ICCEMS 2020

2020 5th International Conference on Civil Engineering and Materials Science

ICNMM 2020

2020 3rd International Conference on Nanomaterials, Materials and Manufacturing Engineering

Singapore || May 15-18, 2020

Conference Program

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ICCEMS 2020

ICNMM 2020

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WELCOME MESSAGE

ICCEMS 2019 & ICNMM 2019

ICCEMS 2018 & ICNMM 2018

Dear participants,

Welcome to 5th International Conference on Civil Engineering and Materials Science (ICCEMS 2020) and 3rd International Conference on Nanomaterials, Materials and Manufacturing Engineering (ICNMM 2020).

As you have been aware, COVID-19 has evolved into a pandemic, and the safety and well-being of our participants is of paramount importance to us. Therefore, after serious consideration, the committee has made the difficult decision to have ICCEMS 2020 and ICNMM 2020 as fully virtual conferences.

The objective of the conferences is to provide a premium platform to bring together researchers, scientists,engineers, academics and graduate students to share up-to-date research results. We are confident that during this time you will get the theoretical grounding, practical knowledge, and personal contacts that will help you build a long term, profitable and sustainable communication among researchers and practitioners in the related scientific areas.

We would like to express our gratitude to our distinguished speakers, IEEE Fellow, Prof. Akira Toriumi, The University of Tokyo, Japan; Prof. Tom Wu, The University of New South Wales, Australia; Prof. Xiaohong Zhu, Sichuan University, China and other distinguished scholars for sharing their deep insights on future challenges and trends in the conferences.

Special thanks to our committee members, all the reviewers, researchers and students who participate in the conferences. Hope you could enjoy the conferences and have an unforgettable experience!

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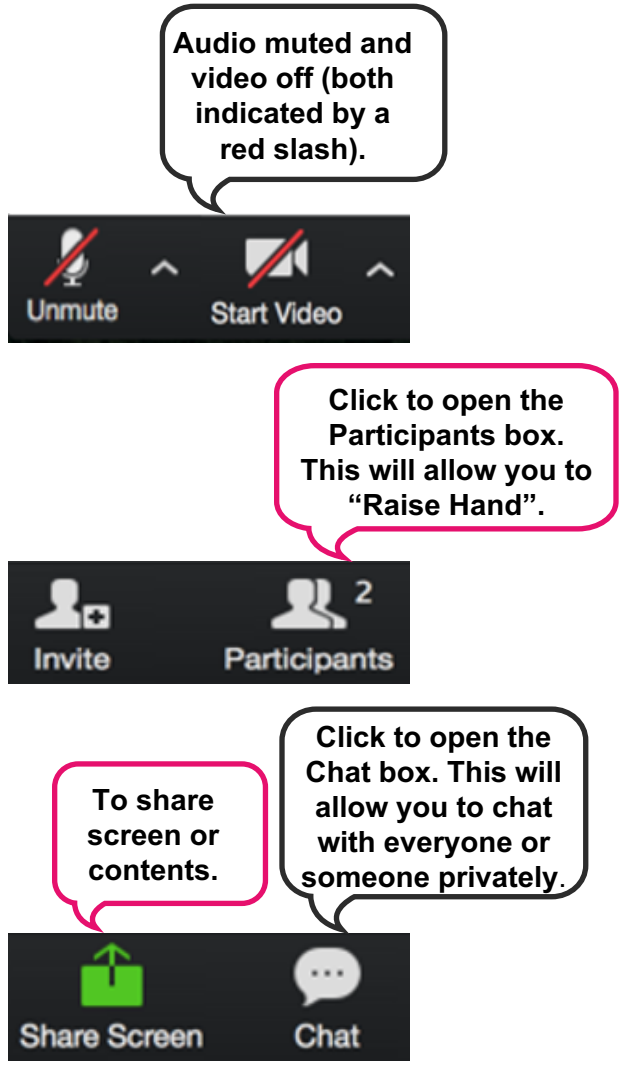

CONFERENCE GUIDANCE

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Conference Committee:
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Author: Paper ID-Full Name
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Conference Time

Check details of your testing and presentation time on **May 15-17**, and make sure to show up on time.

Time Zone

Singapore Local Time/GMT+8
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ICCEMS 2017 Group Photo

ICCEMS 2016 Group Photo

iccemsconf@126.com
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ZOOM TESTING TIMETABLE

Note: 15:40-17:00 alternative time for participants who are unavailable at allocated time.

Paper ID	Date	Singapore Local Time/GMT+8
S013	May 15, 2020	9:00-9:10
S064	May 15, 2020	9:10-9:20
S011	May 15, 2020	9:20-9:30
S022	May 15, 2020	9:30-9:40
S058-A	May 15, 2020	9:40-9:50
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S028	May 15, 2020	11:00-11:10
S030	May 15, 2020	11:10-11:20
S019	May 15, 2020	11:20-11:30

Note: 15:40-17:00 alternative time for participants who are unavailable at allocated time.

ZOOM TESTING TIMETABLE

Paper ID	Date	Singapore Local Time/GMT+8
S020	May 15, 2020	11:30-11:40
S036	May 15, 2020	11:40-11:50
S067	May 15, 2020	11:50-12:00
S073	May 15, 2020	12:00-12:10
S0017-A	May 15, 2020	14:00-14:10
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S0014-A	May 15, 2020	14:20-14:30
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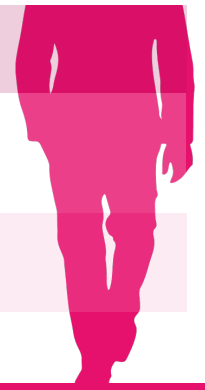
MEETING AGENDA

Saturday – May 16, 2020 (Singapore Local Time/GMT+8)
Keynote Session

Time	Activity	Speaker
Host: Prof. Xiaohong Zhu, Sichuan University, China		
9:30 - 9:40am	**Opening Remarks**	Prof. Xiaohong Zhu, Sichuan University, China
9:40 - 10:30am	**Speech I** Why Don't You Enjoy Ge CMOS?	IEEE Fellow, Prof. Akira Toriumi, The University of Tokyo, Japan
10:30 - 10:35am	Q & A for Speech I	
10:35 - 11:15am	**Speech II** Solution-Processed Perovskite Electronics with Light-Responsive Mixed-Dimensional Heterostructures	Prof. Tom Wu, The University of New South Wales, Australia
11:15 - 11:20am	Q & A for Speech II	
11:20 - 11:40am	Group Photo (Please turn on camera in advance) & Break Time	
11:40 - 12:20am	**Speech III** Inorganic Solid Electrolytes for All-solid-state Lithium Batteries	Prof. Xiaohong Zhu, Sichuan University, China
12:20 - 12:25am	Q & A for Speech III	



MEETING AGENDA

Saturday – May 16, 2020 (Singapore Local Time/GMT+8)
Technical Sessions

Time	Activity	Presentations
13:30 - 16:00pm	Virtual Session 1: Structural Analysis and Assessment	S013 S063 S064 S022 S011 S018 S058-A S025 S054 S061
16:00 - 16:20pm	Session Group Photo (Please turn on camera in advance) & Break Time	
16:20 - 18:20pm	Virtual Session 2: Building Materials and Construction Management	S1002 S024 S028 S030 S036 S019 S067 S020
18:20 - 18:25pm	Session Group Photo (Please turn on camera in advance) & Break Time	

Sunday – May 17, 2020 (Singapore Local Time/GMT+8)
Technical Sessions & Video Replay

9:00 - 10:30am	Virtual Session 3: Material Physics and Chemistry	S2006-A S0003 S0009-A S2002-A S2003-A S2004-A
10:30 - 10:45am	Session Group Photo (Please turn on camera in advance) & Break Time	
10:45 - 12:00pm	Virtual Session 4: Material Characterization	S073 S2001 S0017-A S0014-A S0016
12:00 - 12:05pm	Session Group Photo (Please turn on camera in advance)	
	Poster Session: S012 S037 S038 S039 S040 S042 S043 S044 S047	Click to find the posters
13:30 - 22:00pm	Video Replay	

INTRODUCTIONS OF SPEAKERS

May 16 (Saturday)
9:40am - 10:30am

IEEE Fellow, Prof. Akira Toriumi

The University of Tokyo, Japan

Speech Title: Why Don't You Enjoy Ge CMOS?

Introduction: Ge used to be intensively investigated before 1960. Why Ge was beaten by Si? There were a couple of reasons in terms of (i) junction leakage, (ii) poor passivation, (iii) poor gate stacks, etc. We are now tackling Ge again (*). To overcome a number of challenges, we have to correctly recognize merits as well as demerits of Ge, and to differentiate between intrinsic and optimization challenges. Otherwise, Ge is "a next generation material" forever. High carrier mobility in bulk Ge is often claimed as a big merit of Ge, however, a big discrepancy of the mobility between in the bulk and at the interface has been well known even in Si. To enjoy promising merits, it is beyond question that the interface control is the key.

Biography: Akira Toriumi received the B.S. degree in physics, the M.S. and Ph.D. degrees in applied physics from The University of Tokyo in Japan in 1978, 1980 and 1983, respectively. Then, he joined R&D Center of Toshiba Corporation in Japan, in which he had been engaged in device physics and technology in CMOS miniaturization. He was with Massachusetts Institute of Technology, USA (1988–1990) as a visiting scientist on leave from Toshiba. In May 2000, he moved to Department of Materials Engineering of The University of Tokyo. He had also served as a high-k gate stack group leader in MIRAI Project (a national project for advanced CMOS in Japan) from 2001 to 2007. He retired in March 2019, and he is now an emeritus professor in The University of Tokyo.
Through his professional carrier, his research interests have been on device physics and materials science with regard to semiconductor devices. Particularly, he has investigated gate dielectrics, functional oxides, electron transport and processing science in Si and Ge CMOS, and low-dimensional materials and devices. He has authored and co-authored more than 600 scientific journal papers and conference proceedings, and several book chapters. He received several awards such as IEEE International Reliability Physics Symposium (IRPS), Best Paper Award (1997), Solid-State Device and Materials (SSDM), Best Paper Award (2000 & 2003), IEEE EDS Paul Rappaport Award (2004), SSDM Award (2014), IEEE Cledo Brunetti Award (2016) and JSAP (The Japan Society of Applied Physics) Outstanding Achievement Award (2017). He served as several international conference chairs and committees such as Executive Committee in VLSI Symposium (2008-2017), Program Chair (2005) and Organizing Chair (2018) in International SSDM, General Chair in Si-Nanoelectronics Workshop (IEEE/JSAP) (1999), Executive Committee (2004-2006) and Vice President (2012-2013) in JSAP, Vice Chair (2010-2011) and Chapter Chair (2012-2013) in IEEE EDS (Electron Device Society) Japan.

Prof. Tom Wu

The University of New South Wales, Australia

Speech Title: Solution-Processed Perovskite Electronics with Light-Responsive Mixed-Dimensional Heterostructures

May 16 (Saturday)
10:35am – 11:15am

Abstract: In this talk, I will discuss the advances and challenges of using hybrid materials and heterostructures for high-performance solution-processed electronics. Hybrid organo-metal perovskites have been extensively explored for photovoltaic applications because of their unique physical properties such as superior light absorption, defect tolerance, and ferroelectric polarization. But perovskite-based devices are limited by charge mobility (often two or three orders of magnitude lower than common semiconductors like polycrystalline silicon). I will review various strategies towards enhancing device performance of hybrid perovskites via coupling with low-dimensional materials. We demonstrate that combining 3D hybrid perovskites with high-mobility 1D carbon nanotubes or 2D two-dimensional metal dichalcogenides significantly enhances charge transport and device performance.

Biography: Dr. Tom Wu (吴韬) received his B.S. degree from Zhejiang University in 1995 and Ph.D. degree from the University of Maryland, College Park in 2002. Before joining University of New South Wales (UNSW) in Sydney as a full professor, he worked as postdoc in Argonne National Laboratory in Chicago, assistant professor in Nanyang Technological University (NTU) Singapore, and associate professor in King Abdullah University of Science and Technology (KAUST). Dr. Wu has authored 280 peer-reviewed papers with over 15,000 citations and a H-index of 72 in the areas of oxide thin films, nanomaterials, and hybrid perovskites, with a focus on their electronic, magnetic and optical functionalities. He is among the 2019 Clarivate Analytics List of Highly Cited Researchers. His group has witnessed the career development of 18 PhD students and 30 postdocs. He also serves as an Associate Editor for ACS Applied Materials & Interfaces.

May 16 (Saturday)
11:40am – 12:20am

Prof. Xiaohong Zhu

Sichuan University, China

Speech Title: Inorganic Solid Electrolytes for All-solid-state Lithium Batteries

Abstract: As a typical type of energy storage devices, lithium-ion batteries (LiBs) play a more and more important role in the modern life. However, organic polymer-based electrolytes are widely used in commercial Li-ion batteries, which may cause a large number of safety issues, considering the flammability, electrochemical stability, and leakage. Fires and explosions of LiBs have been reported throughout the world, and thus, safety has become one of the main obstacles for the wide application of LiBs. Therefore, the continued drive for high-performance lithium-ion batteries has imposed stricter requirements on the electrolyte materials and all-solid-state lithium batteries (ASSLiBs) have entered the field. In contrast to organic liquid electrolytes, solid inorganic ones show better thermal and chemical stabilities and also present a great advantage to the point that they can enable the use of high capacity electrode materials. Accordingly, a great deal of effort is underway to improve further the ionic conductivity and electrochemical/chemical stability of inorganic solid electrolytes and the solid electrolyte/electrode interface as well, thereby pushing them further for practical applications. In this talk, I will present our research breakthroughs in studying the preparation, structure, electrochemical properties, and potential applications of several important inorganic solid electrolytes, such as Li-oxide garnets like $Li_7La_3Zr_2O_{12}$ (LLZO), perovskite-type $La_{2/3-x}Li_{3x}TiO_3$ (LLTO), NASICON-type $Li_{1+x}Al_xTi_{2-x}(PO_4)_3$ (LATP), and sulfide-based LGPS-type $Li_{10.35}Ge_{1.35}P_{1.65}S_{12}$.

Biography: Dr. Xiaohong Zhu is currently a full professor at the Department of Materials Science & Engineering, Sichuan University, China. He received his BSc degree in Materials Physics from Sichuan University in 2000 and PhD degree in Condensed Matter Physics from the Institute of Physics, Chinese Academy of Sciences in 2006. After that, he did 3-year postdoctoral research at CNRS and CEA in France, and then joined Sichuan University as a professor in 2009. From April 2012 to April 2013, he was also a research scholar at the Department of Physics & Department of Materials Science and Engineering, University of California, Berkeley, USA. He was selected as a New Century Excellent Talent in University of China in 2009 and an Outstanding Young Scientific and Technological Leader of Sichuan Province, China in 2011, and won the 2018 China Industry-University-Research Collaboration Promotion Award. Prof. Zhu's research interests include mainly graphene-based electrode materials and novel solid-state electrolytes for energy storage devices (supercapacitors and lithium-ion batteries), piezoelectric ceramics, as well as multifunctional oxide thin films and related electronic devices. Until now, he has authored/co-authored more than 110 SCI-indexed papers and 2 scientific books.

Note: Each paper will be presented by the author making a 15-minute presentation within the virtual conference. Authors will also be required to be available for a Q&A section on their paper. Authors that do not meet both these requirements will be considered "no-shows."

TECHNICAL SESSIONS

Virtual Session 1: *Structural Analysis and Assessment* Time: 13:30 - 16:00pm (May 16-Saturday)

Session Chair: Prof. C. W. Lim, City University of Hong Kong, Hong Kong

S013
13:30-13:45

Experimental Analysis of Gradient of Negative Temperature for Polypropylene Fiber Concrete U-shaped Girder

Xu Dong, Shandong Jiaotong University, China

Abstract—To study the negative temperature gradient models of a rail transit U-shaped girder during the winter season, a U-shaped rail transit girder was researched in Qingdao. The temperature field of the midspan section was observed for a 48-h period during the winter. The maximum vertical and horizontal temperature difference distributions were obtained, and the negative temperature gradient models for the winter were established. The results show that the vertical temperature gradient models of the web and bottom slab should be considered. The vertical temperature gradient model of the web is a piecewise function composed of exponential and linear functions. The vertical temperature gradient model of the bottom slab is an exponential function. The transverse temperature gradient of the web is obvious, whereas the transverse temperature gradient of the bottom slab is slight.

S063
13:45-14:00

Elastoplastic Behavior of Wide Flange Beam - to-Wide Flange Column Welded Connections

Merhanna D. Pangandaman, Mindanao State University- Iligan Institute of Technology, Philippines

Abstract—A beam-to-column connection is considered to be one of the most critical sections of various types of load-carrying structures. Many parameters such as the geometrical and material properties of both beams and columns influenced its performance. The purpose of this study is to derive analytical models for the connection's yield and ultimate strength and displacements using the depth of wide flange (WF) beam and WF-column, and the length of WF-beam as design parameters. Experimental tests involved testing of three specimens until reaching their maximum strength. The behavior of the connection observed in the experiment were employed in the finite element analyses (FEA), where the thirty numerical models generated with the parametric script in SolidWorks, provided the design information for the mechanical properties. Lastly, the derivation of analytical formulae used to predict the mechanical properties of wide flange beam-to-wide flange column connections employed regression analysis. In conclusion, (1) There is a good agreement between FEA and test results, (2) The dimensional parameters $LbDb\diagup$ and $DcLb\diagup$ ratios have been found to significantly characterize the elastic-plastic properties of fully welded beam-to-column connections with stiffeners, and (3) The mechanical properties of the connections can be well predicted by the derived analytical formulae.

TECHNICAL SESSIONS

S064
14:00-14:15

Analysis of Stress Law of Lining Structure in Shallow Underground Subway Tunnel
Chao Zhang, Nanjing Institute of Technology, China

Abstract—During excavation of shallow tunnels, it is very important to construct primary support and secondary lining structures to guarantee the stability of tunnel surrounding rock and construction safety. Based on a subway tunnel project, in this study, the typical support and lining model is established by using the finite difference program. Stress characteristics and deformation patterns of the primary support and secondary lining structures is analysed and discussed, and the influencing mechanisms of different tunneling modes on the stress characteristics of the support and lining structures are revealed. The numerical results show that the benching excavation and support can effectively relieve the stress concentration in the primary surrounding rock support of typical subway tunnel project. The secondary lining, which is constructed after the deformations of the tunnel surrounding rock and the primary support tend to be stabilized, can strengthen and protect the tunnel surrounding rock and the primary support structure, bear part of the surrounding rock load, and serve as a safe reserve for the safety of subway tunnel projects.

S022
14:15-14:30

Third-point Flexural Test on Concrete-filled Rectangular Tubular Flange Girders
Jude Shahara Rosales, Mindanao State University - Iligan Institute of Technology, Philippines

Abstract—The influence of shear stud connectors on the horizontal displacement brought about by the occurrence of shear stress at the interface between the rectangular steel tube and in-filled concrete on Concrete-filled Rectangular Tubular Flange Girders (CFRTFG) was investigated. As a composite structure, providing shear stud connectors allow stress transfer between steel and concrete which may result for the two (2) components to work as a single unit. Accordingly, a three-dimensional finite element software called SOLIDWORKS® was employed. Static linear analysis was performed using the finite element (FE) models to study the effect of shear stud connectors on the resulting stresses and slip on CFRTFGs. Results showed that the maximum slip occurred at CFRTFG without shear stud connectors while CFRTFG under full composite action had the least slip. Correspondingly, the maximum shear stress for both CFRTFG under full and partial composite action occurred at the shear stud connectors, while the maximum shear stress for CFRTFG without shear connectors occurred at the supports. Conducting finite element analysis using SOLIDWORKS® proved to be theoretically accurate as in the case of this study.

TECHNICAL SESSIONS

S011
14:30-14:45

Model Tests on Pervious Concrete Pile and Impervious Concrete Pile Composite Foundation
Jun Cai, Southeast University, China

Abstract—Taking the advantages of high permeability and high strength, pervious concrete piles is suitable for improving ground bearing capacity and reduce the post-construction settlement, so pervious concrete pile composite foundation is a new foundation treatment. As pervious concrete piles were designed to accelerate soil consolidation and improve the ground bearing capacity, so model test of pervious concrete piles were conducted to evaluate the consolidation effect. Pervious concrete with porosity 20%, 25%, 30% and 35% was designed to compare the strength and permeability, and the porosity of 30% was selected, so the pile was made for the model test. Compared with impervious concrete pile composite foundation, as the pervious pile shortens the drainage path, pervious concrete pile composite foundation can shorten the consolidation time by about 30.3% and significantly reduce the peak value of excess pore pressure. With the increase of load and consolidation rate of soil around the pile, the stress ratio of pervious concrete pile increase first, then decrease and tend to be flat.

S018
14:45-15:00

Improved Rapid Assessment of Earthquake Hazard Safety of Structures via Artificial Neural Networks
Ehsan Harirchian, Institue structural mechanic, Bauhaus-Universität Weimar, Germany

Abstract—The vulnerability of structures mainly depends on the structural resistance system of buildings to earthquake. It is unlikely that all existing buildings can be inspected in detail. Therefore, rapid methods for evaluating buildings have been developed over the last decades. This paper investigates the earthquake susceptibility through the combination of buildings' geometrical attributes that a ect the vulnerability of building and can be used to obtain an optimal prediction of the damage state of reinforced concrete (RC) buildings using artificial neural networks (ANNs). In this regard, a multi-layer perceptron (MLP) network has been trained and optimized using a database of 145 damaged buildings from the Haiti earthquake. The results demonstrate the practicability and e ectiveness of the selected ANNs approach to classify actual structural damage that can be used as a preliminary assessment procedure to recognize vulnerable buildings.

TECHNICAL SESSIONS

S058-A
15:00-15:15

Study on the Mechanical Properties of Steel Beam-column Joint with Initial Defects by Finite Element Analysis and Experiment

Yuan Zuo, Southeast University, China

Abstract—Due to the welding technology and materials, the welds almost contain defects. The most papers published have researched on mechanical properties of beam-column joint without initial defects. In this paper, the pseudo static tests of steel beam-column joint without defects and initial defects with 1mm width are carried out. Also, the mechanical properties of beam-column joint with and without initial defects are simulated and analysed by Extended Finite Element Method (XFEM). And then, the simulated results are compared with the test data. The results show that the load span has little effect on the mechanical properties of the joint, but the sudden peak value has great damage to the joint. And Extended Finite Element Method can simulate the crack initiation position of the joint, which is basically consistent with the test results. The proposed Extended Finite Element Method is demonstrated that it can well reflect the mechanical properties of the steel beam-column joint under different loading spans, but it can not fit well for low circle fatigue.

S025
15:15-15:30

Calculation Method for the Service Life of Chinese Historical Reinforced Concrete Buildings

Hui Jin, Southeast University, China

Abstract—Almost all of the existed studies on the corrosion of rebars were based on roundsection rebars. However, the square-section steel rebars were widely used in China from 1912 to 1949, and there was no specific calculation model or durability assessment method for this type of historical buildings. In this study, based on the original configuration design of this kind of structures, the experiments of the corrosion-induced cover cracking of a certain number of reinforced concrete members with square-section rebars were carried out with the electrochemical acceleration method. The average rust depths of the square-section rebars at the critical corrosion-induced cover cracking moment were obtained. Then, the calculation method of critical rust depth of steel rebars at the concrete cover cracking moment was presented with data fitting method. Finally, combining with predication of carbonization life of concrete, a calculation method of the service life for Chinese historical RC buildings using square-section rebars was proposed. The research results can provide the basis for the durability assessment and conservation for Chinese historical RC buildings.

TECHNICAL SESSIONS

S054
15:30-15:45

Assessment of Tool Platform Micro Vibrations Induced by Moving Vehicles in Hi-tech Factories
Chien-Liang Lee, Xiamen University of Technology, China

Abstract—This study explores the micro vibrations of floors and tool platforms induced by internal moving automated guided vehicles (AGVs) in hi-tech factories. The equation of motion of a simplified multi-span floor (or beam) system installed with a tool platform under AGV moving forces generated by a modified Kanai-Tajimi power spectral density (MKT-PSD) function is derived. Dynamic time history analyses of the continuous beam model travelled by different AGV weights are performed. The corresponding root-mean-square (RMS) floor and platform vibration spectra are obtained by using a one-third octave band spectrum analysis and in turn used to compare with the micro vibration criterion. Simulated results indicated that the floor and platform vibrations increase with the AGV weight. For the maximum AGV weight considered, the floor vibration exceeds VC-A, while under the minimum AGV weight, the floor vibration reaches VC-B which is required by the vibration-sensitive tools. Moreover, the platform vibrations are far more than VC-A regardless of the AGV weight. Therefore, the introduction of a proper vibration control scheme is recommended to suppress the excessive micro vibrations of the floors and taller tool platforms.

S061
15:45-16:00

Programming for Solving Plane Rigid Frame based on MATLAB
Xiaokun Chen, Yangzhou University, China

Abstract—Based on the idea of the matrix displacement method, this paper designs a program which can be used to solve the internal force of the continuous beam and rigid frame with MATLAB. It mainly demonstrates how to design a program to realize the matrix displacement method with MATLAB. In addition, some techniques are included in order to realize the correspondence between the manual calculation and the computer calculation, such as “Using lambda to locate”, “Crossing out rows and columns” and visual design. Therefore, based on the structural mechanics, combined with the principle of matrix displacement method, this paper shows the whole process from inputting the information of the rigid frame to solving the internal force of the rigid frame to outputting the bending moment diagram using MATLAB as the programming tool.

TECHNICAL SESSIONS

Virtual Session 2: *Building Materials and Construction Management* **Time: 16:20 - 18:20pm (May 16-Saturday)**
Session Chair: Dr. Manote Sappakittipakorn, King Mongkut's University of Technology North Bangkok, Thailand

S1002
16:20-16:35

Mechanical Properties and Sustainability of Palm Kernel Shell Powder (PKSP) as a Partial Replacement of Cement
Gunalaan Vasudevan, Tunku Abdul Rahman University College, Malaysia

Abstract—This research showed the results of experiments evaluating the use of palm kernel shell powder from palm oil refinery waste production as partial replacement of Ordinary Portland Cement (OPC). Many researchers have studied the use of agro-waste as constituents in concrete but not as a partial replacement of cement specifically. Therefore, the objective of this research is to identify the performance of palm kernel shell powder as partial replacement of cement in the production of concrete. Palm kernel shell powder in various amounts, namely 5%,10%,15% and 20 % by volume was added as a replacement for Ordinary Portland Cement (OPC). The results showed that palm kernel shell powder concrete greatly improved the workability, compressive and flexural strength of concrete. All of the testing were followed the American Society for Testing and Materials (ASTM). The workability of concrete was tested by using slump test to check the consistency of freshly made concrete. For compressive strength, a total of 27 cubes with size 150mm x 150mm x 150mm were used to determine the compressive strength of concrete when replace with 5%, 10%,15% and 20% of palm kernel shell powder as a replacement of cement in concrete. The results showed that palm kernel shell powder concrete greatly improved the compressive and flexural strength of concrete. The rate of water absorption of palm kernel shell powder reduced as palm kernel shell powder filled up the existing voids while making it impermeable. However, the compressive strength of the palm kernel shell powder decreases gradually when the amount increased. It can be concluded that the optimum amount of palm kernel shell powder as partial cement replacement is 15%. In the correction, an experimental investigation of ultrasonic pulse velocity(UPV), carbonation test and rebound hammer test was undertaken to palm kernel shell powder and admixtures as partial replacement cement in concrete.

TECHNICAL SESSIONS

S024
16:35-16:50

Research on Application of High Performance Alkali-free Liquid Accelerator in Shotcrete Support
Luchen Zhang, Shandong Jiaotong University, China

Abstract—At present, sprayed concrete has problems such as low strength, large rebound amount, and high dust concentration. Developed a new type of alkali-free liquid accelerator, which can effectively improve the performance of shotcrete. The alkali-free liquid accelerator is mainly composed of aluminum sulfate, active aluminum hydroxide, alcohol amine, amide, and stabilizer. Through laboratory tests and field tests, when the alkali-free liquid accelerator admixture is 5% to 7%, the initial setting time is within 5 minutes, and the final setting time is within 10 minutes. The strength of shotcrete reaches 12.8mpa in one day, and the compressive strength ratio of 28d is more than 95.3%, and the rebound amount is within 10%. Compared with ordinary alkali-free liquid accelerator and alkaline liquid accelerator, the strength of sprayed concrete mixed with the alkali-free liquid accelerator is greatly improved, which is more conducive to the support of the sprayed layer,reduced rebound and dust, effectively improve the construction environment and increase construction efficiency.

S028
16:50-17:05

Effect of Silica Fume and Limestone Powder on Mechanical Properties of Ultra-high Performance Concrete
Manote Sappakittipakorn, King Mongkut's University of Technology North Bangkok, Thailand

Abstract—This research aimed to study the effect of Portland cement replacement with silica fume and limestone powder in Ultra High Performance Concrete (UHPC). Nine mix proportions were designed with a constant amount of binder at 1200 kg per cubic meter of concrete. In these mixes, the cement was replaced with silica fume at 10%, 15% and 20% and limestone powder at 15% and 30% by weight of binder. For all mixes, the ratio of water to binder (W/B) and the steel fiber volume fraction were 0.2 and 2% respectively. After the preparation of test specimens and stream curing for 3 days, compressive strength, flexural strength, and length change due to shrinkage of the UHPC mixes were examined. The results showed that the silica fume increases the compressive and flexural strength (at the first peak load) but the limestone decreases. Without the limestone, the 20% silica fume mix provides the maximum average residual strength. However, when either 15% or 30% limestone is admixed, the optimum residual strength occurs at the 15% silica fume. Moreover, it is worth noting that the reducing amount of cement by replacing either with silica fume or limestone powder effectively reduces the shrinkage.

TECHNICAL SESSIONS

S030
17:05-17:20

SPH Model for Numerical Test of Heterogeneous Rock-like Material
Chaoqun SUN, Shandong Jiaotong University, China

Abstract—Based on the Smoothed Particles Hydrodynamics (SPH) method, a heterogeneous material numerical model is developed for simulation of fracture process of heterogeneous rock-like material, such as rock. The self-developed SPH program is proposed to analyse the mechanical properties of rock-like materials. In the present program, the combined Mohr-Coulomb criterion is adopted. The deformation of rock-like material under uniaxial compression can be analysed, and the acoustic emission in rock-like material can also be clarified. The calculation results show that the SPH simulation model can be used for numerical test of heterogeneous rock-like material. The process of destruction of rock specimen is evolutionary process. Rock acoustic emission records the brittle failure process of rock-like material.

S036
17:20-17:35

Implementation of Design and Build Contract in Government Building Construction Project Practice
Anggoro Putro, University of Indonesia, Indonesia

Abstract—The Development of government infrastructure projects, which has grown rapidly in recent years, require the Indonesian Government, through the Ministry of Public Work and Housing, to socialize the breakthrough of the national construction procurement system with design and build contract. This breakthrough on construction projects is expected to accelerate the achievement of government infrastructure targets, thus supporting national economic growth. The purpose of this research is to identify DB characteristics, implementation, the advantages and disadvantages in Indonesian construction projects, and to analyze the obstacles, conflicts and problems emerging on the construction project implementation. In the construction project implementation, all participants involved hopes that the project can be completed within the objectives. The expected objectives are that the project is completed in time, does not exceed the budget and meets the quality requirements.

TECHNICAL SESSIONS

S019
17:35-17:50

A Review of Carbonated Reactive MgO-stabilized Soil
Zhiheng Shang, Southeast University, China

Abstract—The application of new reactive magnesium oxide (MgO) binder in ground improvement has become a research hotspot. This paper summarized the latest research about the mechanical property potential of carbonated reactive MgO-stabilized Soil, described the electrical characteristics and permeability characteristics of solidified soil research results, analyzed the durability and corrosion resistance of solidified soil research, introduced the exploration of new curing agent engineering application measures. In view of the existing studies, further research about the relationship between the indicators of carbonation and unconfined compressive strength (UCS) were suggested, comprehensively study the corrosion resistance of the solidified soil, systematically study the reaction mechanism of fly ash with reactive MgO, and improve the field test of reactive MgO-carbonized mixing piles have been suggested.

S067
17:50-18:05

Decision-making in the Commercial Space Service Design of Transportation Architecture
Chia-Jung Shen, The Graduate Institute of Design Science, Tatung University, Taiwan

Abstract—Transportation architecture is common globally. The design of rest areas, which allow travelers to rest and refuel, is crucial in such architecture. The design focus of rest areas in Taiwan has shifted from function-oriented features to that meet travelers' diverse needs. Space planning in such areas can be used to integrate highway information, dining services, and leisure activities for travelers; design spaces with local characteristics; and improve service design and innovative service models. This study analyzed the effect of evaluation criteria weights used in highway rest area design tendering in Taiwan on the selection of space designers. The modified Delphi method was used to conduct interviews with experts and select criteria for commercial service space design from a consensus. Subsequently, an analytic hierarchy process was adopted to determine the relative weight of each criterion, and a consistency analysis was conducted. These design criteria were deemed essential by the experts and are thus beneficial for future designers in understanding the aspects in the spatial planning for highway rest areas and acquiring transportation architecture tenders. The results of this study can facilitate identification of highway rest area design criteria, which can serve as a reference for space designers to make related decisions.

TECHNICAL SESSIONS

S020
18:05-18:20

Asphalt Pavement Crack Identification and Segmentation Based on Steerable Filter

Jia Liang, Southeast University, China

Abstract—Pavement cracks play an important role in estimating pavement conditions and implementing pavement maintenance management. However, due to the factors of the acquisition instruments and the pavement surface, the collected images have the disadvantages of uniform illumination and low contrast. This study uses a steerable filter to generate Crack Saliency Map. Otsu method is applied to segment the crack morphology, and the method based on a morphological operation is employed to skeletonize and remove pseudo cracks, and the proposed method was compared with the existing segmentation methods. The results show that the proposed method in this paper can accurately segment crack morphology from complex pavement images, and has stable robustness and reliability.

TECHNICAL SESSIONS

Virtual Session 3: *Material Physics and Chemistry* **Time: 9:00 - 10:30am (May 17-Sunday)**
Session Chair: Assoc. Prof. Kunpeng Ge, East China University of Technology, China

S2006-A
9:00-9:15

Carrier Accumulation Enhanced Auger Recombination and Inner Self-heating-induced Spectrum Fluctuation in CsPbBr3 Perovskite Nanocrystal Light-emitting Devices
Wenhui Wu, Southeast University, China

Abstract—Light-emitting devices (LEDs) based on colloidal semiconductor nanocrystals (NCs) are promising next-generation thin-film display and lighting devices owing to their high luminescence efficiency and size-tunable color. However, the studies of the carrier transport and recombination mechanisms of the NC-LEDs lag far behind. We study the operation mechanisms of the CsPbBr3 NC-LEDs with a working voltage as high as 40V. They exhibit an anomalous hump-shaped bias dependence of luminescence intensity. A theoretical model is proposed to explain this, and it indicates that there is enhanced Auger recombination in the CsPbBr3 NC-LEDs caused by imbalanced carrier accumulation, which causes efficiency droop similar to that in the nitride-based light-emitting diodes. We also report the intriguing phenomenon of electroluminescence spectrum fluctuation of the CsPbBr3 NC-LEDs, which is ascribed to the inner self-heating effect in the emission layer.

S0003
9:15-9:30

Micromagnetic Modeling of Magnetite/Maghemite Particles with a Multi-layer Core-shelled Structure
Kunpeng Ge, East China University of Technology, China

Abstract—Low temperature oxidized core-shelled magnetite is paramount important in recording geomagnetic field. To characterize the effects of transition zone between the core-shell on the magnetic properties of low temperature oxidation of magnetite, micromagnetic models of hysteresis parameters and microstructures of a multi-layer core-shelled model were systematically investigated by MERRILL (Micromagnetic Earth Related Rapid Interpreted Language Laboratory). Numerical simulations indicate that SD particles (<70 nm) remain highly uniform magnetization, but show decreasing coercivities as oxidation preceeds. For fine SV particles (80 nm to 120 nm), the hysteresis parameters respectively increase and dramatic decrease at the early and late stage of oxidation, and the micromagnetic behaviors vary significantly. Finally the hysteresis parameters of larger SV (>130) particles remain nearly unchanged during oxidation. It indicates that fine SV particle are more sensitive to oxidation, and dominate the dramatic change of experiment observation. Overall, low temperature oxidation of magnetite preferring a multi-layer coupled oxidation process from outside to interior and is capable of recording paleomagnetic signals.

TECHNICAL SESSIONS

S0009-A
9:30-9:45

The Relationship between Orbital Hybridization and Superconductivity of Sm Doped YBCO Studied by XPS and XAS
Huihui Zhao, Southeast University, China

Abstract—We have prepared Sm doped $YBa_2Cu_3O_{7-\delta}$ samples by conventional solid state reaction method in air.The XRD and XPS results show the changes of electron structure of $YBa_2Cu_3O_{7-\delta}$ under Sm doping. The XAS and UPS results demonstrate that the hybridization strength between Cu3d and O2p decreases with increasing Sm doping, but the hybridization of Y4d, Ba5d, Sm 4f and O2p increases with increasing Sm concentration, while the superconductivity of the Sm-doped $YBa_2Cu_3O_{7-\delta}$ samples was suppressed. Thus, our experimental results suggest a close relationship between superconductivity and orbital hybridization.

S2002-A
9:45-10:00

Dealloying Synthesis Sandwich-like Structure as a Superior Electrocatalytic Hydrogen Reaction Catalyst
Yin'an Zhu, Southeast University, China

Abstract—The increasing energy shortage and global warming induced by exhausting fossil fuels and wasteful energy consumption have limited global economic growth over recent years. Hydrogen fuel, as the next-generation power source with high-density energy storage, is excepted to ultimately replace fossil fuel-based energy. Water electrolysis for hydrogen has been regarded as one of the promising means with the endless water supply and zero carbon dioxide emission. Despite the low overpotential and fast catalytic kinetics of noble metal (Pt-based) for HER, their large-scale commercialization is severely restrained by high price, intense scarcity, and poor long-term electrocatalytic stability. In this work, we report a facile dealloying method based on amorphous alloy ($Ni_{61}Zr_{36}Mo_3$) to introduce abundant oxygen vacancies (Ov) for electrocatalytic hydrogen evolution reaction (HER). The corroded ribbons are composed of a sandwich-like structure and shows an enhanced HER performance in alkaline electrolyte, delivering current density of -20 mA cm^{-2} at low overpotential of 71±2.6 mV with a Tafel slope of 57±1.2 mV dec^{-1}, in comparison with the crystallized Ni-Mo-O, nanoporous Ni, and even the commercial noble Pt/C catalyst. Additionally, it achieves smaller charge transfer resistance (11.3±0.07 Ω) and long-term stability (100 h).
The excellent performance of nanoporous Ni-Mo-O can be interpreted as the following aspects. First, by dealloying $Ni_{61}Zr_{36}Mo_3$ metallic glass, refined ligaments and uniform pore size distribution were obtained, contributing to the enlarged specific surface area for sufficient interaction between active intermediates and electrode surface. Second, the alloying of Mo element greatly changes the d-orbital filling and coordination environment of Ni. It also ingeniously remedies the shortage of Ni, such as weak metal-hydrogen bond, which restrains the generation of the active sites and leads to the sluggish HER kinetic. More importantly, dealloying introduces high Ov concentration on the surface of the amorphous Ni-Mo-O layer. And the amorphous structure often performs a better HER ability against their crystalline counterpart due to the unsaturated surface sites and defects, and lower energy barriers for water-to-hydrogen process. The above aspects synergistically integrate the perfect HER performance of nanoporous Ni-Mo-O, making it a promising low-cost substitute for platinum-like catalysts in hydrogen production.

TECHNICAL SESSIONS

S2003-A
10:00-10:15

Transition-metal Dichalcogenide/Bse Van Der Waals Heterostructure as a Promising Water-splitting Photocatalyst

Yi Luo, Southeast University, China

Abstract—Hydrogen is considered as a good energy carrier. For example, liquid hydrogen can be used as rocket fuel, and hydrogen fuel cells can be used to produce electricity and power electric cars. However, hydrogen rarely exists on its own and must be extracted from compounds such as water, hydrocarbons like methane, and other organic matter. To produce hydrogen on an industrial scale via electrolysis and steam-methane reforming, a primary energy source such as fossil fuels (natural gas or coal), biomass, solar energy, and electricity (via biomass, geothermal power, solar power or wind turbines) is necessary. Since steam-methane reforming releases carbon dioxide and carbon monoxide, both greenhouse gases, producing hydrogen via electrolysis of water with solar energy as the power source appears to be one of the more environmentally sustainable approaches to renewable energy. In practical applications, however, the consumption of solar energy to produce hydrogen gas from water has faced many challenges owing to the minor spectral response range and low solar utilization of most photocatalysts. Therefore, searching for high-efficiency water splitting photocatalysts is a preliminary task for wider adoption of hydrogen energy. Recent investigations have revealed that some transition metal dichalcogenides (TMDs), such as MoS2 and WS2 are excellent candidates for high-efficiency photocatalysts for water splitting. However, the high recombination rate of photogenerated carriers greatly hinder their practical application. A promising solution involves developing novel TMDs-based van der Waals (vdW) heterostructures with type-II band alignment. We used first-principles calculations to design two new heterostructures—MoS2/BSe and WS2/BSe—as potential photocatalysts and investigated their structures, stabilities, and electronic and optical properties. We found that both MoS2/BSe and WS2/BSe vdW heterostructures are stable and possess inherent type-II band alignment, which significantly suppress the recombination of photogenerated carriers. Furthermore, their band edges straddle the redox potential of water, making them suitable for use as photocatalysts in water splitting. They also possess significant built-in electric fields, relatively high carrier mobilities, and excellent abilities to absorb sunlight. Our theoretical findings should shed light on the design of novel TMD-based photocatalysts for water splitting, and provide useful guidelines for future experiments.

TECHNICAL SESSIONS

S2004-A
10:15-10:30

Heteroatom Ni Alloyed Pyrite FeS_2 as a Pre-catalyst for Enhanced Oxygen Evolution Reaction

Weiji Dai, Southeast University, China

Abstract—Developing earth-abundant and highly active electrocatalysts toward oxygen evolution reaction (OER) is extremely desirable but still facing challenges. Recently, pyrite-phase transition metal sulfides gain considerable attention owing to their robust reserves and efficient catalytic activity. Herein, we report enhancing electrocatalytic performance of OER via heteroatom Ni alloying into pyrite FeS_2 crystal by the facile one-step Ball-Milling reaction method. XRD and TEM pattern shown that the as-prepared $(Fe_{1-x}Ni_x)S_2$ nanocrystalline powders still maintained the pyrite structure. A tailored carbon fiber paper (CFP) loading with $(Fe_{1-x}Ni_x)S_2$ powders ($(Fe_{1-x}Ni_x)S_2$/CFP) was used as the working electrode. Cyclic voltammetry (CV) scan was conducted to evaluate OER performance of the prepared $(Fe_{1-x}Ni_x)S_2$/CFP working electrode. The overpotential needed to achieve current density of 10 mA cm^{-2} (η10) for $(Fe_{0.7}Ni_{0.3})S_2$/CFP electrode is 361 mV, while the η10 of FeS_2/NF electrode is 422 mV in 1 M KOH solution. CV scan cycles were further investigated to find that the $(Fe_{1-x}Ni_x)S_2$/CFP working electrode can reach a stable state and better OER activity after 500 cycles CV scan. The $(Fe_{0.7}Ni_{0.3})S_2$/CFP electrode only needs an overpotential of 288 mV to offer current density of 10 mA cm^{-2} after 500 cycles CV scan. A detailed investigation is carried out for the $(Fe_{1-x}Ni_x)S_2$/CFP electrode after 500 cycles CV scan. XPS results revealed the oxidation state of $(Fe_{1-x}Ni_x)S_2$ after 500 cycles CV scan. TEM images shown that there are large amounts of nanosheets formed on the $(Fe_{1-x}Ni_x)S_2$ powders surfaces. Therefore, it is safe to say the surfaces of $(Fe_{1-x}Ni_x)S_2$ powders were oxidized during the CV scan process to form the Ni doped FeOx nanosheets. XPS results indicated that the doping of Ni in FeOx created oxygen vacancy, which is contribute to the enhanced OER activity. This study not only establishes $(Fe_{1-x}Ni_x)S_2$ as a competitive OER pre-catalyst, but also provides a general strategy to improve electrocatalytic efficiencies by heteroatom alloying.

TECHNICAL SESSIONS

Virtual Session 4: *Material Characterization* **Time: 10:45 - 12:00pm (May 17-Sunday)**
Session Chair: Prof. Rafiqul Noorani, Loyola Marymount University, USA

S073
10:45-11:00

MOFs-derived Co_3O_4 Loaded Hollow In_2O_3 Nanofibers with Greatly Enhanced Acetone Sensing Performance
Lei Zhu, China University of Petroleum, China

Abstract—In this paper, metal-organic frameworks (MOFs)-derived Co_3O_4 were easily functionalized on In_2O_3 nanofibers (NFs) by electrospinning followed a calcination at 600 °C in air. The influences of doping content, morphology, and operating temperature on the acetone sensing performances of In_2O_3 based NFs were comprehensively studied. Our results showed that the 20 wt% Co_3O_4-In_2O_3 NFs exhibited outstanding acetone sensing properties at 300 °C. Exactly, it showed a high response to acetone (S~43.67 @ 100 ppm acetone), which was ~22 times larger than that of pristine In_2O_3 NFs. On the same time, it exhibited a short response time (~13 s). The excellent acetone sensing properties of MOFs-derived Co_3O_4-In_2O_3 NFs can be explained by the formation of p-n junction between Co_3O_4 and In_2O_3. Our work offers a facile and cost-effective approach to load MOFs-derived Co_3O_4 on other metal oxides based NFs as a promising gas sensing material and shows the prospects of MOFs-derived metal oxides loaded in metal oxide NFs used for gas sensors.

S2001
11:00-11:15

Effects of Process Parameter Variation on the Surface Roughness of Polylactic Acid (PLA) Materials Using Design of Experiments (DOE)
Rafiqul Noorani, Loyola Marymount University, USA

Abstract—3D Printing (3DP) is an additive manufacturing technology used to rapidly build parts that are designed using 3D modeling software. 3DP builds a part by adding one layer of the working material at a time until the process is complete. One main concern with 3D printed samples is the high levels of surface roughness, which can result in the rejection of parts by many precision manufacturing companies. The objective of this research is to use the Design of Experiment (DOE) to analyze which factors influence the surface roughness of the part built from a 3D printer. In this research, a two-level, three-factor, full factorial design of experiment is used to select the best combination of factors that will minimize the surface roughness of parts made from Polylactic Acid (PLA) materials. The selected factors are printing orientation, nozzle diameter, and infill percentage. Based on the preliminary result, it is determined all the factors and their two-factor interactions are shown to significantly affect the surface roughness. However, it is shown that the nozzle diameter has had the most effect on surface roughness. These results will be explained in terms of the optical microscopy of the processed PLA test specimens.

TECHNICAL SESSIONS

S0017-A
11:15-11:30

A Simple Way to Fabricate Flexible Sensors with Both Pressure and Displacement Sensing Abilities Achieving High Sensitivity and Linearity

Lan Shi, Fudan University, China

Abstract—Flexible sensors with pressure and displacement sensing abilities have been extensively investigated as the key elements in the electronic skin of robots. But these sensors usually require a converter to convert the nonlinear readout signals into linear readout signals. In this study, a sandwich-structured capacitive sensor with hollow-carbon-PDMS composite as the dielectric layer is exhibited. By adjusting the concentration of carbon and establishing an appropriate evaluation method, the relationship between the capacitance and the pressure, which is exponential, and the relationship between the capacitance and the displacement, which is reciprocal, were controlled to be linear. Hollow-carbon-PDMS achieved a sensitivity of 0.1026 kPa-1 under 10,000 Pa, and a linearity with R2= 0.99182 in terms of pressure sensing, and achieved a sensitivity of 1.2503 mm-1 from 0 mm to 0.4 mm, and a linearity with R2= 0.98497 in terms of displacement sensing. In addition, hollow-carbon-PDMS can be fabricated by an industrially viable and scalable spin-coating or molding method, providing an efficient avenue for realizing large-scale production and good assembling ability of commercial applications.

S0014-A
11:30-11:45

A Mechanical and Tribological Study of a Biomaterial for Cartilage Replacement

Rahul Ribeiro, Alliance University, India

Abstract—Millions of individuals suffer from the bone joint disease arthritis, every year, worldwide. Total joint replacements, the standard for current treatment has certain drawbacks such as wear of the surface, a negative immune response to wear particles, non-matching of the mechanical and tribological properties with natural bone joint tissue. In order to overcome the drawbacks of current materials used in total joint replacements, and mimic natural cartilage, hydrogel composite materials were investigated. Inter penetrating networks of Poly Hydroxyethyl Methacrylate (PMMA) and Poly Acrylamide were synthesized with nano clay particles as reinforcement. Tribological and compression tests were carried out. Four lubricants-simulated body fluid (SBF), and SBF with 0.1, 0.2, 0.3 mg/ml of Hyaluronic acid (HA) were incorporated in the tribological tests. The counter material was a stainless steel pin. It was found that the nanoclay particles significantly improved the strength of the composite. Increasing the HA concentration led to an increase in viscosity of the lubricant and a corresponding increase in the coefficient of friction. An increase in crosslink density also led to an increase in the coefficient of friction. The addition of nano clay did not significantly affect the frictional force.

TECHNICAL SESSIONS

S0016
11:45-12:00

Study on Polarization and Adhesion Property of Gecko Inspired Mushroom-shaped Pillars

Mingyue Lu, Nanjing University of Aeronautics and Astronautics, China

Abstract—Geckos can run swiftly on various surfaces, is not only related to the micro-nano structure of their setae, but also related to the charged keratin in biological tissues of epidermis. Many gecko-inspired structural materials have been developed in order to obtain desired adhesion property. Much research has been done to improve their adhesion by changing chemical composition and optimizing micro-nano structure, but little research has been done on the effect of surface charge. Therefore, this study aims to investigate the effect of surface charge on the adhesion of gecko-inspired materials, and to explore a new way to improve their adhesion performance. In this work, the dry adhesive materials made of polyvinylsiloxane (PVS) with mushroom-shaped pillars were polarized under high voltage. The results showed that polarized samples with the mushroom-shaped pillars facing the positive electrode have more negative charge, and the adhesion was improved a lot with increasing charge.

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