device with GO as HIL was 54.78Cd/A at 6.48mA/cm^2 which was higher than the device with HAT-CN as HIL. The current efficiency of the device with HAT-CN as HIL could rise fast at low current density(below 0.5mA/cm^2) via charge generation. In addition, inhibiting hole injection characteristics of GO make the device reaches higher performance. The investigation demonstrates that the emitting device fabricated with solution-processed GO as hole injection layer shows better optical performance than organic hole injection layer such as HAT-CN.

ABSTRACT

LISTENERS LIST

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NOTE