COVER PAGE

2020 The 10th International Conference on Key Engineering Materials (ICKEM 2020)

2020 International Workshop on Materials and Design (MatDes 2020)

Madrid, Spain | March 26-29, 2020

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CONTENTS

WELCOME

Dear distinguished delegates,

It is our great honor and pleasure to welcome you to 2020 The 10th International Conference on Key Engineering Materials (ICKEM 2020) and 2020 2nd International Workshop on Materials and Design (MatDes 2020). We'd like to express our heartfelt appreciation to our chairs, sponsors, technical committee members, organizing committee members, authors and delegates, who made a lot of efforts and contributions year by year. Thanks to your support and help, we can hold this conference successfully and always keep making progress.

The evaluation of all the papers was performed based on the reports from anonymous reviewers, who are qualified in the related field. We are glad to receive more than 170 submissions from 35 countries and regions this year: Algeria, Brazil, Bulgaria, China, Ecuador, Egypt, Hungary, Honduras, India, Iraq, Italy, Japan, Kazakhstan, Kuwait, Latvia, Lebanon, Malaysia, Mexico, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Russia, Saudi Arabia, South Africa, South Korea, Spain, Taiwan, Thailand, Turkey, United Arab Emirates, UK in this program.

A word of special welcome is given to our keynote speakers who are pleased to make contributions to our conference and share their new research ideas with us. They are Prof. Alexander Korsunsky from Trinity College, Oxford University, UK; Prof. Kwang Leong Choy, University College London, UK; Prof. Geoffrey Mitchell, Institute Polytechnic of Leiria, Portugal.

On March 27-28, we have 8 parallel presentation sessions. We believe that by this conference, you can get more opportunity for further communication with researchers and practitioners with the common interest in key engineering materials.

Your suggestions are warmly welcomed for the further development of the conferences in the future. Wish you have a fruitful and memorable experience in Madrid, Spain! We look forward to meeting you again next time. The platform is ready, so please seize this opportunity to show your thoughts and opinions confidently. Wish you will enjoy this conference, contribute effectively toward it and take back with you knowledge, experiences, contacts and happy memories of these days. Thank you for your attention!

Yours sincerely,

Conference Chair,
Vice President, Trinity College, Oxford University, UK
Editor in Chief, Materials & Design

AGENDA OVERVIEW

March 26, 2020 (THU) | Conference Preparations		Venue
10:00-17:00	**Registration & Materials Collection**	Lobby
March 27, 2020 (FRI) Morning | Keynote Speeches		**Venue**
09:30-09:40	**Opening Remarks**- Prof. María Teresa Villalba-Díaz, Universidad Complutense, Spain	CAT+CON+EJE+FORO (Ground Floor)
09:40-10:20	**Keynote Speech I** Prof. Alexander Korsunsky, Trinity College, Oxford University, UK	CAT+CON+EJE+FORO (Ground Floor)
10:20-10:30	Group Photo	
10:30-10:50	Coffee Break & Poster Presentations	
10:50-11:30	**Keynote Speech II** Prof. Kwang Leong Choy, University College London, UK	CAT+CON+EJE+FORO (Ground Floor)
11:30-12:10	**Keynote Speech III** Prof. Geoffrey Mitchell, Institute Polytechnic of Leiria, Portugal	CAT+CON+EJE+FORO (Ground Floor)
12:10-13:30	Lunch	Restaurant (Ground Floor)
March 27, 2020 (FRI) Afternoon | Parallel Sessions		**Venue**
13:30-16:00	**Session 1-- Materials and Design** Chaired by Prof. Alexander Korsunsky Trinity College, Oxford University, UK	CAT+CON (Ground Floor)
	Session 2-- Composite Material Chaired by Prof. José Roberto Moraes d'Almeida, Pontifícia Universidade Católica do Rio de Janeiro, Brasil	EJE+FORO (Ground Floor)
	Session 3-- Electronic Material Chaired by	ORATORIO+TRIBUNA (Ground Floor)
16:00-16:15	Coffee Break	
16:15-18:30	**Session 4-- Building Material** Chaired by Asst. Prof. Shwan H. Said, Northern Technical University, Iraq	CAT+CON (Ground Floor)
	Session 5-- Metallic Material Chaired by Prof. Zoubeida HAFDI, Mostefa Benboulaid Batna 2 University, Algeria	EJE+FORO (Ground Floor)

AGENDA OVERVIEW

	Session 6--Polymer and Nano Material Chaired by	ORATORIO+TRIBUNA (Ground Floor)
18:30-20:00	Dinner	Restaurant (Ground Floor)
March 28, 2020 (SAT) Morning | Parallel Sessions		**Venue**
9:00-12:05	**Session 7-- Materials Physics and Chemistry** Chaired by Prof. Armando Ramalho, Polytechnic Institute of Castelo Branco, Portugal	Junta (Ground Floor)
9:00-12:05	**Session 8-- Material Processing** Chaired by Assoc. Prof. Abdulaziz AlHazaa, King Saud University, Saudi Arabia	Oratorio (Ground Floor)
March 29, 2020 (SUN) | Social Program		
Local Custom Self-Experience		

VENUE

ILUNION Suites Madrid

Add: Add: C/ López de Hoyos, 143. 28002. Madrid

Convenient Transportation:

Adolfo Suarez Madrid-Barajas Airport is 9.2 km form the hotel.
By taxi: About 15 minutes.
By Metro: Around 33mins. Metro Line 8 (2 stops)-get off at Mar de Cristal-Metro Line 4 (5 stops)- get off at Alfonso XIII metro station

Contact Information:

Sales Manager: Natalia Kechkina
Email: reservassuites@ilunionhotels.com
Tel.: +34 917 44 50 00

VENUE

Local Information:

Weather	6℃~16℃/42.8℉~60.8℉ Cloudy
Time Zone	GMT +1
Currency	€ Euro
Important Phone Numbers	- Police:112 - Ambulance: 112 - Fire: 112

Coronavirus disease (COVID-19) advice for the Participants:

 **Wearing Mask**	*Please wear mask during the conference. *Before putting on a mask, clean hands with alcohol-based hand rub or soap and water. *Cover mouth and nose with mask and make sure there are no gaps between your face and the mask. *Avoid touching the mask while using it; if you do, clean your hands with alcohol-based hand rub or soap and water. *Replace the mask with a new one as soon as it is damp and do not re-use single-use masks. *To remove the mask: remove it from behind (do not touch the front of mask); discard immediately in a closed bin; clean hands with alcohol-based hand rub or soap and water.
 **Wash your hands frequently**	Regularly and thoroughly clean your hands with an alcohol-based hand rub or wash them with soap and water.

VENUE

Avoid touching eyes,nose and mouth	Hands touch many surfaces and can pick up viruses. Once contaminated, hands can transfer the virus to your eyes, nose or mouth. From there, the virus can enter your body and can make you sick.

AGENDA

[March 26, 2020]

ILUNION Suites Madrid

Lobby Bar

10:00-17:00

Registration & Material Collecting

Give your **Paper ID** to the staff

↓

Sign your name in the attendance list and check the paper information

↓

Check your **conference kit**, which includes conference bag, name tag, lunch & dinner coupon, conference program, the receipt of the payment and an USB drive with paper collection.

Oral Presentation Guideline

- Get your presentation PPT files prepared. Please copy your PPT to the computer 15 minutes before your session on January 13. The size of PPT is 16:9.
- Regular oral presentation: 15 minutes (including Q&A).
- Laptop, projector & screen, laser sticks will be provided by the conference organizer.
- 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 after the session by the session chair.

AGENDA

Poster Guideline

Please read it carefully:

- ✧ Please bring your own poster.
- ✧ Prepare the Poster

  *Your poster should cover the KEY POINTS of your work.

  *The title of your poster should appear at the top about 25mm (1”) high.

  *The author(s) name(s), affiliation(s) and mailbox are put below the title.

  *Posters are required to be condensed and attractive. The characters should be large enough so that they are visible from 1 meter apart. Suggested Poster with size of A1 (594mm×840mm width*height), with conference short name and paper ID on right up corner.

- ✧ During poster session, the author should stand by your poster, explaining and answering doubts or questions.
- ✧ Carefully prepare your poster well before the conference. All illustrations, charts, etc., to be posted should be prepared in advance as materials for these purposes will not be available at the meeting site.

! Attention

- ✧ In order to keep everyone's property safe, kindly notice that only the participants wearing the attendance card can be allowed to enter the meeting room. If you have any accompanying person, please do inform our staff in advance when you do the registration. Thanks for your understanding and cooperation.
- ✧ Please always keep your belongings with you. The organizer of the conference does not assume any responsibility for the loss of personal stuff of the participants.
- ✧ Don’t stay too late in the city, don’t be alone in the remote area. Be aware of the strangers who offer you service, signature of charity, etc., at many scenic spots.
- ✧ Wearing masks during the whole conference period.

AGENDA

[March 27, 2020]

Morning

CAT+CON+EJE+FORO (Ground Floor)		
09:30-09:40	**Opening Remark**	**Prof. María Teresa Villalba-Díaz, Vice Dean** Universidad Complutense, Spain
09:40-10:20	**Keynote Speech I**	**Prof. Alexander Korsunsky, Vice President, Trinity College, Oxford University, UK, Editor in Chief, Materials & Design**
		Title-
10:20-10:50	**[Group Photo &Coffee Breaks]**	
	Poster Display- Material Characteristic	
	M1-0019,M1-0049,M1-0139,M1-0050,M1-0125-A, M1-0128-A,M1-0095, M1-0126,M1-0113,M1-0004, M1-0096, M1-0067, M1-0121	
10:50-11:30	**Keynote Speech II**	**Prof. Kwang Leong Choy, University College London, UK**
		Title- Nanoengineered Coatings and Surfaces
11:30-12:10	**Keynote Speech III**	**Prof. Geoffrey Mitchell Institute Polytechnic of Leiria, Portugal**
		Title- Manufacturing plastics parts with definition of the properties at the point of manufacturing – the ultimate digital definition

Lunch Restaurant

<12:10-13:30>

AGENDA

[March 27, 2020]
Afternoon

CAT+CON (Ground Floor)	
13:30-15:45	**Session 1--[Materials and Design]** Chaired by Chaired by Prof. Alexander Korsunsky, Vice President, Trinity College, Oxford University, UK
	9 Presentations—M1-0026-A, M1-0028, M1-0039-A, M1-0115-A, M1-0135-A, M1-0061, M1-3004-A, M2-0007-A, M1-0063
15:45-16:00	**Coffee Break**
16:00-18:15	**Session 4--[Building Material]** Chaired by Asst. Prof. Shwan H. Said, Northern Technical University, Iraq
	9 Presentations—M1-0071, M1-0058, M1-0072, M1-0120, M1-0073, M1-0142, M1-0140, M1-0105, M1-0112
EJE+FORO (Ground Floor)	
13:30-15:45	**Session 2--[Composite Material]** Chaired by Prof. José Roberto Moraes d'Almeida, Pontifícia Universidade Católica do Rio de Janeiro, Brasil
	9 Presentations—M1-0042, M1-0083-A, M1-0099, M1-0100-A, M1-0102, M1-0098-A, M1-0109-A, M1-0104, M1-0101
15:45-16:00	**Coffee Break**
16:00-18:15	**Session 5--[Metallic Material]** Chaired by Prof. Zoubeida HAFDI, Mostefa Benboulaid Batna 2 University, Algeria
	9 Presentations—M1-0034-A, M1-0103, M1-0145-A, M1-0141 M1-0153, M1-0092, M1-0134, M1-0154, M1-0074

AGENDA

ORATORIO+TRIBUNA (Ground Floor)	
13:30-16:00	**Session 3--[Electronic Material]** Chaired by
	10 Presentations—M1-0082, M1-0129-A, M1-0122, M1-0106, M1-0052, M1-0056, M1-0132, M1-0127, M1-0150, M1-0148
16:00-16:15	**Coffee Break**
16:15-18:30	**Session 6--[Polymer and Nano Material]** Chaired by
	9 Presentations—M1-0143, M1-0069, M1-0144, M2-0008, M1-0046, M1-0047, M1-0078, M2-0006, M1-0149

Dinner **Restaurant**

<18:30-20:00>

AGENDA

[March 28, 2020]
Morning

Junta (Ground Floor)	
9:30-12:00	**Session 7—[Materials Physics and Chemistry]** Chaired by Prof. Armando Ramalho, Polytechnic Institute of Castelo Branco, Portugal
	10 Presentations—M1-0006-A, M1-0007-A, M1-0031-A, M1-0008-A, M2-0002, M1-0108, M1-0057, M1-0054, M1-0032, M1-0123-A
Oratorio (Ground Floor)	
9:30-12:15	**Session 8--Part 1--[Metallic Material]** Chaired by Assoc. Prof. Abdulaziz AlHazaa, King Saud University, Saudi Arabia
	11 Presentations—M1-0005-A, M1-0053, M1-0086, M2-0005-A, M1-0111, M1-0089-A, M1-0002-A, M1-0044, M1-0033-A, M1-0124, M1-0130

Lunch@Restaurant
<12:15-13:30>

AGENDA

Social Program Recommendation
[March 29, 2020]

Recommendation 1 	**Palacio Real** The massive size of the Palacio Real is its most imposing feature. Madrid's Royal Palace boasts more than 2,500 ornately decorated rooms. Built in 1764, the palace served as the royal residence beginning with Carlos III. The last royals to reside there were Alfonso XIII and Victoria Eugenie in the early 1900s.
Recommendation 2 	**Plaza Mayor** The most famous of Madrid's many stately plazas, the Plaza Mayor dates back to 1619, when it lay outside the city's bounds and was used to host bullfights. During the Spanish Inquisition, many accused heretics met their death there. Three sides of the rectangular cobblestone plaza are bordered by block-long rows of three-story apartments completed in the late 18th century.
Recommendation 3 	**Prado Museum** The Museo del Prado is one of the most popular tourist attractions in Madrid. The 18th century structure designed by architect Juan de Villanueva houses one of the world's finest art collections. A 2007 expansion has made the famed museum easier to navigate. With more than 7,000 works of art representing culture and history from the 12th century to the early 19th century, however, it's impossible to see everything in a single visit.

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Recommendation 4 	**Retiro Park** Known as the Parque del Buen Retiro or El Retiro, the park is a 350-acre spread of gardens, fountains and buildings located at the edge of the city center. Retiro Park began as a monastery in the 1500s. It was expanded into a royal park when Phillip II moved his court to Madrid in 1561. It's been part of the public domain since 1868. A favorite spot for tourists and locals alike, the park features a large artificial pond where people can rents kayaks and canoes.
Recommendation 5 	**Gran Via** The Gran Vía is known as the Broadway of Madrid because it's "the street that never sleeps." The grand boulevard runs through central Madrid from the Plaza de España to Calle de Alcalá. Although the street now seems integral to the bustling capital, it's actually a fairly recent addition to the city. Completed in 1910, the Gran Vía is lined with hundreds of shops, restaurants and businesses.
Notes	**Due to the epidemic of New coronavirus, to ensure the health and safety of the participants for the greatest possibility, after the discussing of the organizing committee, the social program on March 29th is cancelled; participants can arrange the day by yourselves. Appreciated for your understanding.**

SPEAKERS

Prof. Alexander Korsunsky
Trinity College, Oxford University, UK

Alexander Korsunsky received his degree of Doctor of Philosophy (DPhil) from Merton College, Oxford, following undergraduate education in theoretical physics. His current appointment is Professor of Engineering Science at the University of Oxford and Trinity College. He has given keynote plenaries at major international conferences on engineering and materials. He has developed numerous international links, including visiting professorships at Universitá Roma Tre (Italy), ENSICAEN (France) and National University of Singapore.

Prof Korsunsky's research interests concern developing improved understanding of integrity and reliability of engineered and natural structures and systems, from high-performance metallic alloys to polycrystalline ceramics to natural hard tissue such as human dentin and seashell nacre.

Prof Korsunsky co-authored books on fracture mechanics (Springer) and elasticity (CUP), and published over 200 papers in scholarly periodicals on the subjects ranging from neutron and synchrotron X-ray diffraction analysis and the prediction of fatigue strength to micro-cantilever bio-sensors, size effects and scaling transitions in systems and structures.

Support for Prof Korsunsky's research has come from EPSRC and STFC, two major Research Councils in the UK, as well as also from the Royal Society, Royal Academy of Engineering (RAEng), NRF (South Africa), DFG (Germany), CNRS (France) and other international and national research foundations. Prof Korsunsky is a member of the editorial board of Journal of Strain Analysis published by the Institution of Mechanical Engineers, UK (IMechE).

Prof Korsunsky is consultant to Rolls-Royce plc, the global aeroengine manufacturer, whom he advises on company design procedures for reliability and consistency. He spent a period of industrial secondment at their headquarters in Derby, UK (supported by RAEng), and made recommendations on R&D in structural integrity.

Prof Korsunsky plays a leading role in the development of large scale research facilities in the UK and Europe. He is Chair of the Science Advisory Committee at Diamond Light Source (DLS) near Oxford, UK, and Chair of the User Working Group for JEEP (Joint Engineering, Environmental and Processing) beamline at DLS. These activities expand the range of applications of large scale science to problems in real engineering practice.

Prof Korsunsky's research team at Oxford has involved members from almost every part of the globe (UK, FR, DE, IT, China, India, Korea, Malaysia, South Africa).

Title---

Abstract---

SPEAKERS

Prof. Kwang Leong Choy,
University College London, UK

Kwang Leong Choy [D.Phil (oxon)., DSc, FIMMM, FRSC] is the Professor of Materials Discovery and the Director of the UCL Institute for Materials Discovery at University College London (UCL) since 2014. She obtained her Doctor of Philosophy (D.Phil.) in Materials Science from the University of Oxford and Doctor of Science (D.Sc.) in Materials from the University of Nottingham. She has been employed at University of Oxford, Imperial College London and University of Nottingham before joining UCL. She has extensive experience in in materials creation, discovery and exploitation of eco-friendly, cost-effective and sustainable high performance thin films and nanomaterials processing technologies, especially for clean energy and engineering applications. She has authored over 230 peer-reviewed publications, including 5 books and 20 patents in nanomaterials, thin films and coatings for structural, functional and biomedical applications. She is the recipient of Grunfeld Medal Prize and has given over 150 keynote papers/invited lectures and conference session Chairman. She is leading a multidisciplinary research team ranging from material scientists, chemists, physics, coating specialists, bioengineering, nanobiotechnology, and engineers. Her team is conducting cutting edge research and technology exploitation of high performance, eco-friendly and cost-effective processing of new nanostructured materials, nanocomposites and superthin/thin/thick films coated products for thin film solar cells, clean energy, energy storage, electrical, optoelectronics, environment, health care, and biomedical applications. She has been elected to several prestigious fellowships such as Fellow of the Institute of Materials (2007-present), Royal Society of Chemistry (2010 - present), European Science Foundation NANO network (2008-2014), Chartered of Science, CSi (2007- present), as well as on editorials boards (Editorial Board of Nano-Micro Letters, Journal of Nanomaterials, and Guest Editor of “Surface Engineering” and “Chemical Vapour Deposition”). She has been the Founder, Inventor and Director of Innovative Materials Processing Technologies Ltd and Co-Founder of Southside Thermal Sensing (spin-out companies from Imperial College London). She was awarded a Visiting Professorship (2001/03) by the Swedish Engineering Research Council at the University of Uppsala, Visiting Professorship for Senior International Scientist at Ningbo Institute of Materials Technology and Engineering (NIMTE, 2010/2012), and Chinese Academy of Sciences (2011/2013). She has secured and managed numerous multimillion pounds national and European flagship research programmes with extensive collaboration with academia and industry. She has also established multi-million pound state-of-the art nanomaterials, innovative thin/thick films processing and characterisation facilities.

Title--- Nanoengineered Coatings and Surfaces

Abstract- This presentation gives an overview of the innovation in the development of high performance nanoengineered coatings and surfaces using chemical vapour deposition (CVD) as well as novel, scalable, eco-friendly aerosol assisted CVD based methods for the deposition of high purity nanostructured coatings, including nanocomposite coatings with well controlled structure and composition at nanoscale level. The process principles and deposition mechanism will be presented. The surface and interface control to produce robust, adherent nanostructured coatings would be

discussed. The relationships of the process/structure/property of the superthin/thin/thick nanostructured coatings will be described. The scientific and technological significant of these methods will be discussed. The potential applications of such low cost and high-performance nanostructured coatings for energy generation, storage and transmission, optoelectronics, healthcare and biomedical as well as engineering, especially for extreme environments will be highlighted.

SPEAKERS

Prof. Geoffrey Mitchell

Institute Polytechnic of Leiria, Portugal

Geoffrey Mitchell is Professor and Vice-Director of the Centre for Rapid and Sustainable Product Development at the Polytechnic Institute Leiria in Portugal. Geoffrey Mitchell carried out his doctoral work at the University of Cambridge in the UK and subsequently held a post-doctoral fellowship at Cambridge and a JSPS Fellowship at Hokkaido University in Japan. Prior to his current position he was Professor of Polymer Physics at the University of Reading, UK and from 2005 he was the founding Director of the Centre for Advanced Microscopy at Reading. His research work bridges physics, biology, chemistry and technology and he is a Fellow of both the Institute of Physics and the Royal Society of Chemistry as well as the Royal Society for the Encouragement of Arts, Manufactures and Commerce.

Geoffrey Mitchell is passionate about direct digital manufacturing (DDM) which enables products to be manufactured directly from a digital design without the need for specialist tooling or moulds and the development of novel materials to support the emerging technologies. He is fascinated by the opportunities that arise from merging electrospinning in to the family of DDM technologies. He brings a wealth of experience working with polymer based materials both natural and synthetic. He is particularly interested in the scales of structure present in all materials and especially biopolymers. He has developed and made extensive use of x-ray and neutron scattering methods coupled to computational molecular modelling and electron microscopy techniques.

He is a Visiting Member of the Medical Physics and Clinical Engineering Department of the Oxford Universities NHS Foundation Trust. He is the editor of a book “Controlling the Morphology of Polymers Multiple Scales ” published by Springer in 2016.

Title--- Manufacturing plastics parts with definition of the properties at the point of manufacturing – the ultimate digital definition

Abstract-

March 27, 2020

Session 1

Materials and Design

13:30-15:45

CAT+CON

Chaired by Prof. Alexander Korsunsky

Vice President, Trinity College, Oxford University, UK

9 Presentations—

M1-0026-A, M1-0028, M1-0039-A, M1-0115-A

M1-0135-A, M1-3004-A, M2-0007-A, M1-0063, M1-0061,

***Note**:

- Please arrive 30 minutes ahead of the session to prepare and test your PowerPoint.
- Certificate of Presentation will be awarded to each presenter by the session chair when the session is over.
- 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.
- Please keep all your belongings at any time!

M1-0026-A	Effect of Different Electrodeposition Methods on Structure and Properties of Pure Zirconium Coating on Zirconium-Niobium Alloy Substrate **Yusha Li** University of Science and Technology Beijing, China Abstract- Zirconium can effectively reduce the oxidation rate of the cladding under water loss accidents and improve the safety margin of the reactor. In this work, zirconium coating on Zirconium-Niobium alloy substrate was obtained by direct current, single pulse and double pulse electrodeposition methods from FLINAK-K2ZrF6 molten salt. The crystal structure, microstructure, thickness of the coatings and the adhesive strength between the coatings and Zirconium-Niobium alloy substrate were investigated by XRD, SEM and scratch test techniques: The results show that the pure zirconium coating with hexagonal crystal structure can be obtained on the zirconium-niobium alloy substrate by both of direct current, single pulse and bidirectional pulse electrodeposition three methods. Zirconium coating obtained by direct current deposition has a large surface porosity, and the zirconium grains preferentially grow along the (110) direction. While the zirconium coating obtained by pulse electrodeposition is more compact, and the zirconium grains preferentially grow along the (002) direction. The zirconium coating obtained by bidirectional pulse electrodeposition has the best performance and the highest hardness value, and the bonding strength between zirconium coating and zirconium-niobium alloy substrate presents the highest value of 35N.
M1-0028	On Capacitance-Voltage Characteristics of Non-Hydrogenated Amorphous Silicon/Crystalline Silicon Heterojunctions for Solar-Cell Applications **Zoubeida Hafdi** Mostefa Benboulaid Batna 2 University, Algeria Abstract- This work presents the performance of a HIT solar cell which was fabricated for the first time in the Advanced Electronics Laboratory of Batna 2 University by sputtering silicon on p-type crystalline silicon substrate. This initial effort was a tentative to learn about the fabrication technique and the control of the deposition parameters involved in the fabrication process. Preliminary capacitance voltage measurements confirm an abrupt junction model in consistence with the earlier published data. A junction depth of 0.58 μm and a diffusion voltage of 1.65 V were obtained. A defect density in the gap of non-hydrogenated amorphous silicon of 6.93 1014 cm-3 was computed indicating the presence of defect states.
M1-0039-A	Tin whiskers prefer to grow from the [001] grains in a tin coating on aluminum substrate **Shuang Tian**, Yushuang Liu, Peigen Zhang, Jian Zhou, Feng Xue and Zhengming Sun Southeast University, China Abstract-In this paper, we tried to understand the features of the tin grains from which whiskers preferentially grow. The growth behavior of Sn whiskers on a 50 μm thick Sn coating was in-situ observed by mapping the grain orientations before and after

	annealing using electron backscatter diffraction (EBSD) technique. Sn whiskers were found to grow preferentially from the (001) or near-(001) grains surrounded by the grains having perpendicular orientations, such as (100), (110) and (210). The compressive stress in the coating, originated from the thermal mismatch between Sn and Al, as measured by X-ray diffraction, increases at the initial annealing stage and decreases with the growth of Sn whiskers. Due to the large grain size of the prepared coating, the contribution to Sn atomic diffusion by grain boundaries is insignificant. The dominant diffusion mode for whiskers growth is lattice diffusion. The orientation of the whiskers remain consistent with the underneath coating grain. The growth of whiskers is accompanied by the relaxation of residual thermal stresses.
M1-0115-A	Tougher Ceramics: Bio-Inspired Designs Applied On The Nanoscale **Koen Evers**, Simone Falco, Richard I. Todd and Nicole Grobert University of Oxford, United Kingdom Abstract-Technical ceramics are everywhere in our lives due to their high strength, hardness and chemical and wear resistance - unmatched by any other type of material available. There is one main problem that needs to be solved for more widespread application; their brittleness. Resistance to crack propagation or 'toughness' is almost non-existent. By studying and learning from natural materials we can apply microstructural architectures that have been created through millions of years of evolution. A main source of inspiration herein is nacre, the material found in abalone seashells. This natural material has an impressive combination of both strength and toughness. We explore different methods to create platelet-like building blocks and to self-assemble these building blocks into an aligned, nacre-like microstructure. Specifically, metallic oxide nanoparticles and carbon nanomaterials such as carbon nanotubes are used together with alumina micro-platelets to generate more sophisticated building blocks than those that are currently used in nature. We found that by using nanomaterial-functionalised building blocks in a biomimetic approach, we can provide toughness to ceramics, and see a radically different mechanical response (from brittle fracture to a graceful nacre-like failure), while at the same time being able to tailor conductive properties. These materials have been tested in impact tests, which show that our nacre-like microstructural design is successful in diverting and dispersing energy, resulting in a non-brittle ceramic that is interesting for various mechanical engineering applications where ceramic components are preferred but brittle failure is unacceptable.
M1-0135-A	Tungsten-carbide-rich protective nano-coatings produced by noble gas ion-mixing **Adel Sarolta Racz,** Zsolt Fogarassy, Peter Panjan, Zsolt Kerner and Miklos Menyhard MTA EK MFA, Hungary Abstract-Tungsten-carbide (WC) has favorable properties, like high melting point and hardness and good corrosion resistance. Therefore it is widely applied as protective coating in harsh applications. Herein we will show a novel route to produce WC coatings at room temperature. C/W multilayer structures - with individual thicknesses of 10-20

	nm - are irradiated by xenon and argon atoms. Simulation methods (TRIDYN, SRIM) are used to calculate the ion-solid interactions. Due to irradiation at the interfaces intermixing happens and WC compound formation also occurs. The layer thickness and the in-depth distribution of the WC are determined by Auger electron spectroscopy depth profiling. We show that the thickness of the WC-rich region can be tailored by changing the ion irradiation conditions and the layer structure. The corrosion resistance of the layers was tested by potentiodynamic corrosion test in 3.5 w/w% NaCl solution. Process-property relationships are discussed.
M1-0061	Highly luminescent undoped carbon nano-dots driven from folic acid and passivated by polyethylene glycol **Yasmin M. Bakier**, Mohsen Ghali, Mohamed Sami and Waheed K. Zahra Egypt-Japan University of science and Technology, Egypt. Abstract-Carbon nanodots (CDs) are considered nowadays as one of the most interesting fluorescence nanomaterials with various technological applications in almost all aspects of needs e.g., in medicine, biology and engineering. Yet, as reported in many previous works, undoped CDs suffer from low quantum yield particularly when synthesized at relatively low temperatures. Here, we report on synthesis and characterization of a small size (4.7 nm in diameter) intentionally undoped CDs with high fluorescence intensity, from Folic Acid as a single precursor, using hydrothermal process at relatively low temperature 200oC. By attaching organics species of diamine-terminated oligomeric poly-ethylene glycol (PEG) to the surface of the derived CDs, a much stronger photoluminescence from the passivated dots was observed. Namely, we observe a strong enhancement of the CDs quantum yield from 44.4% to 67.5% by varying the PEG concentrations from 0 to 0.2 mM, respectively.
M1-3004-A	Tuning luminescent properties of atomically resolved NaxGa4+xTin-4-xO2n-2 oxides **J. García-Fernández,** M. García-Carrión, A. Torres-Pardo, M. Hernando, R. Martínez-Casado, E. Nogales, B. Méndez, J. Ramírez-Castellanos and J. M. González-Calbet Universidad Complutense de Madrid, Spain Abstract-Wide band gap semiconducting oxides, with band gap energy (Eg) above 3.5 eV, such as Ga2O3, ZnO, TiO2 or SnO2 are attractive materials for a huge number of applications due to their multi-functionality [1]. Some of them can be the basis of different homologous series, which under adequate circumstances can constitute an efficient route to provide tailored bandgap materials with modified optical/electrical properties [1, 2]. This is the case of the NaxGa4+ xTin-4-xO2n-2 system (n=5-7; x≈0.7) which has attracted particular interest as potential materials in batteries and photocatalysts [3, 4]. X-ray and neutron diffraction characterization show that the n=5 and 6 terms crystallize in the space group C2/m, while the n=7 member does in Pbam. The combination of imaging electron microscopy techniques such as (S)TEM-HAADF and ABF with spectroscopic analysis by EELS shows that n=5 and 6 terms are formed by the ordered intergrowth of β-Ga2O3 slabs and TiO6 octahedra (Fig. 1a). On the other hand, the n=7 member is formed by TiO6 octahedra sharing vertices with both GaO4

	tetrahedra and GaO6 octahedra. In all cases, hexagonal or orthogonal tunnels are formed, where the Na+ cation is visualized in the centre by ABF mode. The luminescent bands have been studied by cathodoluminescence (CL) and photoluminescence (PL) techniques. In the case of n=5 and 6 phases the luminescent spectra are composed by a broad band in the visible range, centered on 2.5 eV, and less intense bands in the UV range (Fig. 1b). However, for the term n=7, the main band is observed at 1.6 eV (infrared range), as well as a band wider but less intense in the visible, centered at 2.8 eV (Fig. 1b). Finally, the values of the band gap, by PL of excitation (PLE) for each oxide have been obtained. The structural-properties relationships which can widen the performance and applicability of these materials in the field of tunable optoelectronic devices will be discussed.
M2-0007-A	Effect of Microstructure and Crystal Texture on the Wear of Additively Manufactured Stainless Steel **Mohanad Bahshwan**, Connor Myant and Thomas Reddyhoff Imperial College London, UK Abstract-The subject of wear in engineered components such as gears, cams, bearings, etc. across all industries has been investigated for decades. Though, studies comparing the wear of metals produced by additive manufacturing (AM) versus conventional methods remain not only sparse, but also produce contradictory findings. Although the hardness of materials being compared was reported, it is unrealistic to assume that hardness alone accounts for the aftermath of the complex wear process. Here we explain the effect of microstructure, crystal texture, and applied normal load on the wear of AM-ed via laser-powder-bed-fusion austenitic 316L stainless steel compared with wire-drawn 316L. We show that factors such as applied normal load, microstructure, and crystal texture can be altered to increase the rate of latent-hardening in AM-ed specimens which ultimately results in wear resistance superior to those conventionally manufactured. This work sheds light on the production of AM-ed bearing surfaces with tailor-made microstructure and crystal texture for enhanced wear resistance.
M1-0063	Microstructural and Mechanical properties of Ti-Mn-Zr alloys **Ahmed H. Awad** and Mohamed Abdel-Hady Gepreel Egypt-Japan University of Science and Technology, Egypt. Abstract-Beta titanium alloys (β-Ti) have been a subject of great interest since the 1980s. In this study, the microstructure, mechanical and corrosion behavior of new low-cost β-type Ti-14Mn-xZr (x=0, 3 and 6 wt.%) alloys are studied. The novel alloys were fabricated by arc melting followed by annealing treatments at 900°C for 6 hrs then quenched in ice water to achieve good homogenization. The microstructure, mechanical properties, and corrosion properties of the alloys were investigated. The XRD patterns show a single β phase in all alloys and confirmed by the microstructural analyses. Both the compression strength and the hardness of the alloys were increased by increasing the Zr-content in the alloy due to the solid solution strengthening as well as the higher β-phase stability. Also, Zr addition decreased the corrosion rate of TiMnZr alloys.

March 27, 2020

Session 2

Composite Material

13:30-15:45

EJE+FORO

Chaired by Prof. José Roberto Moraes d'Almeida, Pontifícia Universidade Católica do Rio de Janeiro, Brasil

9 Presentations—

M1-0042, M1-0083-A, M1-0099, M1-0100-A, M1-0102

M1-0098-A, M1-0109-A, M1-0104, M1-0101

***Note**:

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SESSION 2

M1-0042	Influence of different carbon materials on electrical properties of epoxy-based composite for bipolar plate applications **Andres F. Rigail-Cedeño**, Mayken Espinoza-Andaluz, Joan Vera, Mishell Orellana-Valarezo and Maria Villacis-Balbuca Faculty of Mechanical Engineering and Production Science, Ecuador Abstract- During the last years, polymer composite bipolar plates have been developed from appropriate carbon materials and polymers. Considering these materials, there are several factors that influence the effective electrical properties of bipolar plates for polymer electrolyte fuel cell (PEFC) applications. This research focuses on the development of a composite of graphite/epoxy resin/aliphatic amine, which be technically feasible as a material for use in PEFC and meet international commercial standards. Our study focuses on finding a threshold percolation limit on the secondary filler having an Expanded Graphite (EG) as primary filler. The synergistic effect of Carbon Black (CB) and Graphite Nanoplatelets (GNP) as secondary fillers in proportions of 0, 0.5, 1, 2, and 3 wt.% on EG with particle size greater than 300 μm and content of 40 wt% are analyzed. The methodology in this composite processing did not include any solvent and relatively low temperature processing is performed. The processing conditions were studied to understand the impact on the electrical properties of the composite. The best results were obtained with carbon black at 1%, obtaining an in-plane electrical conductivity at about 50 S/cm. The appropriate dispersion of the CB through the Epoxy/EG matrix creates bridges connecting plates that improve the flow of electrons compared to GNP composites.
M1-0083-A	Assessment of the mechanical performance of polyethersulfone and polysulfone composites reinforced with thermal treatment glass fibers **Galal Sherif**, Dilyus Chukov and Victor Tcherdyntsev National University of Science and Technology (MISIS), Russia Abstract- Aerospace, automotive, structural industries, and many other industries are working to replace as many as they can by polymeric composites materials because of their good mechanical properties, chemical resistance, and high strength to weight ratio. Due to this growing demand, considerable efforts have been dedicated to find new ways to improve the properties of these composites. Polysulfone (PSU) and polyethersulfone (PES) are two high-performance thermoplastics which having high mechanical properties in addition to high service temperature and thermal resistance. These properties qualified PES and PSU composites for use in high-performance applications. The present study seeks to demonstrate the influence of removing the fibers' sizing -by thermal treatment- on the interface interaction between the glass fiber (GF) and polyethersulfone (PES) and polysulfone (PSU) in PES and PSU matrix composites. The composites were produced using the compression molding technique. Different fiber to polymer ratios of 50/50, 60/40, and 70/30 % were studied. Three-point flexural test and shear test were performed to study and evaluate the changes in the mechanical properties of the composites. Flexural strength of 550 MPa in addition to 33 GPa Young's modulus were achieved. The chemical structure of the composites was analyzed using

	FTIR. While the microstructure was demonstrated with SEM. From the observed results, it was proved that the thermal treatment of the glass fibers before using in the composite have to enhance the mechanical properties. SEM showed an improvement in the interface bonding between the fibers and the polymer.
M1-0099	The influence of MnO2 content on the sinterability and mechanical properties of MnO2-TiO2 composite **Lephuthing Senzeni Sipho**, Okoro Avwerosuoghene Moses, Ige Oladeji Oluremi and Olubambi Peter Apata University of Johannesburg, RSA Abstract- In a bid to synthesize transition metal oxides with enhanced density and mechanical properties have triggered the fabrication of various metal oxide with outstanding properties for functional applications. In order to achieved this, in this study, TiO2 based composites reinforced with MnO2 (5, 10 and 15) wt.% was fabricated using spark plasma sintering technique. Beforehand, samples were admixed using gentle milling powder processing to homogenously mix the MnO2 in TiO2 powders. Thereafter, the pristine TiO2 and admixed composites were sintered at 1200°C alongside with heating rate of 50 oC/min and compressive pressure of 25 MPa at holding time of 5 minutes. It was observed from the results that the addition of MnO2 in TiO2 influenced the microstructures and phases of the sintered samples which was revealed using scanning electron microscope (SEM) and X-ray diffraction (XRD) technique. Furthermore, the sintering characteristics, densification and microhardness of the sintered samples were also investigated. Though, there was decrease of relative densities from 99.99 to 98.5 % with increase of MnO2 content in TiO2 however the microhardness was improved due to the effectiveness of the mixing process.
M1-0100-A	Development of carbon fiber reinforced composite materials, based on polyethersulfone matrix **Valerii Torokhov,** Dilyus Chukov, Dmitry Zherebtsov and Galal Sherif National University of Science and Technology "MISiS", Russia Abstract- Carbon fiber reinforced polymers (CFRP) take a big part of present engineering. There is a demand for this type of composite materials in aerospace industry, car manufacturing and production of sports equipment, which is due to the unique mechanical properties of CFRP. However, most of the modern carbon fiber reinforced composites contain thermoset polymers, such as epoxy resin, as a matrix. Here appears a problem of early curing, that entails some problems in transportation and storage of prepregs (pre-impregnated single layer of future composite, that is used as semifinished product). Due to the irreversibility of curing process, material, that is already cured, cannot be reproduced or corrected. Another big problem is a long process of production of epoxy composite, that sometimes takes up to 24 hours. Moreover, most of the modern epoxy resins have a low temperature of degradation, that is about 180 ^{0}C. All these issues limit application of such material. The usage of high-temperature thermoplastic matrix can solve the problems of carbon fiber reinforced epoxy resins. As the result, thermoplastic matrix can expand properties of CFRP and broaden scope of

	application of such composites. However, to increase mechanical properties of such composite, the improvement of fiber-matrix interection is required. In this study, polyethersulfone (PES) was used as a matrix polymer, due to its good mechanical properties and high glass transition temperature, that is about 225 ^{0}C. In order to reduce viscosity of the polymer, PES was dissolved in N-Methyl-2-pyrrolidone (concentration of 20 wt.%). After that, carbon fibers were impregnated with the solvent in different weight proportions. Fiber contents were: 50 wt. %. (marked as 50/50), 60 wt. %. (60/40), 70 wt. % (70/30). Then impregnated fibers were dryed at a temperature of 100 °C for 4 hours. Than the prepregs were compression molded at 350 °C and applied pressure of 10 MPa. Mechanical tests of received samples showed, that the best composition was 50/50. Flexural stress and elastic modulus for this composite were 600 MPa and 50 GPa, respectively. Heat resistance of composite was estimated with methods of heat deflection temperature (HDT) and dynamo-mechanical analysis (DMA). It was found, that carbon fiber reinforced PES loses its thermal stability at temperature of about 190 °C. To improve mechanical properties of the PES based composites, surface modification by thermal oxidation of carbon fibers was conducted. To investigate the adhesion between PES and carbon fibers an interlaminar shear stress of the composites was studied. It was found, that surface modification can significantly improve mechanical properties of the composites and its heat resistance. An interlaminar shear stress was increased from 19,7 MPa for PES, reinforced with initial fibers, to 43,8 MPa for PES, reinforced with oxidized at 500 °C fibers. Due to improvement of adhesion, maximum flexural stress was also improved to 960 MPa. HDT also have raised to 210 °C. To understand mechanisms of formation of adhesion after the oxidation, scanning electron microscopy (SEM), atomic-force microscopy (AFM) and X-ray photoelectron spectroscopy were conducted. It was shown, that oxidation results in major changes in morphology and chemical composition of the fiber's surface. Hydroxyl, epoxy, ether, carboxyl and many other functional groups were formed after the surface modification. Hereby, new composite materials based on a high temperature thermoplastic polymer reinforced with carbon fiber were produced. It was found, that surface modification of carbon fiber by thermal oxidation can improve the fiber-matrix interfacial interaction, that results in an increase in all the properties of the new material. New CFPR have wider range of advantages, compared with epoxy-based composites, that's open new ways of their practical application.
M1-0102	Studies on Corrosion Properties of Spark Plasma Sintered Al (TiFe-SiC) Composites in Chloride Environment **Samuel Olukayode Akinwamide**, Miltia Lesufi , Nthabiseng Kumalo and Peter Apata Olubambi University of Johannesburg, South Africa Abstract- Aluminium matrix composites has been developed to serve as a replacement for other conventional engineering materials in specific applications where excellent properties are required. The corrosion behavior of sintered pure aluminium and aluminium matrix composites (AMCs) was investigated in this study. The powders of

	pure aluminium (matrix) and particles of silicon carbide and ferrotitanium (reinforcements) were homogeneously dispersed using high energy ball milling. Spark plasma sintering technique was used for consolidating the milled powders into a sintered compact. Microstructural examination of the sintered pure aluminium and composites showed a homogeneous dispersion of the reinforcements within the aluminium matrix. The fabricated composites also recorded an improved corrosion resistance in a corrosive medium of 3.5 wt.% sodium chloride (NaCl) from the potentiodynamic and potentiostatic polarization tests. The corroded specimens were further assessed for pitting using a scanning electron microscope (SEM). The corrosion resistance of the sintered specimens was observed to be improved upon the addition of SiC and TiFe reinforcements.
M1-0098-A	The mechanical properties of self-reinforced composite materials based on UHMWPE fibers produced by hot compaction **Dmitry Zherebtsov**, Dilyus Chukov and Valerii Torokhov National University of Science and Technology "MISiS", Russia Abstract- The properties of ultra-high molecular weight polyethylene (UHMWPE) mainly depend on its molecular and supramolecular structure. Isotropic UHMWPE structure consists of folded chain structure (lamellar crystals) and amorphous part between crystals. The degree of crystallinity is about 60%. The tensile strength of isotropic UHMWPE is about 25 MPa, the Young's modulus is about 750 MPa. There are methods for producing high-performance UHMWPE fibers which have the structure with molecular chains oriented along the fibers' axis. In this case, UHMWPE molecules form crystals based on extended chain, and the degree of crystallinity can reach up to 99%. The mechanical properties of such fibers are significantly higher than that of isotropic UHMWPE. The Young's modulus of such fibers is 120 GPa, and the tensile strength is 4 GPa. Due to a low density (≈ 0.97 g / cm3), the fibers have a record high values of a specific strength. However, it is difficult to use UHMWPE fibers in bulk or composite materials because of their chemical inertness to most materials. This problem may be solved using the concept of self-reinforced composite material (SRC), where the matrix and the reinforcing element are the same material with different supramolecular structure. In this work, the samples based on UHMWPE fibers were obtained by hot compaction. This method based on the heating of initial fibers up to 150 °C, 155 °C or 160 °C at pressure of 25 MPa or 50 MPa. Partial surface melting of the initial fibers occurs during the heating. After cooling, This molten part, which already has an isotropic structure, forms a matrix of the SRC. The use of high pressure during hot pressing allows to increase the melting temperature of the fibers and allows to avoid relaxation processes which cause a decrease in mechanical properties. The compression tests showed that the Young's modulus of the samples obtained at a pressure of 25 MPa, increases from 6.05 to 7.02 GPa with an increase in temperature from 150 °C to 160° C, respectively. For the samples obtained at a pressure of 50 MPa an increase of Young's modulus was also observed from 5.89 GPa to 6.40 GPa, respectively, with increasing of hot compaction temperature. The compressive strength of the

	samples obtained at a pressure of 25 MPa increases from 31.8 MPa to 37.5 MPa with rising of hot compaction temperature. The compressive strength of the samples obtained at a higher pressure (50 MPa) and at same temperatures was 29.8 MPa, 32.5 MPa and 36.4 MPa, respectively. In this case, the higher pressure of hot compaction results in creating of lower matrix volume which allows to better distribution the applied load across the volume of the SRCs. From other side, the high temperature of obtaining causes the increase of matrix content into SRC. Thus, an approach for obtaining of bulk composite materials based on UHMWPE fibers without the use of additional matrix material was proposed. The proposed hot compaction method at various pressures and temperatures allows to vary the fiber to matrix ratio resulting in various mechanical properties of the SRCs.
M1-0109-A	Synthesis Of Carbon-Containing Composites In Solid-Phase Combustion Mode **Sergey Fomenko**, Sanat Tolendiuly and Adil Akishev Institute of Combustion Problems, Kazakhstan Abstract- The development of new structural carbon-containing ceramic materials based on zirconium, silicon, chromium and titanium carbides is very relevant today, as they have a large set of unique properties and are suitable for the production of high-temperature refractory products used in units and assemblies of modern engineering. The aim of this work is to obtain composites by the method of self-propagating high-temperature synthesis (SHS) in the solid-state technological combustion mode, where high-temperature carbides and MAX phases formed that increase the technical and chemical properties of refractories. The main technological method for producing SHS - carbon-containing refractory materials was to conduct metallothermic solid-phase combustion of metal oxides in the presence of carbon. The main sources of energy were finely dispersed powders of aluminum and silicon. Industrial concentrates were used as oxidizing agents, products of complex technological processing of raw materials containing zircon, ilmenite, and chromium oxide. The filler was waste electrode graphite in the form of grain about 1-3 mm in size and a powder dispersion of less than 90 microns. The exothermic mixture was closed with a hydrolyzed ethyl silicate solution with a SiO2 content of 20–25%. The silica sol has good rheological properties, it moistens the particles of the graphite filler well, and after natural drying within 2-4 hours it completely goes into solid state due to heterocoagulation to form a structured silica gel matrix, which contains the rest of the mixture components and after drying the material is an exothermic composition containing significant amount of ultrafine silica. When heated in a muffle furnace to 1100-1150 °C, an exothermic reaction began, the temperature of the combustion process reached 1400-1700 °C. At such synthesis temperatures, the reduced metal reacted with carbon to form refractory carbides (TiC, SiC, ZrC) and MAX phases (Ti3SiC2, CrxSiyCz), as a result of which a material formed that possesses not only highly refractory properties but also erosion resistance to aggressive melts. Thus, carbon-containing materials were obtained by the method of solid-phase synthesis, which in terms of basic characteristics surpassed traditional carbon and carbon-graphite refractories. These materials can be used as a lining material in the

	repair of various melting furnaces, as well as for the manufacture of foundry molds, crucibles, molds.
M1-0104	Influence of Alumina Addition on the Densification Behaviour and Microhardness of Al2O3-Ti6Al4V Composites **Okoro Avwerosuoghene Moses**, Lephuthing Senzeni Sipho, Ajiteru Oluwaniyi Azeez, Oke Samuel Ranti and lubambi Peter Apata University of Johannesburg, South Africa Abstract- Light-weight materials that exhibit excellent mechanical and thermal properties at cryogenic and elevated temperatures are the focus of automobile and aerospace industries. In this study, alumina reinforced Ti6Al4V composites with improved microhardness were synthesized by ball milling of composites powders and sintering the admixed powders using spark plasma sintering at the sintering temperature, heating rate, constant compressive pressure and holding time; 1100 oC, 100 oC/min, 50 MPa and 10 minutes respectively. The sintered composites were analyzed to ascertain the effect of alumina addition on the relative density and densification behaviour and microhardness. The results indicated that the alumina particles were uniformly dispersed and attached to the Ti6Al4V particles after ball milling. The composite shrinkage rate depicted two stages of densification behaviours which are associated with the plastic deformation of the particles during sintering and fast densification of the composites powders. Additionally, the sintered composites indicated high relative density in the range of 96-99.7 percent, improved microhardness values in the range of 367-1049 HV. However, the relative density decreases with the increase in alumina content.
M1-0101	Influence of Aluminium Content on the Microstructure and Densification of Spark Plasma Sintered Nickel Aluminium Bronze **Okoro Avwerosuoghene Moses**, Oke Samuel Ranti, Falodun Oluwasegun Eso and Olubambi Peter Apata University of Johannesburg, Republic of South Africa Abstract- In a bid to fabricate nickel aluminium bronze alloys (NAB) with appreciable densification and improved microhardness, spark plasma sintering (SPS) technique was employed in this research. The NAB alloy was synthesized from starting elemental powders comprised nickel (4 wt.%), aluminium (6, 8 & 10 wt.%) and copper using dry milling technique. Starting elemental powders were homogeneously milled using low-speed ball mill for 8 hours at a speed of 150 rpm and a ball to powder ratio of 10:1. Subsequently, the milled powders were sintered using the SPS technique at 750 oC under a compressive pressure of 50 MPa and heating rate of 100 oC/min. Both the powders and sintered alloys were characterized using scanning electron microscope and X-Ray diffractometer to ascertain the microstructural and phase evolutions during the processing of the NAB. Also, density measurements and microhardness test were conducted to examine the integrity of the sintered alloys. The results indicated that the aluminium diffused towards the grain boundaries of the alloy after sintering and the microhardness of the alloys improved with the increase in aluminium content.

March 27, 2020

Session 3

Electronic Material

13:30-16:00

ORATORIO+TRIBUNA

Chaired by

10 Presentations—

M1-0082, M1-0129-A, M1-0122, M1-0106, M1-0052

M1-0056, M1-0132, M1-0127, M1-0150, M1-0148

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SESSION 3

M1-0082	Production and characterization of Nano-polyaniline and carbonized Polyaniline for potential application as energy storage devices **Hamdiya Orleans-Boham**, Noha A. Elessawy , Ahmed El-shazly and Marwa F Elkady Egypt-Japan University of Science and Technology (E-JUST), Egypt. Abstract- Polyaniline (PANI) in the nano form was prepared by a simple sol-gel method. The prepared PANI was carbonized under a direct nitrogen gas carbonization method to produce carbonized polyaniline(C-PANI). The difference in morphology and structure of the two prepared materials were studied and characterized for structure and morphological analysis by FT-IR spectrometry, X-ray diffractometry, scanning, and transmission electron microscopy. The Nano-PANI and C-PANI had a pore diameter of 84.96 and 90.86 nm which surface areas of 18.8 and 14.42 m 2 /g respectively. The prepared Nano-PANI was in emeraldine salt state; C-PANI was completely carbonized.The prepared materials were applied as electrode coating materials on the copper sheet which acted as a substrate and it produced a smooth coating. This is promising and can further be studied for electrochemical applications. Further work is ongoing to ascertain its' electrochemical capacitance properties. The method of preparation of the Nano-PANI and Nano C-PANI is eco-friendly and simple for the production of mass material for industrial purposes.
M1-0129-A	Synthesis of 2,5-Diformylfuran by using dual-functional magnetic catalyst Liang-Jung Chien, **Chin-Hung Chan** and Yicheng Wang Ming Chi University of Technology, Taiwan Abstract- 2,5-Diformylfuran (2,5-DFF) contains two rather reactive aldehyde groups and one furan ring, and this chemical can be converted into other high value-added chemicals and pharmaceutical intermediates. 2,5-DFF is one of the important products derived from 5-HMF via selective oxidation. Synthesis of 2,5-diformyfuran (DFF) from fructose is a tandem reaction that typically involves two steps catalyzed by two different catalysts, including fructose dehydration to 5-hydroxymethylfurfural (HMF) catalyzed by an acid catalyst and subsequent HMF oxidation to DFF catalyzed by a redox catalyst. To shorten reaction steps and fit economic efficiency, this research develop facile synthesis method to anchor graphene oxide (GO) and sulfonic acid on the surface of silica-coated (Fe3O4) magnetic particle to obtain a new magnetically separable and longtime stable catalyst. Various reaction conditions, including catalyst loading, reaction temperature, reaction duration and solvent, were investigated. The result was demonstrated that DFF yield of 72.3% was achieved at the mild reaction conditions (140℃) in a one pot and two-step reaction (nitrogen and oxygen). More importantly, the catalyst could be reused for several times without the loss of its significant catalytic activities.
M1-0122	High-Performance Numerical Modeling of Toxic-Free CZTS Solar Cell Structure **Tariq Al Zoubi**, Mohamed Moustafa, Ghaylen Laouini and Shadi Yasin American University of the Middle East, Kuwait Abstract- A systematic numerical study of a toxic-free CZTS solar cell model based on the

	ZnO buffer layer is numerically investigated and analyzed using the SCAPS-1D simulation platform. The proposed toxic-free CZTS model exhibits an improvement in the current density (Jsc) of about 1.41 mA/cm2 and 6.33 % in quantum efficiency (QE) compared to the conventional toxic structure. The simulation results of the eco-friendly model reveal an optimum efficiency of about 19.96 % at a bandgap energy of 1.42 eV and with absorber thickness as low as 1600 nm. It has been observed that increasing the doping level from 1015 cm-3 to 1018 cm-3 results in an efficiency enhancement of about 2.5 %. To maintain the high-performance of the device, the ZnO buffer layer must be as thin as 100 nm with a bandgap energy of 3.3 eV. The increase in buffer layer thickness above 100 nm leads to deterioration in the device performance. This might be ascribed to the increase of the recombination rate due to the increase of carrier diffusion length away from the junction at thicker ZnO thicknesses.
M1-0106	Development and analysis of a product made from pink pine nuts in the south of Nuevo León Andrea Paola Espinosa Treviño, **Maria Guadalupe Moreno Treviño**, Daniel Oliveira Galvão Do Vale, Fatima Rubio Moreno and Nancy Lucero Tapia Ruíz Universidad de Monterrey, Mexico Abstract- Nowadays one of the most evident problems in Mexico is hunger, malnutrition, and food safety, according to The Hunger Project México (2016) the 23.3% of the total population lives in poverty food, and the 12% suffer chronic malnutrition. Applying innovative tendencies and the industrial engineering, our project provides the option for the generation of a food product that is consider organic waste in this case is the "pink pine nut" this, because to its properties and benefits among which are, control in levels of fats, high protein concentration, and also fatty acids that are essential as omega 3 and 6. In addition to minerals such as Iron (Fe), Magnesium (Mg) and Potassium (K) necessary for the proper functioning of the body. This project was managed for the municipality of Aramberri located in the state of Nuevo León since the pink pine nuts are abundant in this region and wasted on a large scale.
M1-0052	Effect of the piezoelectric substrate and the gas type on the sensing behavior of the SAW based gas sensors **Mohamed Moustafa**, Tariq Alzoubi, Mostafa Elnaggar and Ghaylen Laouini The American University in Cairo, Egypt Abstract- A finite element analysis method (FEM) is utilized to investigate the response of the SAW based gas sensor with the application of different piezoelectric substrates and by exposing the device to different volatile organic compounds (VOC) gases. The analysis has been developed using the Comsol Multiphysics software. The study presents and discusses the effect of the total displacement and the shift in the working frequency of the SAW gas sensor, due to the mass loading of the VOC gas. The results show that, among the investigated piezoelectric substrates, lithium niobate substrate reports the lowest total displacement which is associated with the highest SAW resonance frequency with a value approximated to 855 MHz. While, barium sodium niobate substrate reveals the highest frequency shift with a value of 281.5899 HZ, for the Dichloromethane (DCM)

	gas. Additionally, the simulation results for the SAW sensor response under the influence of several VOCs are shown, where the reduction in the resonance frequency is used for the detection of the gas concentration. The highest frequency shift is reported for the Tetrachloroethene (PCE) with a value of about 17300.22 Hz.
M1-0056	Morphological, Optical and AC Electrical Properties of Polyaniline Emeraldine Salt/poly(vinyl acetate)/coconut shell charcoal sheets **Ma. Erika Goldamaire F. Agcaoili** and Alvin Karlo G. Tapia University of the Philippines Los Banos College, Philippines Abstract- Carbon-polymer composites are being developed for industrial applications including sensing, electromagnetic shielding and electronics among others. In this work, ground Polyaniline emeraldine salt (PAni-ES) and coconut shell charcoal (C) powder were mixed with polyvinyl acetate (PVAc). The resulting mixture was fabricated into sheets using simple casting method. The resulting air-dried PAni-ES/PVAc/C sheets were characterized using SEM for morphological studies. The SEM micrographs of the samples showed that the globular aggregates appear within the surface when PAni-ES is introduced in the sample. Also, visible light spectroscopy shows the variation of compositions of the fabricated samples. Using an impedance analyzer (20 Hz to 20 MHz), it was observed that the conductivities of the sample increase with increasing frequency and polyaniline content. The AC conductivity of the fabricated samples also exhibit universal power law behavior at which the mode of charge transfer happens hopping conduction.
M1-0132	Development of sulfonic supported acids and their application in power to gas systems **Rosanna Viscardi**, Vincenzo Barbarossa, Raimondo Maggi and Francesco Pancrazzi ENEA, Italy Abstract- Dimethyl ether (DME) is an environmentally friendly fuel that is being widely considered as an alternative fuel to replace petroleum fuels. DME can be produced by dehydration reaction of methanol by using solid catalysts in catalytic reactions. This study shows the influence of catalyst's surface acidity on the catalytic activity in the dehydration of methanol to DME. In this work, the conversion of methanol to dimethyl ether has been investigated using a continuous flow fixed-bed reactor at temperatures between 60°C and 350°C and 1 bar. Sulfonated catalysts with –SO3H acid function were tested and compared with conventional catalysts as γ-Al2O3. SiO2, MCM-41 and fluoropolymer were used as inorganic and organic supports for sulfonic groups. The experimental results demonstrate a good catalytic activity for the functionalized MCM-41 and the fluoropolymeric material. Effects of H2O on the activity and deactivation of these catalysts were also studied.
M1-0127	Development of molecular auxiliaries capable of improving coating corrosion resistance and adhesion Liangjung Chien, **Yuzhi Zhang** and Yicheng Wang Ming Chi University of Technology, Taiwan Abstract- Taiwan belongs to the subtropical monsoon climate, surrounded by the sea on

	all sides. Due to the erosion of moisture, salinity, and wind and sand, it costs a lot of money each year to protect the steel from corrosion. The most common protection method is spray coating on steel Coating to prevent external water vapor and salt ions from eroding the main steel, but the coating is only adhered to the surface of the substrate by physical coating. After prolonged exposure to sunlight, water vapor and salinity, it is easy to cause. The poor adhesion between the paint and the material causes the coating to peel off and lose the effect of corrosion protection. In order to improve the above shortcomings, appropriate additives will be synthesized to improve the corresponding molecular additives for different metal materials to enhancing adhesion as well as corrosion resistance. This research uses dual procedure to form high tolerance polyester resin by undergoing esterification reaction in 170-180oC between polyol which contain neopentyl structure and polybasic acid that contain benzene ring and use acidulant in 90-100oC to block the chain and form polyester. By way of GPC, FTIR and titration, this research discus the effect of reaction time to molecular weight and acid value. The result demonstrates molecular weight and acid value emerge contrary tendency; Acid value could be adjusted via the mount of added acidulant in the second procedure. The most appropriate molecular weight of polyester is 4000-5000 through the analysis results. Acid value could be adjusted to fit various materials and shorten reaction time as well as lower the cost. Finally, this research will also use pull adhesion testing and NORSOK M501 to normalize adhesion force. With this novel additive, it can directly be coated without pretreatment and meanwhile, enhancing adhesion as well as corrosion resistance.
M1-0150	Effect of Silica Fume and Rice Husk Silica in Bio-epoxy composites **Andres Rigail**, Ana Rivas, Clotario Tapia, Gladys Garcia and Gabriela Saavedra ESPOL, Ecuador Abstract- The plastic industry is having a rising interest in using bio-resin materials and waste materials for high performance applications. This research assessed the effect of two types of silica in the thermo-mechanical properties and curing behavior of bio-based epoxy composites. Bio-silica (BS), obtained from rice husk in our laboratories, and silica fume (SF), Aerosil 150, has been used for the development of these composites. An aliphatic epoxy resin, based on Sorbitol Glycidyl Ether (GE60), was crosslinked with two polyetheramine hardeners having oxypolyethylene (PEO) and oxypropylene (PPO) repeating units in the backbone, respectively. The bio-based aliphatic epoxy composites were prepared by a solventless procedure and were cured at room temperature. In general, the epoxy amine systems were reinforced with 3 wt% of both silicas (BS and SF). The degree of silica dispersion, thermo-mechanical properties and curing monitoring of the composites were analyzed by several techniques described in the paper. The thermal stability increased in both filled networks, but a remarkable improvement in the GE60/PEO/3BS system was observed when compared to SF composites. Besides, mechanical properties were also enhanced in the SGE/PEO/3BS system, with 25% of improvement in the Young Modulus and Tensile Strength respect to the other systems. However, the SF composites showed a more significant percentage of epoxy conversion when compared with epoxy-Biosilica networks. The higher hydrophilicity of PEO was

	relevant in terms of BS dispersion, kinetic reactions, and thermo-mechanical performance.
M1-0148	Effects of Hydration on the AC Electrical Properties of Bentonite Arvin Lester C. Jusi, Dyl C. Dalas, Elmer Estacio and **Alvin Karlo G. Tapia** University of the Philippines Diliman, Philippines" Abstract- The low frequency conductivity of bentonite was investigated using an impedance analyzer (20 Hz – 20 MHz). Pellets of pure bentonite clay was hydrated at different hydration levels. Results reveal that the AC conductivity increases with hydration of bentonite. Also, an equivalent circuit model with resistor, capacitor and constant phase elements was obtained from fitting of the Nyquist plots. The resistance of equivalent circuit components decreased with increasing hydration.

March 27, 2020

Session 4

Building Material

16:00-18:15

CAT+CON

Chaired by Asst. Prof. Shwan H. Said, Northern Technical University, Iraq

9 Presentations—

M1-0071, M1-0058, M1-0072, M1-0120

M1-0073, M1-0142, M1-0140, M1-0105, M1-0112

***Note**:

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SESSION 4

M1-0071	Permanent Deformation Behavior of Cohesive Subgrade Soils Classified as A-4a and A-6a **Mohammad Ali Khasawneh** Prince Mohammad Bin Fahd University, Kingdom of Saudi Arabia Abstract- The subgrade layer, upon which the pavement is constructed, will have a large impact on structural design. The study aims at characterizing permanent deformation properties of cohesive subgrade materials including. A new testing procedure, stage loading, was used to test the permanent deformation of subgrade materials at different stress levels and load repetitions; this technique allows researchers to explore the effect of stress history on the accumulation of plastic deformation besides saving time, effort, and test specimens. The permanent deformation results showed a constant increasing rate of plastic strain at higher stress levels. The results obtained could be used to help engineers in characterizing the cohesive subgrade materials. Statistically, soil type and water content were found to be statistically significant at the 0.05 significance level, whereas, at the 0.1 significance level stress level, soil type and water content were found to be significant factors in affecting permanent stain.
M1-0058	State-of-The-Art Developments in Light Transmitting Concrete Shwan H. Said **LiTraCon** Northern Technical University, Iraq Abstract- As the rapid population growth, many of tall buildings were established on limited areas one close to other creating huge obstacles for transmitting the natural sunlight into these buildings. The artificial illumination is not the decisive solution to overcome this problem due to the high energy consumption. After numerous of experiments conducted by engineers to imbue new and modern features on concrete, an innovative, smart and novel construction material called “light transmitting concrete” (LiTraCon) has emerged in last decade, manufactured by embedding optical fibers in concrete. The new material characterized by allowing the light to pass through itself. LiTraCon has smart properties such as energy saving, green construction material, decorative and aesthetic appearance, enhancing the daylight indoor quality of building and less carbon emission. The latest developments attained by researchers are presented and discussed in this article such as the impact of optical fibers on the mechanical properties, durability and the light transmittance ability of LiTraCon. Results showed that the mechanical properties are almost the same as the plain concrete. The optical fibers have an adverse effect on the durability. Finally, increasing the content and diameter of optical fiber enhanced the optical transmittance ability of LiTraCon.
M1-0072	Analytic Methods to Evaluate Bituminous Mixtures Enhanced with Coir/Coconut Fiber for Highway Materials **Mohammad Ali Khasawneh** and Saeed Kriem Alyaseen Prince Mohammad Bin Fahd University, Kingdom of Saudi Arabia Abstract- Most of the pavement structures, worldwide, are made with Hot Mix Asphalt (HMA) as this is one of the most economical materials available and it is also very

	suitable for different climatic conditions. However, the HMA pavement normally requires frequent maintenance and rehabilitation due to damages caused by excessive traffic loading. Therefore, one of the alternatives to minimize the damage of pavement and to prolong its service life is to use modifiers that are used in the asphalt pavements. This study demonstrates the properties of HMA mixed with coir fiber. The laboratory results reveal that coir fiber is effective in increasing the Marshall stability of ordinary HMA mixes. The coir fiber increases the Marshall stability of ordinary HMA by 41%. Consequently, coir fiber has promising potential in modifying asphalt mixtures. Additionally, comprehensive statistical analysis was carried out to validate conclusions drawn based on laboratory results. It was clearly concluded, statistically, that changing the Coir Fiber Content (CFC) has a significant effect on almost all Marshall test values.
M1-0120	Crushed concrete waste influence on dune sand mortar performance. Contribution to the valorization **Yacine Abadou**, Abderrahmane Ghrieb and Rosa Bustamante University Ziane Achour, Djelfa, Algeria Abstract- In the region of South Algeria, there is a significant presence of quality aggregates. However, excessive use of these materials can result in significant environmental impacts. For these reasons, it would be advisable to use other substitute materials such as dune sand and construction waste to preserve these resources and avoid excessive pollution of the environment. The aim of this work is to valorize the concrete waste to make it a useful material to correct the dune sand granulometry, in order to manufacture mortars with satisfactory performances in terms of consistency and mechanical strength. To obtain this objective, a methodology for the formulation of mixtures based on the progressive substitution of dune sand by the studied waste was adopted. Several tests were then carried out to examine the effect of the incorporation of waste on the main properties of the mortar fresh and in the cured state. These characteristics were compared to those of the control mortar (consisting only of alluvial sand, cement and water). The results obtained show that the inclusion of the waste used can improve the workability and compactness of the mortars studied, and increase their compressive strengths in the short and long term. Moreover, it has been observed that its incorporation induces a decrease in tensile strength.
M1-0073	The Influence of the AASHTO Rigid Pavement Design Equation Variables on the Load-Carrying Capacity of the Pavement Structure: A Parametric Study **Mohammad Ali Khasawneh** and Tamara Hussein Bani Ata Prince Mohammad Bin Fahd University, Kingdom of Saudi Arabia Abstract- The effect of design variables on the modification of traffic capacity utilized for rigid highway pavement designed by AASHTO procedure was investigated and studied. The variation in the total equivalent single axel load (ESAL) that a pavement can carry due to a change in the overall standard deviation, reliability level, serviceability index, slab thickness variation, rupture modulus, drainage coefficient, load transfer and elastic concrete and the subgrade reaction modulus ratio (Ec/K) has been inspected and examined. AASHTO rigid pavement design equation was divided into

	different simple models that introduce and explain the relation between the change in each design variable and their effect on the total ESAL to be held by roadway pavement. The sensitivity analysis was conducted for rigid pavement to understand pavement performance with the effect of design parameters as design inputs using Microsoft Excel. Based on the sensitivity analysis, rigid pavement input parameters were ranked from most sensitive to insensitive to help pavement design engineers to identify the level of importance for each input parameter. The results of the analysis showed that pavement thickness and reliability have the highest effect on pavement capacity while load transfer coefficient, overall standard deviation, coefficient of drainage, (Ec/K), present serviceability index and modulus of rupture have less effect.
M1-0142	Effect of clay loading on the water resistance of ternary-filled natural rubber composites **Clare L. Garing** and Bryan B. Pajarito University of the Philippines - Los Baños, Philippines Abstract- Water immersion was performed on 13 natural rubber (NR) composites filled with varying proportions of carbon black (CB), organically-modified bentonite (M-BNT) and raw bentonite (BNT), to determine the effect of clay loading on the water barrier properties of ternary-filled NR composites. These composites were prepared using a third-degree simplex lattice mixture design of experiment. Specimens were immersed at 80℃ deionized water for 1200 h to measure their percentage water uptake and diffusion coefficient. Results showed that mixing 2.5 phr M-BNT and 2.5 phr BNT to 10 phr of CB provides outstanding water resistance to NR composites. It improved the percentage water uptake by 25.07% and diffusion coefficient by 45.12% as compared to pure CB filler (15/0/0). However, increase in clay loading to pure M-BNT (0/15/0) and pure BNT (0/0/15) led to poor water resistance due to aggregation of fillers. But this observation is less pronounced in M-BNT due to its increased hydrophobicity as a result of organic modification. Contour plots generated from reduced hierarchical models were able to give a graphical representation of the observed results. High values of coefficient of determination with values of 95.40% and 90.15% were computed for percentage water uptake and diffusion coefficient, respectively.
M1-0140	Evaluation of thermomechanical behavior in controlled atmospheres of SiC obtained from sawdust residues of the Peruvian timber industry. **Verónica Cecilia Bringas Rodríguez**, Fredy Alberto Huamán Mamani, Janice Jamilet Paredes Paz and Jhony Frank Gamarra Delgado Universidad Católica San Pablo, Peru Abstract- The possibility of using biomass as a precursor of silicon carbide has been studied for many years. In this investigation, reaction formed silicon carbide was synthesized from sawdust residues of Peruvian wood. Residues were packed in cylindrical solid pieces by hot pressing and they were subsequently pyrolyzed and infiltrated with metallic silicon in a vacuum atmosphere. SiC pieces were obtained with silicon remaining in their porosities, so a chemical attack was performed to clean the samples. Mechanical and thermomechanical properties were evaluated in different environments

	to know the behavior of SiC through compression tests. The highest values were obtained at room temperature under normal conditions, a maximum stress of 686 MPa was achieved, in all cases the samples had a fragile behavior as expected. In thermomechanical tests it was observed that resistance decreased according to the gradual rise in temperature. Finally, tests at 500 ℃ in oxidizing, inert and reducing atmospheres showed that the SiC maintained its maximum compression stress within the range of thermomechanical tests under normal conditions, which means that this material was not sensitive to chemical changes, being stable in all tests. At present, this work continues in the investigation of thermomechanical behavior for temperatures above 1100 ℃ in different atmospheres.
M1-0105	Mercury Bio adsorption (Hg) in Aqueous solution through Mexican Coast's pelagic Sargassum Jacobo Tijerina, Daniel Oliveira, Andrea Espinosa, Gerardo Espinosa Garza, Imelda de Jesús Loera-Hernández and **María Guadalupe Moreno Treviño** Universidad de Monterrey, Mexico Abstract- This article aims to investigate the effectiveness of Sargassum in eliminating mercury in wastewater. The most toxic form of mercury is the methyl mercury, as 90% is absorbed in the body, and mercury chloride only by 2%. Current cleaning methods can be very expensive. Some adverse effects of methyl mercury include, mainly, damage to the brain and kidneys, but it can also cause nervous system disorders. The percentage of Mercury adsorbed by sargassum was analyzed, varying contact times, sargassum concentrations and particle size in microns. Several processes were used, as 4 kilos of sargassum were washed with detergent and water, dehydration techniques were applied to dry the product inside a drying oven, and pulverization was also implemented to obtain 1800 g in different particle sizes (from 100 microns to 300 microns) of product. Subsequently, solutions were prepared with concentrations of Mercury ranging from 10 to 100 ppb. To analyze the effectiveness of its adsorption, 2, 4 and 6 grams of sargassum were deposited in said solutions at contact times of 20, 40 and 60 minutes to finally calculate the decontamination rates of water by different formulas. The fatty acid profile was also analyzed for the adsorbent for a possibility of another property of sargassum.
M1-0112	Optical Sensing of Pyridine Based on Green Synthesis of Passivated Carbon Dots **Heba Elsayed,** Mohsen Ghali, Waheed Zahra and Mohamad Ayad Egypt-Japan University of Science and Technology, Egypt Abstract- Carbon dots (CDs) have been synthesized hydrothermally from fresh potatoes for the detection of pyridine. The synthesized CDs have been characterized by UV-Visible spectrophotometer, FTIR, TEM and fluorescence measurements. They have a small size of 11 nm and show a blue emission under UV excitation. The CDs were found to be passivated when mixed with pyridine, hence we utilize them as pyridine-optical sensor. The detection limit of the pyridine using our CDs reached low concentration of 0.21 µM, which is lower than the similar fluorescent sensors in literature, based on carbon nanoparticles synthesized from other sources.

March 27, 2020

Session 5

Metallic Material

16:00-18:15

EJE+FORO

Chaired by Prof. Zoubeida HAFDI, Mostefa Benboulaid Batna 2 University, Algeria

9 Presentations—

M1-0034-A, M1-0103, M1-0145-A, M1-0141

M1-0153, M1-0092, M1-0134, M1-0154, M1-0074

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SESSION 5

M1-0034-A	The formation of metallic whiskers from Sn-xBi/Ti2SnC **Yan Zhang**, Dandan Wang, Peigen Zhang and Zhengming Sun Southeast University, China Abstract- Sn whiskers has seriously haunted the electronics industry for more than half century, and lead-free, reliable mitigation strategies are much-needed. However, its growth mechanism has been elusive because of the difficulties associated with the investigations, including high randomness of the Sn whisker growth, long incubation period, poor repeatability. Consequently, developing the desirable mitigation strategies has stagnated. Herein, on a new platform of Sn-xBi/Ti2SnC (x = 0, 5, 15, 20) prepared by ball-milling, fast tin whisker growth with reliable repeatability is realized when incubated at 150 ℃ for 1h, which greatly facilitates the mechanism-seeking research. The results show that a large number of whiskers form on the surface of the samples, which are generally composed of single crystals of β-Sn, and various in morphology and size. Moreover, the growth density of Sn whiskers rises obviously with the increasing content of Bi, which might be attributed to the promoted atom mobility in the alloy. To illustrate the mechanisms behind, first-principles calculation was carried out to calculate the vacancy formation energy. The results show that the addition of Bi element contributes to a lower vacancy formation energy and thus a lower atom migration barrier. Therefore, the relationship between whisker growth density and atom migration process has been established. The present work might be beneficial for further uncovering Sn whisker growth mechanisms, thus developing a long-awaited lead-free tin whisker mitigation strategy in the future.
M1-0103	Impact of dispersion methods on the interfacial reactions, structural integrity and distribution characteristics of MWCNT in Ti6Al4V alloy **Oluwaniyi Azeez Ajiteru**, Thato Sharon Tshephe, Avwerosuoghene Moses Okoro and Peter Apata Olubambi University of Johannesburg, Republic of South Africa Abstract- In recent times, the use of carbon nanotubes (CNTs) as a reinforcement material in producing light weight titanium matrix composites (TMCs) continue to attract researchers in the field of advanced materials development. This is due to the outstanding properties of carbon nanotubes and the potentials uses of TMCs in numerous applications such as petrochemical, automobile, military, sport amongst others. Despite the utilization of carbon nanotubes as reinforcement materials in metal matrices, achieving optimal properties in the resulting nanocomposites remains a major problem. This research attempted to study the use of two distinct methods to disperse multiwalled carbon nanotubes (MWCNTs) in Ti6Al4V. 0.5 wt.% MWCNTs was blended with Ti6Al4V powders by means of (dry and wet milling) using low energy planetary ball mill. In the wet milling method, ethanol was used as the dispersant. The dispersion characteristics, phase analysis and structural integrity of MWCNTs in Ti6Al4V after dispersion was examined using characterization techniques such as scanning electron microscopy, X-Ray

	diffraction and Raman spectroscopy. The SEM micrographs indicated good dispersion in dry milling when compared to wet milling. Phase identification depicts the lack of formation of any intermetallic compound such as TiC. Additionally, the increase in (ID/IG) ratio obtained from the Raman spectra confirmed the presence of slight deformation to the C-C network in the MWCNTs.
M1-0145-A	3D printing of metallic structures using sustainable cellulose hydrogel ink **Carla Joyce Nocheseda**, Rigoberto Advincula and Alvin Kim Collera Metals Industry Research and Development Center, Philippines Abstract- There is a need for an environment friendly solutions for widespread adoption of 3D printing of metallic structures but without the use of laser beam or electron beam to locally fuse metallic particles in a powder bed. This paper focuses on the development of a cellulose based hydrogel ink for additive manufacturing of metallic structures. The metallic ink is composed of stainless steel 316L powders, a bio-compatible polymer, carboxymethyl cellulose (CMC) dissolved in deionised water. It is then added with montmorillonite clay and guar gum not only resulted in enhanced storage stability of the composite ink formulations but also had a beneficial effect on the swelling of the ink during extrusion as well as ease of removal from printing platform. The metal 3D printing method made up of the solvent cast 3D printing of metallic structures using the metallic ink at room temperature followed by thermal treatments on the as-printed structures that decompose the cellulose-based binder and sinter the steel powders, to achieve all-metal structures.
M1-0141	Effects of Harmonic Structure on the electrochemical behavior of biomedical Ti6Al4V obtained by Spark Plasma Sintering **Karla Miriam Reyes Leiva**, Bruno B. L. dos Santos, Nerio Vicente and Claudia Eliana Bruno Marino Universidad Tecnológica Centroamericana UNITEC, Honduras Abstract- Metallic implants with Harmonic Structure (HS) has been reported to perform better mechanical properties compared to traditional microstructure on several biomedical alloys. Researchers have shown mechanic improvement when obtaining this microstructure but, there is a literature gap about electrochemical behavior of this alloys related to harmonic microstructure obtainment. Thus, in this paper the HS Ti6Al4Vwas obtained by Spark Plasma Sintering in order to be compared on its electrochemical behavior to commercial alfa-beta Ti6Al4V ELI (Extra Low Interstitial), which is one of the most studied alloy for implants due to its biocompatibility and because of its good relation of the mechanical and electrochemical properties under its alfa beta microstructure. X-ray diffraction analysis was conducted to verify the morphology and microstructure of the alloys, Open Circuit Potential curves were obtained in chloride media followed by voltammetry profile analysis on simulated blood solution, finally the electrical parameters of the corrosion process was obtained using Electrochemical Impedance Spectroscopy. The results indicated that the materials presented a very

	similar electrochemical behavior with high polarization resistance, with almost no difference in the values of the curves, indicating there is no inference on the electrochemical behavior or corrosion resistance from the Ti6Al4V alloy with the harmonic structure.
M1-0153	Tool wear progression and Optimization in End milling of AISI 316 Peter Odedeyi and **Khaled Abou El Hossein** Nelson Mandela University, South Africa Abstract-The high-performance machining of difficult-to-cut stainless steel (AISI 316) demands the development and optimization of high-performance tools that can withstand tool load without compromising the surface quality of the components been produced. To justify the optimization feasibility of coated carbide tool in end milling application, a material removal and Productivity approach by evaluating the tool life under optimized cutting condition were carried out in this research work. Tool wear value of 0.174mm was achieved through optimization at low values of feed, speed and depth of cut. However, an increased feed, depth of cut and speed promised to yield better volume removed in return making tool life to be truncated faster.
M1-0092	Effect of Ammonium Persulfate on the Growth of MnO2 Nanostructures Prepared via Hydrothermal Synthesis for Supercapacitor Applications **Christian Laurence E. Aquino**, Alloyssius E.G. B. Gorospe, Bethel Faith Y. Rezaga, Romar Angelo Avila, Joshua Kae Macugay, Jomar Tercero, and Mary Donnabelle L. Balela University of the Philippines Diliman, Philippines Abstract. In this work, we present the hydrothermal synthesis of MnO2 nanostructures with various morphologies for supercapacitor applications. Varying molar ratios of MnCl2•4H2O and (NH4)2S2O8 were mixed in 15 mL of deionized water. Hydrothermal treatment was done at 120 °C for 12 h. XRD results revealed that tetragonal β-MnO2 was formed for all samples. SEM images show that at an equimolar ratio (1:1), rod-like nanostructures with diameters around 45 nm and 0.65 μm in length were formed. Increasing the ratio to 1:0.5 resulted to the formation of hollow urchin-like microstructures with rods of length and diameter of about 1 μm and 82 nm as primary structures. The average diameter of the whole urchin was measured to be around 6.7 μm. Cyclic voltammetry was employed to calculate the specific capacitance of the fabricated nanostructured electrodes at 5 mV/s scan rate. The highest specific capacitance was obtained at 1:0.75 MnCl2•4H2O to (NH4)2S2O8 ratio with a value of 87.068 F/g.
M1-0134	Silver Recovery from Waste Radiographic Films using Oxalic Acid **Mary Donnabelle Balela**, Pia Monique Rheinhardt, Nareija Najma Tanggol and Jaycee Urriquia University of the Philippines, Philippines Abstract- Silver (Ag) has countless medical and industrial applications which

	makes it an attractive area of research, particularly in the recycling and recovery of Ag from industrial wastes. Waste radiographic films contain significant amounts of Ag that can be recovered. Current methods of Ag recovery from waste radiographic films are not cost-effective and are harmful to the environment. In this work, Ag was recovered from waste X-ray films using oxalic acid as stripping solution. Factors, such as oxalic acid solution concentration, temperature, and time, were varied. XRD and SEM results confirm that Ag was recovered in its metal form. It was found that increasing the temperature, oxalic acid concentration and stripping generally improves the recovery of Ag. Reusability test confirmed that the stripping solution can be used multiple times. However, the initial Ag recovery of 68.95% decreased to 28.21 % after 3 cycles of reuse.
M1-0154	Design and Development of Magnetorheological Fluid Machine for Flat Surface Finish Odwa Myataza and **Khaled Abou El Hossein** Nelson Mandela University, South Africa Abstract- Surface finishing of glass and ceramics flats is difficult to perform using already existing traditional processes because of the brittle nature of these materials. In order to make traditional processes be able to accommodate these materials, relatively expensive aiding devices and approaches are required. The newly developed magnetorheological (MR) fluid finishing offers a solution to this problem at a relatively low cost. Magnetorheological fluids have been used in mechanical engineering applications because of the rheological behavior they possess under a magnetic field which enables the manipulation and pressure of loose abrasives on the machined surfaces and perform cutting action. This paper describes the design and development of an MR fluid machine-tool for flat surface finishing. The design presented herewith includes the design of the mechanical aspects of the ball-end tool machine and its support structure for a three-axis motion system. The objective of this study is realized based on utilizing a magnetic field, magnetorheological fluid and CNC router design to perform flat surface finishing.
M1-0074	Adsorption of Bovine serum albumin in Aqueous solution onto Multiwalled Carbon Nanotubes for Medical Application **Saowapa T. Niyomthai**, Prasit Pavasant and Pitt Supaphol King Mongkut's University of Technology North Bangkok, Thailand Abstract. Carbon nanotubes (CNTs) exhibit interesting physical and chemical properties that are useful for biomedical applications. In this work, the adsorption of bovine serum albumin by multi-walled carbon nanotubes modified with mixed H2SO4/HNO3 was investigated. The minimum time to reach adsorption equilibrium was determined to be 6 h for pristine MWCNTs and for MWCNTs with a modified surface. The maximum adsorption capacities of BSA on the pristine and treated MWCNTs were 532.56 and 771.87 mg/g, respectively. Both the Langmuir and Freundlich isotherms were well fitted to the adsorption data and could best

	describe the behavior of the adsorption process. The modified surface of the MWCNTs exhibited higher absorbability than the pristine MWCNTs because the modified MWCNTs possessed a greater surface area and large amounts of oxygen-containing functional groups. Moreover, the release characteristics of BSA with MWCNTs exhibited a relatively rapid initial release phase, followed by a phase involving a sustained release. The study could be used for prolonged drug release model in medical applications.

SESSION 6

March 27, 2020

Session 6

Polymer and Nano Material

16:15-18:30

ORATORIO+TRIBUNA

Chaired by

9 Presentations—

M1-0143, M1-0069, M1-0144, M2-0008

M1-0046, M1-0047, M1-0078, M2-0006, M1-0149

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SESSION 6

M1-0143	Influence of pre-annealing on densification, microstructure and microhardness of Spark Plasma Sintered TiO2-MnO2 composites Lesego Mmakgetjepe Mohlala, Nonhlanhla Precious Cele, **Peter Apata Olubambi** and Tien-Chien Jen University of Johannesburg, South Africa Abstract- Manganese oxide and titanium dioxide have received substantial research attention as suitable pseudocapacitors electrode materials. TiO2-MnO2 composite electrodes were fabricated using Spark Plasma Sintering technique. TiO2-MnO2 composites with 10% MnO2 AND 30% MnO2 were sintered at a temperature of 1000 °C and applied pressure of 25 MPa. To investigate the influence of annealing, the second batch of powders with similar compositions were pre-annealed at a temperature of 500°C for 5 minutes. The effect of pre-annealing on the densification, microstructures, phase transformations, and microhardness were thus investigated. The powders and compacts were characterized using Scanning electron microscopy (SEM) and X-ray diffraction (XRD). Results indicated that the microstructures, phases, densification and microhardness were influenced by the pre-annealing stage. The formation of new phases was observed in both XRD patterns and SEM micrographs. Moreover, the relative density and microhardness increased when the composites were pre-annealed prior to sintering.
M1-0069	Surface Characterization of Porous Ti-6Al-4V Dental Implant by Metal Injection Molding with Palm Stearin Binder System **N. H. Mohamad Nor**, M. H. Ismai, N. A. Abu Kasim and J.B. Saedon University Technology of MARA (UiTM), Malaysia Abstract- The osseointegration rate of Ti-6Al-4V dental implants is related to their composition and surface roughness. Rough-surfaced implants favour both bone anchoring and biochemical stability. This paper focused on the surface characteristic of highly porous Ti-6Al-4V dental implant by metal injection molding with palm stearin binder system with an addition of sodium chloride as space holder which has been established in the fabrication of porous Ti-6Al-4V. The integrated pores obtained on the dental implant provides the space for mineralized bone to growth and diffuse into the dental implant and improve the anchorage of the dental implant towards the bone and prevent dental implant loosening. The average surface roughness (Ra) of 4.62 ± 1.33 μm and 5.83 ± 1.25 μm was within the proposed ideal surface roughness of 1-10μm. In addition, the existence of lamellar of α-β phase on the surface as-polished dental implant would improve both the mechanical as well as the elastic properties.
M1-0144	Effect of Ag-Au nanoparticles reinforcement on microstructure and electrochemical properties of Spark Plasma sintered TiO2-MnO2 composites Lesego Mmakgetjepe Mohlala, Nonhlanhla Precious Cele, **Peter Apata Olubambi** and Tien-Chien Jen University of Johannesburg, South Africa

	Abstract-Transitional metal oxides such as MnO2 and TiO2 have received considerable attention as electrode pseudocapacitive materials due to their low cost, environmental friendless and excellent capacitive performance. Recent research has shown that silver and gold nanoparticles are promising reinforcements for improving the electrochemical, catalytic and optical properties of transitional metal oxides for numerous technological applications. In this study, the effect of silver and gold nanoparticle reinforcements on spark plasma sintered TiO2-10MnO2 composites was investigated. The density, phase composition, microstructure, hardness and electrochemical stability of the resulting materials are reported. Results showed that compacts reinforced with silver and gold nanoparticles have increased porosity which is important for facilitating ion diffusion from the electrolyte and increasing number of active sites. An additional intermediate phase, TiMnO3, was observed in all spark plasma sintered composites. The reinforced composites were more electrochemically and thermodynamically stable than the compacts without the nanoparticles
M2-0008	Peach Palm (Bactris gasipaes, Kunth): Pseudo-wood for Sustainable Jewelry Design **Ana Paula Pinto Pinheiro** and José Roberto Moraes d'A'meida Pontifícia Universidade Católica do Rio de Janeiro, Brasil Abstract-The stipe of peach palm (Bactris gasipaes, Kunth) provides a pseudo-wood with high mechanical properties that can be used to make numerous objects. As every timber, this pseudo-wood is a natural and renewable composite, with a lifespan limited by the degradation of its basic components. This degradation can be caused by chemical reactions or biological agents able to accelerate the process of deterioration. In this context, this study aimed to evaluate, under laboratory conditions, microstructural and biodeterioration characteristics of the peach palm pseudo-wood to evaluate its use in jewelry. The results showed the usefulness of this material for jewelry design, since it is both wear resistant and also it has an outstanding resistance to deterioration by sweat and water. Besides, polished surfaces are very nice looking and attractive.
M1-0046	A low voltage, flexible, gr43raphemeased electrothermal heater for wearable electronics and localized heating applications **Sandra Tembei**, Amr Hessein, Ahmed El-Bab and Ahmed El-Moneim Egypt Japan University of Science Technology, Egypt Abstract- Recent years have seen a rapid increase in the level of sophistication in modern day devices which has given rise to the demand for better performance in all of their components, one of which is the heating element. Two excellent approaches to this need would be to improve the materials from which these Joule's heating elements are made and the other to design improved heater geometries for best temperature distribution. In this paper, we discuss a high performance electrothermal heater prepared from laser reduced gr43raphemexide (LrGO) deposited on Polyethylene Terephthalate (PET) flexible Substrate. The

	surface morphology and structural properties of the prepared LrGO films were investigated by means of Scanning Electron Microcopy (SEM), X-Ray Diffraction (XRD) and Raman Spectroscopy (RS). Electrothermal (ET) responses of the fabricated electrothermal heaters to different driving DC voltages were studied by Infrared thermal Imagery. An electrothermal heater with a low Sheet resistance of ~ 52 Ω/□ was fabricated and it can attained a steady state temperature of up to 135 °C in only 10 seconds when a low voltage of 9 V was applied. A finite Element model (FEM) was prepared for this heater which agreed well with the experimental results. Power consumption for this heater is as low as 3 mW/Cm2, making it a suitable candidate for energy-saving applications such as wearable electronic.
M1-0047	Synthesis and characterization of natural rubber/clay nanocomposite to develop electrical safety gloves **Carlos-Eduardo Pinto-Salamanca**, Andrés Fernando Rigail-Cedeño and Martín Emilio Mendoza Oliveros Universidad Pedagógica y Tecnológica de Colombia, Colombia Abstract- This research focuses on the synthesis of natural rubber (NR)/clay nanocomposites to develop electrical safety gloves. The mixture included sulfur as a cross-linked agent, dibenzothiazole disulfide (MBTS) as catalysis of the vulcanizing processes, zinc oxide (ZnO), and stearic acid (SA) as chemical activators to control the reaction. The manufacturing process of the sample compounds was developed to evaluate the optimal processing parameters. The main criterions were the formulation quantities, temperature conditions, curing time, mixing speed and mixing time. This method allowed the absence of lumps, bubbles or pores to evaluate the texture, color, strength, and elongation in the samples. Some samples simulate a finger form and size. The NR/clay nanocomposites were synthesized, with organo-clay reinforcements in 0.5, 1 and 2 wt% fractions. The nanocomposites were characterized by different methods. SEM was used to observe the morphology and distribution of the clay in the matrix, the NR crystallinity was accessed via XRD, the main functional groups of the nanocomposite were identified by FTIR spectroscopy, and DSC distinguished the glass transition temperature.
M1-0078	3D-printing methacrylate/chitin nanowhiskers composites via stereolithography: mechanical and thermal properties **Reymark D. Maalihan**, Bryan B. Pajarito and Rigoberto C. Advincula University of the Philippines Diliman, Philippine Abstract- We report on the mechanical and thermal properties of stereolithography (SLA) 3D-printed methacrylate (MA) resins reinforced by chitin nanowhiskers (CNWs). CNWs were synthesized by acid hydrolysis of crab shell chitin and nanocomposites with 0 wt%, 0.5 wt%, 1.0 wt%, and 1.5 wt% CNWs loading were prepared by slurry compounding method. The obtained CNWs (diameter = 23 ± 5 nm, length= 253 ± 100 nm, and aspect ratio = 11 ± 3) are

	uniformly dispersed within the bulk of MA matrix at 1.0 wt% loading due to formation of hydrogen bonds between the hydroxyl and carbonyl groups of CNWs and MA. The addition of up to 1.0 wt% CNWs to neat MA enhances the tensile strength, strain at break, modulus, and maximum thermal degradation temperatures of the nanocomposites. Moreover, the incorporation of CNWs not only improves the mechanical and thermal properties, but also preserves the excellent resolution and accuracy of 3D-printed MA/CNWs nanocomposites.
M2-0006	Simulation and Optimization of a CFRP and a GFRP Floating Pontoon **Mohamed N. Lotfy**, Elsayed Fathallah, Yasser A. Khalifa and Abdelrahim k. Dessouki Military Technical College, Egypt Abstract--According to the unique mechanical properties of composite materials, the replacement of the conventional materials like steel with composite materials is increasing in all fields. The low weight / capacity characteristics of composite materials make it possible to accommodate much more loads. Because of the great importance of the floating bridges for both military and civilian purposes especially in crises, the evolution of floating bridges is necessary. The traditional transportation steel ferry is composed of floating steel pontoons to accommodate the MLC-70 (Tank load) of weight equals (63.5 t). In this study, the steel floating pontoon is replaced with composite pontoon simulated for both carbon fibres polymers and glass fibres polymers with the laminate configuration[∝° / ∝° /∝° / … ./∝°]. The finite element analysis is performed using ANSYS software. The capacity of the ferry is increased to reach (90 t) instead of (70 t). The total deformation is determined under the applied load. The failure criteria is investigated for both composite models (Tsai-Wu, Tsai-Hill, maximum stress and maximum strain). The nonlinear buckling analysis is also, investigated. The optimization process is designed and performed to get the optimum number of layers and angles orientation of the composite layers as well as possible.
M1-0149	Effect of preparation method on magnetic properties of stoichiometric zinc ferrite **Miguel A. Cobos**, Patricia De La Presa, Jose A. Jimenez, Irene Llorente, Jose M. Alonso, Asuncion Garcia-Escorial, Pilar Marin and Antonio Hernando Instituto De Magneticos Aplicado-Universidad Complutense Madrid, Spain Abstract- Zinc ferrite with general chemical composition (Zn2+)[Fe3+]2O4 has a normal spinel configuration at room temperature with Zn in (A) tetrahedral sites and Fe in [B] octahedral sites in a cubic closed packing of oxygen atoms. As in spinel ferrites the A-B super exchange interaction is much stronger than the interaction between A-A and B-B cations, the absence for this normal configuration of Fe3+ magnetic cations at A sites results in weak antiferromagnetic exchange interactions between Fe atoms at B sites, making bulk ZnFe2O4 antiferromagnetic below 10 K. It has been reported that synthesis and processing methods can have a significant

	influence on the physical properties of spinels since it can produce a metastable disordered structure. In this case, the structural formula must be written as (Zn1-xFex)[ZnxFe2-x]O4, where x represents the degree of inversion (defined as the fraction of A sited occupied by Fe cations). This redistribution of Zn2+ and Fe3+ cations leads to the onset Fe3+ - Fe3+ magnetic interaction between A-B sublattices. In this work, it has been evaluated the magnetic properties of commercial powders of zinc spinel and samples prepared by the three most common methods (ceramic synthesis, mechano-synthesis, and sol-gel). Since magnetic interactions and therefore, the magnetic properties, are determined by microstructural parameters such as the arrangement of the ions, lattice parameter and crystallite size, X-ray powder diffraction (XRD) analysis was performed in order to understand the relation between microstructure and magnetic properties.

March 28, 2020

Session 7

Materials Physics and Chemistry

09:30-12:00

Junta

Chaired by Prof. Armando Ramalho, Polytechnic Institute of Castelo Branco, Portugal

10 Presentations—

M1-0006-A, M1-0007-A, M1-0031-A, M1-0008-A, M2-0002, M1-0108, M1-0057, M1-0054, M1-0032, M1-0123-A

***Note**:

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SESSION 7

M1-0006-A	Dynamic Response Of A Suspension System Having Magnetorheological Shock Absorber With Fuzzy Logic Controller **Goutam Pohit** Jadavpur University, India Abstract- A car suspension system is intended to dampen the vibration of a car's wheel in response to a disturbance in the road. Car suspensions do this by receiving a load and dissipating it into a damper. Dampers in vehicles are generally known today as shock absorbers. Traditionally automotive suspension designs have been compromise between the three conflicting criteria's, namely, road handling, load carrying, and passenger comfort. The suspension system must support the vehicle, provide directional control using handling maneuvers and provide effective isolation of passengers and load disturbance. The primary function of vehicle suspension system is to minimize the vertical acceleration transmitted to the passenger which directly provides road comfort. There are three types of suspension system; passive, semi-active and active suspension system. Most vehicles today use the traditional passive suspension system to control the dynamic performances of a vehicle such as vertical acceleration, pitch and roll. However, the performance of a passive suspension system is inconsistent with respect to the road profiles. On the other side, some of the luxury cars use the active suspension system which rely on the ECU of the vehicle and are expensive. Semi-active suspension systems combine the positive aspects of the passive and active suspension systems to bring about better dynamic response of the vehicle. Among semi active control devices, magneto-rheological (MR) dampers are particularly interesting because of the high damping force they can produce with low power (being possible to operate with batteries), simple mechanical design and low production costs. In this work, three different car models are developed with varying suspension systems, namely, passive suspension, semi-active suspension with a MR damper predicted by the Bouc-Wen model and semi-active suspension with MR damper predicted by Fuzzy Logic controller. The parameters of the Bouc-Wen model can be changed depending on the external conditions. Keeping these values constant may not guarantee the best performance of MR damper. This is especially true when the road profile changes continuously. By updating these parameters based on the road conditions will allow the MR damper to function most efficiently. Variation of these parameters is done through fuzzy logic control. The dynamic model of the passive and semi-active suspension systems are developed in Simulink environment of MATLAB. The simulation of the dynamic vehicle models was conducted on different road profiles. The fuzzy logic control exhibited the best response in terms of stability as well as effectiveness of the system is concerned. This type of control strategy will pave the way for intelligent automotive suspension systems in the future.
M1-0007-A	Free Vibration Analysis of Axially Graded Structural Elements Incorporating

	Piezo-Layers **Anirban Mitra**, Kashi Nath Saha and Arunabha Chanda Jadavpur University, India Abstract- Functionally Graded Materials (FGM) are inhomogeneous mixtures of two or more constituent materials that exhibit continuous gradation of properties in one or more spatial directions. The gradation is obtained by varying the volume fraction of the constituents according to a desired function. The advantage of FGMs, when compared against contemporary layered composites, is that due to continuous transition there is reduction in residual and thermal stresses, stress concentration. Moreover, delamination problem is eliminated completely. Such materials also ensure high strength to weight ratio, high thermal resistance and low maintenance cost. Due to these advantages, there are various applications of graded materials in critical fields, such as, space shuttles, nuclear reactors, aircrafts, combustion chambers, chemical storage and distributions lines etc. Depending on the direction of variation of material properties, these materials can be categorized as transversely graded (variation along transverse/thickness direction) and axially graded (variation along axial/longitudinal direction). Literature review of existing research work reveals that there are plenty of papers in the field of transversely graded structural elements. However, there are relatively fewer studies considering axially graded elements and especially vibration and control of axially graded beams/plates incorporating piezoelectric layers as sensors and actuators. The present work is focused on performing a modal analysis of axially graded beams attached with piezo-patches through commercially available finite element software, ANSYS. The system is modeled with the patches bonded onto the surface of the beam/plate and appropriate material properties are supplied. Axial gradation of the structural elements is achieved by defining the material properties as dependent upon the temperature and applying it as thermal loading to the nodes as a function of the coordinate points. The objective is to determine, first of all, the natural frequencies of the system and also determine the time-displacement plots. Finally, a control strategy is implemented to reduce the vibration amplitude.
M1-0031-A	Recycling process of beryllium and beryllides as neutron multipliers for fusion applications **Jae-Hwan Kim** and Masaru Nakamichi National Institutes for Quantum and Radiological Science and Technology, Japan Abstract- A huge amount of neutron multipliers with several hundred tons are supposed to be loaded in a water coolant solid blanket system for a demonstration (DEMO) fusion reactor. These multiplying materials have been studied focusing fabrications, characterizations in specific, neutron irradiation, oxidation, and so on. The authors also have contributed to R&Ds on the neutron multipliers, including developments for the fabrication processes, characterizations, etc. and have established a novel fabrication process for the world's first beryllide pebbles [1]

	using a plasma sintering process and a rotating electrode process. Since the recycling process of the used neutron multipliers is considerably important from the viewpoint of its high cost and few reported found, R&Ds on the recycling process are indispensable. Concerning the used materials, there might be several anticipated impurities, oxygen generated from oxides on the surface, Li relating compounds (if the mixing pebble packing concepts for DEMO applications adopted [2]), and so on. Not only these impurities but also neutron-induced helium or tritium inside of neutron multipliers can exist. Accordingly taking into account all these, the recycling process should be suggested as simplified. In this presentation, the authors suggested the current processes, plasma sintering and rotating electrode process as the recycling process for removing the anticipated impurities and defects.
M1-0008-A	Experimental study on active control of a rotor-shaft system **Anirban Mitra** and Kashinath Saha Jadavpur University, India Abstract- Research in rotor dynamics is aimed at improving the understanding of rotor dynamic phenomena and improving the performance of rotating machinery. In rotor dynamics the structural modeling is generally adequate and most research is centered on fluid-structure interactions: bearings, seals, blade forces, squeeze-film dampers, active support elements, etc. It is here that the nonlinearities are concentrated. Several efforts have been put on developing intelligent condition monitoring systems with advanced practicability, sensitivity, reliability and automation. However, it is felt that experiments with active control using electromagnetic components along with various sensors, controllers, power amplifiers, actuators etc. would be useful for the users. In the present work, primary focus is on restoration of a critical speed testing set-up and to augment it with active control using piezo-electric sensors. The present work endeavors to study the dynamic characteristic of rotor system and also strives to look into active control of unwanted vibrations generated in the system. Two different control components are implemented and these are, namely, Moment Control (Axial) and Radial Control (Radial). According to the specific type of control, sensors are placed in appropriate positions (transverse to the disk for axial control and radial to the disk in radial control). Once the system is set in motion through external excitation, the signal is picked up by the sensors and sent to the controller circuit to generate the controlling signal, which is amplified and applied through a set of electro-magnets.
M2-0002	New Fatigue Life Design Approach for Metal Sheets with Discontinuities **Mohammed Algarni**, May Alashwal, Mohammed Zwawi and Bassem Felemban King Abdulaziz University, Saudi Arabia Abstract- The existing references of Wöhler data curves (S-Nf fatigue life) for fully reversed cycling loading fail to incorporate the discontinuities effect on metal sheets fatigue life. Experimental results show that the discontinuities, i.e., holes

	and notches weaken metal sheets and reduce fatigue life. The notch fatigue strength reduction factor (Kf) cannot incorporate the discontinuity effect into the fatigue life prediction models. This paper investigates a new method to study the discontinuity effect on metals fatigue life by applying the Discontinuity Stress Triaxiality (DST) factor to fatigue life prediction models. Three discontinuity geometries were studied in order to investigate the different effect of different radius. A simulation using ABAQUS FEA was used to export the stress triaxiality at the notch root element. The results show that this new method can help in predicting fatigue life for high-strength metals and metals with sharp notches, unlike the Kf factor. Also, the theoretical results show good correlation with the experimental results.
M1-0108	Thermal Flows Influence On The Change Of Temperature Stresses In Surface And Inner Layers Of Refractories Sergey Fomenko, Adil Akishev and **Sanat Tolendiuly** Satbayev University, Kazakhstan Abstract- The work is devoted to the study of the heat fluxes effect on refractory materials and the temperature stresses with a temperature gradient. These parameters were determined using experimental setup allows to investigate the micro- and -macro level structural processes of a material. Macro- and microstructural studies have shown that a heat flow intense and appeared thermal stresses can contributes to the formation of structural defects and the rupture of intercrystalline bonds. Thermal stresses and the changeable loads occurring during this process can form complex structures in the material in the form of disconnected blocks separated by pores. Electron microscopic studies of structural and phase transformations under the exposure of heat pulse fluxes showed a layer-by-layer change in the internal structure with the formation of microcracks at temperatures from 500°C to 1500°C and heating rates in the range from 5°C/min to 45°C/min. It is identified that the change of temperature stresses depends on the phase changes during thermal effect on the refractory material.
M1-0057	Development of a preliminary Finite Element Model to assess the effects of friction on the residual limb of a transfemoral amputee **Armando Ramalho**, Miguel Ferraz, Marcelo Gaspar and Carlos Capela Polytechnic Institute of Castelo Branco, Portuga Abstract- The use of numerical modelling tools allows optimizing the development of complex anatomical artefacts, such as customized prostheses for lower limb amputees. These numerical tools make it possible to characterize the interfacial interactions taking place between different parts of the prosthesis and the residual limb. This allows for understanding which rectifications and fittings having to be made on the custom design of the artificial body part without the need for manufacturing and donning prostheses. To such end, current research focused on the development of a preliminary Finite Element Model to assess the effects of friction on the residual limb of a transfemoral amputee, as the friction on the

	contact between the soft tissues, the liner and the prosthesis of the amputee is of major importance for his/her health and comfort.
M1-0054	Co-precipitation Synthesis of Mg-Al-CO3 layered double hydroxides and its Adsorption Kinetics with Phosphate(V) Ions **Yasmin Edañol**, Juan Antonio Poblador, Timothy Jemuel Talusan and Leon Payawan Jr. University of the Philippines, Philippines Abstract- Phosphorus (P) is an essential mineral nutrient in crop production. Phosphorus runoff and leaching from agricultural lands leads to eutrophication, causing hypoxia and anoxia in bodies of water. Mitigation of this problem through P removal is essential to prevent detrimental damages to the environment. In this work, Mg-Al-CO3 layered double hydroxides (LDH) were synthesized via co-precipitation method and its capacity as a potential phosphate(V) adsorbent was investigated. Analysis of various material properties of the Mg-Al-CO3 LDH was performed using Fourier transform spectroscopy (FTIR), powder X-ray diffraction (pXRD), thermogravimetric analysis (TGA), and field emission-scanning electron microscopy (FE-SEM). The adsorption behavior of phosphate(V) ions on Mg-Al-CO3 LDH was studied using spectrophotometric techniques. Furthermore, the adsorption kinetics of phosphate(V) ions on Mg-Al-CO3 LDH was found to fit the Langmuir isotherm model, following a pseudo-second order rate law. Moreover, the results suggest the adsorption of phosphate(V) ions unto Mg-Al-CO3 LDH is dependent on chemisorption.
M1-0032	Comparative Study of Hydrothermal Synthesis Routes of Zeolite A **VEGERE Kristine**, KRAVCEVICA Rita, KRAUKLIS Andrey E. and JUHNA Talis Riga Technical University, Latvia Abstract- Four different methods for zeolite A (Linde Type A; LTA) synthesis were investigated and compared. The four investigated synthesis methods were the microspheres, the metakaolin-based, the NaOH-accelerated metakaolin-based and the aluminosilicate gel-based methods, respectively. The impact of the hydrothermal synthesis temperature was studied at 60, 80 and 100 °C was studied for each of the methods. The final product (zeolite A) was characterized and compared using XRD, SEM, EDS, FT-IR and BET. The most efficient synthesis route, resulting in the purest product, was determined to be an aluminosilicate gel-based method (fourth) followed by a microspheres method (first), both being most efficient at 80 °C.
M1-0123-A	Comparative Study of Methyl Orange Removal Using Commercial MOFs (Fe-BTC, Cu-BTC, and ZIF-8) **Rana Sabouni** American University of Sharjah, United Arab Emirates Abstract- The removal of azo dye methyl orange (MO) from aqueous solutions is investigated in batch setup using commercially available metal-organic

	frameworks (MOFs) as promising potential adsorbents. The experimental work examines the removal efficiency, pH effect on adsorption, and adsorption mechanism of MO on three MOFs including Fe-BTC, Cu-BTC, and ZIF-8. The results show that at the same MO initial concentration (15 mg/L) and the same amount of adsorbent (100 mg), Fe-BTC has the highest removal efficiency of 91%, followed by ZIF-8 (63%), and finally Cu-BTC (35%). Also, it was found that the structure of Fe-BTC and ZIF-8 remained intact whereas Cu-BTC was damaged due to instability in water. Furthermore, pH effect experiments showed that Fe-BTC maintained consistent adsorption capacity over a wide range of pH suggesting that it could be a good candidate for dye removal from wastewater. In addition, the kinetic analysis of the experimental data showed that MO adsorption on Fe-BTC could be described by the Elovich model, whereas the PFO and PSO models best described the adsorption on ZIF-8. The equilibrium isotherm study revealed that the experimental data could be best described by the Langmuir isotherm model. Finally, the calculated thermodynamic parameters indicated that the adsorption process was endothermic in the case of Fe-BTC and exothermic in the case of ZIF-8.

March 28, 2020

Session 8

Metallic Material

09:30-12:15

Oratorio

Chaired by Assoc. Prof. Abdulaziz AlHazaa,

King Saud University, Saudi Arabia

11 Presentations—

M1-0005-A, M1-0053, M1-0086, M2-0005-A, M1-0111

M1-0089-A, M1-0002-A, M1-0044, M1-0033-A, M1-0124, M1-0130

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SESSION 8

M1-0005-A	Effect of casting techniques on tribological behavior of Al-SiC metal matrix composites **Shouvik Ghosh** and Prasanta Sahoo Jadavpur University, India Abstract- Aluminium based composites with ceramic reinforcements have gained acceptance in industries due to lighter weight, low cost and ease of processing. Tribological applications of such composites are quite remarkable and thus researchers around the globe have shown interest in studying the tribological characteristics, viz. friction, wear, corrosion resistance etc. The studies are mostly conducted at different applied load and sliding speed for varying volume fraction of reinforcement. In the past few decades, the researchers have concentrated their focus mainly on Al-SiC composites fabricated using different grades of aluminium alloy as base matrix. The present study evaluates the role of processing techniques on tribological behavior of Al-SiC composites. Tribological behavior of Al-SiC metal matrix composites prepared using two different fabrication techniques, viz. sand cast and squeeze cast techniques are studied in a multi- tribotester (TR-25, DUCOM, India) under dry sliding conditions and ambient atmosphere for varying volume fraction of reinforcement, applied load and sliding speed. Friction increases with increase in applied load and sliding speed and volume fraction of reinforcement. Wear test results show increased wear rates at higher load and speed, while increase in SiC volume fraction yields decrease in wear rate. Corrosion study conducted in 3.5% NaCl solution shows that squeeze cast composites have better corrosion resistance than sand cast composites. Vickers's microhardness test shows improved hardness properties for squeeze cast composites compared to sand cast ones. The microstructure study of wear tracks reveals domination of abrasive wear with minor traces of adhesive wear.
M1-0053	Characterizing a Multi-Step Spark Plasma Sintered Pure Titanium. **T. Arthur Phahlane,** M. Ramaesele Mphahlele, J. Diatta, E. Olevsky, S. Ranti Oke and P. Apata Olubambi University of Johannesburg, South Africa. Abstract- This paper investigates the effects of the single-step and multi-step spark plasma sintering (SPS) techniques and sintering pressure on densifying pure titanium powder. Four samples were densified, one sample using the single-step SPS under the sintering conditions 1200oC – 60MPa – 0min isothermal holding time. The three other samples using the multi-step SPS under the schedule 880-900-800oC at pressures 20MPa, 30MPa and 50MPa respectively with 5min isothermal holding time. The sintered samples were characterized by metallographic analysis, microhardness testing, SEM-EDS and XRD. It was found that the sample that attained the highest relative density was sintered at 1200oC. However, the samples with the highest strength were those sintered using the multi-step spark plasma sintering with the highest strength achieved for the sample sintered at sintering pressure of 50MPa using the multi-step SPS technique.

SESSION 8

M1-0086	Femtosecond laser microfabrication of micro-channels on (100) silicon surfaces **M. A. Al-Gawati**, Abdulaziz N. Alhazaa, Abdullah N. Alodhayb, Zeyad A. Almutairi and Hamad A. Albrithen King Saud University, Saudi Arabia Abstract- Surface texturing of silicon has a wide range of applications in various industries such as microelectronics and medical devices. This work aims to fabricate micro-channels on the silicon surfaces using femtosecond laser micromachining technique. Single pass of femtosecond laser wavelength of 1026 nm was focused on the surfaces by objective lens that has a numerical aperture of 0.1. Different micro channels were fabricated by different average powers (50, 100, 200, 400 mW) and different scan speeds (1, 5, 10, 20, 30, and 40 mm/s). The microstructure, dimensions, and surface roughness of the fabricated micro-channels were investigated by Field Emission Scanning Electron microscope (FE-SEM), Atomic Force Microscope (AFM). Micro-channels fabricated at low scan speed of 1mm/s has V-shape like structure and deeper compared with that fabricated micro-channels at higher speeds. In addition, micro-channels fabricated at high scan speeds of 30 and 40 mm/s has parabola like structure. It was noticed that the depth of the fabricated micro-channels increased as scan speed decreased. Laser affected areas decreased as scan speed increased. Width and depth increased with the average laser power applied. Average surface roughness (Ra) were measured to be 703 and 554 nm for the micro-channels fabricated at scan speeds 30 and 40 mm/s respectively.
M2-0005-A	Evaluation of Non-cyanide Electroplated Ag-PTFE Composite Coating for Use in Threaded Tubular Connections **Huirong Le** University of Derby, United Kingdom Abstract--Threaded tubular fittings are used in a wide variety of industries for critical applications involving fluid transfer in a pressurised or vacuum system. These fittings are made of corrosion resistant metals such as stainless steel which are desirable in corrosive operating conditions; however, stainless steel is prone to galling which can cause threads to seize, resulting in loss of productivity. To prevent this, threads are electroplated using silver (Ag) coatings which prevent galling and serve as a solid lubricant during the connection make-up process. The Ag cyanide electroplating process currently used in industry is both hazardous to human health and its wastes are detrimental to the environment. The objective of this work is to evaluate environmentally friendly self-lubricating Ag and Ag-PTFE composite coatings using a non-cyanide electroplating process against the commercially available cyanide Ag coating through the analysis of torque-angle signatures and the torque-angle slope which characterises the make-up process. Results from the experiments suggest that the non-cyanide Ag-PTFE coating is a potentially viable replacement option. Investigation and analysis of the coating performance have also highlighted potential risks of failure through poor

	lubrication during the make-up process and suggestions for improving the make-up process.
M1-0111	A numerical insight on machining burr formation: A comprehension-to-optimization approach Muhammad Asad, Hassan Ijaz, Muhammad Azhar Ali Khan, Asim Asghar yaseen, Taha Waqar and Abdul Aziz Afzal Prince Mohammad Bin Fahd University, Saudi Arabia Abstract- An insight into comprehension and optimization of exit burr formation in orthogonal machining case is presented in the work. Formation of exit burr has been simulated using a three dimensional FE based machining model. Variation of "pivot-point" (point of maximum bending stress, appearing at workpiece exit edge) location on workpiece end and its appearance with respect to tool position during cutting process has been correlated with burr formation process. To minimize the burr formation, machining process variables (including speed, feed and tool rake angle) optimization have been realized employing Abaqus®. Burr lengths at exit end along workpiece depth of cut (ap) are quantified and optimum machining parameters generating less burrs for machining of AA2024 are identified. Simulated results pertaining to chip and cutting forces are fairly matched with related experimental results in the published literature.
M1-0089-A	Joining aluminum to titanium sheets by spark plasma (SPS) technology **Abdulaziz Alhazaa** and Muhammad Shar King Saud University, Saudi Arabia Abstract- Aluminum rods were successfully joined to titanium using the process of spark plasma sintering (SPS). Initial trials to achieve the joints at 500 and 520 C were attempt but the bonds were failed. Therefore, two sets of bonding temperatures were selected (540 and 600 C) under a fixed uniaxial pressure of 20 MPa. Various bonding times were used from 5 to 60 minutes for each set of temperature. The obtained bonds were analyzed by Scanning Electron Microscopy and Energy Dispersive spectroscopy (SEM/EDS) where two distinctive layers were observed based on Ti/Al. One layer consists of TiAl3 and the other layer which is located at the aluminum side contain solid solution as revealed by X-ray diffraction. The diffusion layer and the thickness of the IMCs was toticed to increase with increasing bonding times. The shear strength was measure for the bonds and the microhardness analysis was also applied across the joint regions.
M1-0002-A	Use of electroless nickel coatings in corrosion prevention of reinforcement steel bars **Sarmila Sahoo** Heritage Institute of Technology, India Abstract- Reinforcement steel used in concrete structures suffers from pitting corrosion and chloride attacks. The present work proposes the deposition of electroless nickel coatings to provide barrier protection due to their proven

	corrosion resistance. The effect of deposition of Ni–P, Ni–P–W and Ni–P–Cu coatings on the corrosion behavior of Fe—600 grade rebars in 3.5% NaCl has been investigated with the aid of potentiodynamic polarization and electrochemical impedance spectroscopy. The corrosion potential of bare rebar was observed to be −653 mV while that of electroless Ni–P, Ni–P–W and Ni–P–Cu coatings was −436, −391 and −356 mV respectively. The corrosion current density of the rebars also decreased significantly by the application of electroless nickel coatings. Nyquist plots also revealed a bigger semicircular loop for the coated rebars. The chloride attack was severe on the bare uncoated rebar and scanning electron micrograph revealed severe cracking. On the other hand, the vulnerability of the electroless coated rebars to pitting corrosion decreased greatly.
M1-0044	Mold Design and Casting of an Impeller using MAGMASoft **Muhammad A. A.**, Khan Anwar K. Sheikh and Muhammad Asad Prince Mohammad Bin Fahd University, Saudi Arabia Abstract- The use of computer simulations has significantly increased in modern metal casting over the past few years. With these simulations, the prediction and minimization of casting defects has become very convenient without following the conventional trial-and-error method of metal casting. This study presents the utilization of simulation tools in predicting two important casting defects, hotspots and porosity. An aluminum impeller with a moderately complex geometry is selected for which the initial and modified casting layouts are simulated using MAGMASoft. Hotspots and porosity are predicted and minimized using simulations and the impeller is cast based on the modified casting layout with minimal defects. Simulations and experimental results are found to be in good agreement. It is concluded that a casting process can be accurately modeled using simulations together with defect prediction and minimization. Moreover, the predicted high quality of castings can be achieved if the process is done in a controlled manner while exactly matching the parameters used in simulations.
M1-0033-A	The beauty and the deed of silver during arc erosion of Ag/Ti3AlC2 contacts **Dandan Wang**, Wubian Tian, Jianxiang Ding, Peigen Zhang, Yan Zhang and Zhengming Sun Southeast University, China Abstract- Ag/MAX electrical contact materials exhibit excellent arc erosion resistance and thus have bright application prospects. In present work, the arc erosion behaviors of the Ag/Ti3AlC2 composite were investigated, focusing on the Ag matrix. Various morphologies of Ag like 0D nanoparticles, 1D whiskers, 2D plates and 3D spheres were observed. Chain-like and agglomerated Ag nanoparticles are found to be formed due to the evaporation and deposition process. Ag whiskers grow in and around the eroded pits, which contain mainly the TixOy phase with minor Ag. Additionally, Ag plates with an edge length/thickness ratio up to 100 nucleate and grow from nanoparticles. Moreover, the flowing or splashing of melted Ag leads to the formation of micron-sized spheres with

	nano-sized ones depositing on their surfaces. The mechanisms responsible for the various Ag morphologies, especially for nanoparticles and whiskers, are proposed and discussed.
M1-0124	The characteristics of limestone and anthracite coal as filter media in treating pollutants from groundwater Nor Azliza Akbar1, Hamidi Abdul Aziz and Mohd Nordin Adlan Universiti Teknologi MARA; /University Sains Malaysia, Malaysia Abstract- The performance of limestone and anthracite coal were evaluated for the removal of pollutants from groundwater. The physical and chemical properties of two filter materials were characterised through X-Ray diffraction (XRD), X-Ray fluorescence (XRF), field emission scanning electron microscopy (FESEM) and Fourier transform infrared spectroscopy (FTIR). XRD analysis showed that the main peaks of calcite (CaCO3) are the predominant phase of limestone, whereas quartz and graphite are the crystalline phase of anthracite coal. The presence of calcium oxide (CaO) as the major composition indicated that limestone demonstrates a good ability for cation exchange. FTIR spectrum analysis showed that the functional groups present on the limestone surface are mostly hydrophilic groups, and anthracite exhibits hydrophobic characteristic. Limestone has the potential to adsorb heavy metal pollutants, whereas anthracite has the capability to adsorb organic pollutants. Therefore, the two filter materials can be used as alternatives to remove pollutants in treating groundwater.
M1-0130	Materials Selection and Design of External Fixator Clamp for Metacarpal Fractures **Eduardo Magdaluyo Jr** University of the Philippines, Philippines Abstract- Metacarpal fractures are one of the most common types of fractures, comprising nearly 20% of emergency room visits. These types of fractures, however, are often neglected and left untreated. The lack of treatment, which usually due to high cost, may lead to deformities and disabilities for the affected patient. This study involved material selection and design of a miniature external fixator that may be easily manufactured, leading to improved accessibility and affordability. The study used Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) multi-criteria decision-making method to screen candidate materials and determine which materials were the most suitable to the desired application. For a metallic fixator, Ti6Al4V was identified to be the best material and for a polymer-based fixator, the high-density polyethylene (HDPE) was found to be the most suitable. A design was also developed to serve as a basis for prototype.

March 27, 2020

Poster Presentations

10:20-11:00

CAT+CON+EJE+FORO

14 Presentations—
M1-0019, M1-0049, M1-0139, M1-0050, M1-0125-A, M1-0095, M1-0128-A
M1-0126, M1-0113, M1-0004, M1-0096, M1-0067, M1-0003, M1-0121

M1-0019	The influence of deposition technique on oxidation resistance on different nickel superalloys **Marek Goral**, Kamil Ochal and Tadeusz Kubaszek Rzeszow University of Technology, Poland Abstract- The aluminizing is a basic method of surface protection of aircraft engine elements produced from nickel superalloys. In present article four methods of aluminide coatings deposition were used: pack cementation, above the pack/ vapor phase aluminizing, slurry, and chemical vapor deposition (CVD). The selected superalloys: Inconel 100, Inconel 713 and MAR M247 were used as a base material. The Al concentration and thickness of aluminide coatings were analyzed on as-deposited coatings. The results of cyclic oxidation test at 1100oC showed that aluminide coatings produced in low-activity CVD process was characterized by excellent corrosion resistance. It was a result of removing of impurities from coatings during low-activity CVD process.
M1-049	Tool Wear of AlCrW-based-coatings on Cemented Carbide Tools Prepared by Arc Ion Plating in Dry Cutting of Alloy Steel AISI 5120H **Tadahiro Wada** Nara National College of Technology, Japan Abstract- To improve both the critical scratch load and micro-hardness of (Al, Cr) N coating film, (Al, Cr, W)-based coating film was developed. In this study, to clarify the tool wear of the (Al,Cr,W)-based coated tool in the cutting of alloy steel AISI

	5120H, the wear progress and wear mechanism of the coating film in the cutting of alloy steel AISI 5120H using six types of (Al,Cr,W)-based coated tools were investigated. The cutting conditions were a cutting speed of 5.00 m/s, feed rate of 0.25 mm/rev and cutting depth of 0.1 mm. The following results were obtained: 1) The wear progress of the (Al64, Cr28,W8) N-coated tool was slower than that of the (Al60, Cr25, W15) N-coated tool. 2) When a (Al64,Cr28,W8)-target was used to deposit a cemented carbide with a bias voltage of -150 V, the wear progress of the (Al64,Cr28,W8)N coated tool was slightly slower than that of the (Al64,Cr28,W8)(C,N)- or the (Al64,Cr28,W8)C-coated tool. 3) The wear progress of the (Al64, Cr28, W8) N coated tool with a bias voltage of -30 V was the slowest.
M1-0139	Mechanical Properties and In Vitro Biocompatibility Evaluation of TiN/TiO2 Coated Ti6Al4V Alloy **Maria P. Nikolova**, Veselina Nikolova, Veronika L. Ivanova, Stefan Valkov, Peter Petrov and Margarita D. Apostolova University of Ruse "A. Kanchev", Bulgaria Abstract- Production of a mechanical matched and bioactive bone substitute is important for biomedical application in bone defects repair. In this paper, as-received (AR) and solution treated (ST) Ti6Al4V was coated with PVD deposited TiN/TiO2 films. The microstructure, phase composition, adhesion, and hardness of the bioactive coatings were characterized. Except near stoichiometric (200) and (220) textured TiN phase, XRD analysis revealed that the superficial TiO2 consisted of rutile and anatase with ratio 71%-29% and 85%-15% on the surface of AR and ST samples, respectively. With SEM cross-section micrographs it was measured that the thickness of the nitride and oxide was 3.3 and 0.5 μm, respectively. The scratch test showed that the coating deposited on the treated substrate exhibited ability to higher critical load (72.0±3.16 N) as opposed to that on AR substrate (43.4±1.42 N). The coating deposited on the ST substrate had higher nanohardness and elastic modulus (5.33 GPa and 145.70 GPa, respectively) than that on AR alloy (2.73 GPa and 37.70 GPa, respectively). Cell adhesion, viability, and bone mineralization of osteoblast cells were determined using adsorption, MTT assay, and microscopy. The coated samples displayed better cell attachment and cytocompatibility with no negative effects on MG63 cells. Increased cell viability by almost 100% was seen after 24 h on both coated samples relative to the bare AR alloy. After 31 days, the mineralized areas at coated ST surface were almost twice higher as opposed to the coated AR samples because of the different surface characteristics and oxide composition.
M1-050	Coupled numerical simulations of the SIMCENTER 3D for casting equipment made of grey cast iron **Marcin Drajewicz**, Piotr Cichosz and Stanislaw Rudy Rzeszow University of Technology, Poland Abstract- Since many years the global economy has been focused to constantly increase profitability. One of the ways leading to this goal is optimization. The

	optimal production process creates savings by reduction of labour, material usage, production waste or costs of poor quality. The product could be also optimized, by increasing performing parameters such durability, reliability or other specific useful features. Those days many methods of optimization is available, but the most advanced are based on the computing simulation, which are able to simulate processes and phenomena that apply to the product and allows applying its modification to maintain key parameters with reduction of cost of production. The article describes the process of preparation and running the simulation of ingot mould production process. Ingot mould is an element of a casting accessory, made of grey cast iron. Presented research was a part of a larger process aimed at extending the poured life by describing and simulating the phenomenon occurring in an element during its production and operation. The work carried in the Siemens Simcenter 3D environment and usage of the Multiphysics solver to perform coupled thermal and structural analyses.
M1-0125-A	A low friction sliding system based on ionic liquid type polymer brushes combined with molecularly smooth sheets **Toshio Kamijo**, Hiroyuki Arafune, Takashi Morinaga and Takaya Sato National Institute of Technology, Japan Abstract- Ionic liquids (ILs) are organic salts consisting of anions and cations that exist as liquids at room temperature. The ILs bear many attractive properties such as negligible volatility, low flammability, and relatively high thermal durability. These properties can be varied in a controlled fashion through systematic changes in the molecular structure of their constituent ions. Recently, some studies have been reported which aim to use the ionic liquids as a new lubricant. However, at present, most of the low friction tribomaterials using ILs are not reported. In this study, we are developing a low friction sliding system using ionic liquid polymer brush. The sliding system is a lubrication system composed of the concentrated ionic liquid type polymer brush layer (ILPB) wet with an ionic liquid and a smooth glass ball (Maximum height roughness < 3 nm) obtained by gluing the smooth glass sheet to a glass ball with UV resin. The ILPB synthesized by the surface-initiated atom transfer radical polymerization (ATRP) of ionic liquid type monomer on a silicon substrate surface-modified with ATRP-initiating groups. Combining ILPB and the smooth silica sheet has provided quite low friction coefficient values (≦ 0.001) at a sliding speed of 0.010 m/s under a normal load of 9.8 N at the same position to confirm the stability of its low frictional property. All through the 4000 friction cycles, the friction coefficient value of smooth glass ball/ILPB maintained a value of 0.003 showing that the super lubricity of polymer brushes was maintained after a long time exposure and repeated usage. In contrast the glass ball (Maximum height roughness = 220 nm) /ILPB showed an immediate increase of the friction coefficient value within the first ten cycles, even under a much lower load (0.98 N). Molecular smoothness of the facing materials of polymer brushes was clarified as being essential to achieve super lubricity on a macroscopic tribology scale.

M1-095	Theoretical Study on Anisotropic Magnetoresistance Effect for Weak Ferromagnets with a Crystal Field of Tetragonal Symmetry **Satoshi Kokado** and Masakiyo Tsunoda Shizuoka University, Japan Abstract- We derive an expression of the anisotropic magnetoresistance (AMR) ratio for weak fer-romagnets with a crystal field of tetragonal symmetry using the electron scattering theory. This the-ory is based on the two-current model consisting of a conduction state and localized d states with a spin−orbit interaction and the crystal field. The expression of the AMR ratio is related to the partial density of states of each orbital at the Fermi energy. On the basis of this expression, we investigate the sign of the AMR ratio. In addition, we analyze the experimental result of the negative AMR ratio at low temperature for a typical weak ferromagnet, bcc Fe.
M1-0128-A	Lubrication properties of double network gels composed of ionic liquids **Hiroyuki Arafune**, Toshio Kamijo, Takashi Morinaga and Takaya Sato National institute of technology, Japan Abstract- Double network (DN) gels composed of strong but brittle 1st gel and soft 2nd gel are expected as low frictional materials like artificial joints due to their high mechanical strength and low friction. Utilizing ionic liquids exhibiting negligible volatility and thermal stability as swelling agent instead of water is effective way to inhibit the solvent evaporation and provide robustness on DN gel. In this study, we synthesized ionic liquid-type double network gels and characterized their mechanical and lubrication properties.
M1-0126	An Investigation of Thickness Distribution in Single-Point Incremental Forming with Different Forming Parameter in Hot-Diped Zinc-Coated Cold-Rolled Steel **Khompee Limpadapun** and Ramil Kesvarakul King Mongkut's University of Technology North Bangkok, Thailand Abstract- Single-Point Incremental Forming (SPIF) process is a new sheet forming process for rapid prototype and small batch production. SPIF is higher formability limits than conventional sheet metal forming processes. In this paper, to study of thickness variation in SPIF with measured experimental data on Hot-Diped Zinc-Coated Cold-Rolled Sheet is studied via single-point incremental forming process. The experiment designed to study on a specimen which had been forming with SPIF process, had a frustum of a cone, a wall angles wer 4 angles 45 degree, 50 degree, 55 degree and 60 degree, had collected by measure the specimen distance along surface both length of slant and circumference. The results were slightly different of the acquired thickness on the thickness which calculated by the Sine Laws , which had been admit for prediction of thickness on SPIF. The thickness distribution on the specimens were irregular distribution. The wall angle

	60 degree was the highest varied. The Thickness distribution on the surface in SPIF process is uneven. SPIF process generates high percentage of thinning of the parts, that the percentage of thinning of frustum of a cone on wall angles 45 degree, 50 degree, 55 degree and 60 degree were maximum value of percentage of thinning in 29.48%, 35.06%, 45.02% and 53.78%. SPIF process to became surface is thinner without being fracture than conventional forming processes such as stamping or deep drawing.
M1-0113	Constitutive Modelling of LZ91 Magnesium-lithium Alloy Sheet by Uniaxial Tension Loading Tests **S.L. Zhou**, W. Liu and S.C. Fu Wuhan University of Technology, China Abstract- Magnesium-lithium (Mg-Li) alloy is a kind of ultra-lightweight metallic materials with much lower density than those of conventional magnesium alloy or aluminum alloy. Here, the mechanical behavior of LZ91 Mg-Li alloy sheet was investigated by uniaxial tension loading tests, including standardized uniaxial tension tests and plane strain tests, in which the strain field was measured by 2D digital image correlation (DIC). Firstly, the true stress-true strain curves along the rolling and transverse directions are higher than that along the diagonal direction. The Hocket-Sherby hardening model is more accurate to represent the true stress-true strain curve of LZ91 Mg-Li alloy sheet. Then, the anisotropic coefficients increase with the plastic strain increasing up to about 10%. After that, the anisotropic coefficients become stable, and the ones along the rolling and transverse directions are below 1 while the ones along the transverse direction are above 1. At last, the yielding stresses in the plane strain tests along the rolling and transverse directions were adopted instead of equi-biaxial yield stress and anisotropic coefficient to simplify the experimental procedures for parameter identification of Yld2000-2d yield function. By comparison of the predicted and experimental results, the Yld2000-2d yield function was validated to describe the anisotropic yielding behavior of LZ91 Mg-Li alloy sheet.
M1-0004	A molecular dynamics modelling adsorption study of Cu and Ag nanoparticles on pristine and functionalized graphene surfaces **Isabel Lado-Touriño**, Arisbel Cerpa Naranjo and Mariana P. Arce Universidad Europea de Madrid, Spain Abstract- The overuse of antibiotics has led to the flourishment of antibiotic-resistant bacteria and consequently to the need to develop new, more efficient pharmacological compounds. It is well known that graphene oxide (GO) doped with metallic particles exhibits broad-spectrum antimicrobial activity. In addition, in order to improve the pharmacokinetic behavior of these compounds and their solubility in biological media, polyethylene glycol (PEG) is attached to the graphene surface. Among the different available characterization techniques, molecular dynamics simulations (MD) deserve special attention, as they allow the study of different materials from a molecular point of view. In this work, MD

	simulations of the adsorption of small Ag and Cu clusters on pristine graphene and PEGylated graphene oxide (GO_PEG) surfaces were carried out. The results are presented in terms of adsorption energies, mean equilibrium distances between nanoparticles and graphene surfaces, radial distribution functions and diffusion coefficients of the metallic nanoclusters. These preliminary results show that PEGylation of the surface is critical to strengthen the interaction between the surfaces and the metallic clusters, which, in turn, is a key factor for improving the efficacy of these compounds.
M1-0096	Effects of AlN on the Reactive Sintering of Porous Al2TiO5 Composites **Mettaya Kitiwan**, Mongkol Kongsak, Duangduen Atong and Yoshito Wakui King Mongkut's Institute of Technology Ladkrabang, Thailand Abstract- The porous Al2TiO5/Al2O3 composites were fabricated by reactive sintering at 1500–1700 C in nitrogen atmosphere. The staring materials Al2O3 and TiO2 were mixed in an equimolar ratio and the addition of AlN was 5–40 mol%. The effects of AlN content and sintering temperature on phase composition, linear shrinkage, pore sized distribution, porosity and microstructure were investigated. The XRD results showed that the composites mainly consist of Al2TiO5 while the peak intensity of Al2O3 increased with AlN content. The median pore sizes decreased with increasing AlN content and were in the range of 2–6 m, 1–2 m, 0.4–0.7 m, and 0.3–0.5 m for composites using 10, 20, 30, 40 mol% AlN, respectively. The porosities of ATN10 and ATN20 were from 20% to 10% at 1600 C to 1700 C while the porosities of ATN30 and ATN40 were almost constant in between 11 and 13%. The addition of AlN effectively decrease the grain size of Al2TiO5 and led to reduce microcrack at the grain boundary.
M1-0067	Study on evolution law of lateral thickness difference of Polymer-coated steel in laminating process **Jiyang Liua**, Qingdong Zhang, Libo. Geng, Boyang. Zhang and Liyuan. Zhang University of Science and Technology Beijing, China Abstract- In order to meet people's requirements for materials saving and environmental protection, the metal packaging industry has proposed a new functional composite material: the polymer-coated steel, which is designed to replace the tinplate in the traditional packaging industry. In this paper, the three-dimensional contour of the TFS surface was measured by a white light interference three-dimensional shape analyzer and the endothermic exothermic curve during PET heating was measured by TG-DSC. The numerical simulation model of the laminating roll-PET-TFS is established according to the difference of the transverse melting thickness of the polymer film during the laminating process. The numerical results showed that the difference of the transverse melting thickness of the PET film gradually decreases with the increase of the initial temperature of TFS and the increase of the filming speed. The optimum film temperature range is found according to the transverse melting thickness difference of PET film. The model of optimum laminating temperature and

	allowable laminating temperature is established. The optimum process parameters are proposed to control the thickness difference of the film transverse melting with the initial temperature of TFS is 628.15 K and the laminating speed is 100 m / min.
M1-0003	Development of High Efficiency CZTS Solar Cell through Buffer Layer Parameters Optimization Using SCAPS-1D **Shadi Yasin**, **Ziad Abu Waar** and Tariq Al Zoubi American University of the Middle East, Kuwait Abstract- In this paper, numerical modelling and simulation using SCAPS-1D software have been carried out in order to investigate the effect of different buffer layers (CdS, CdSe and CdTe) on the efficiency of Cu2ZnSnS4 (CZTS) solar cells. The photovoltaic properties (open-circuit voltagM1-0044e (VOC), short-circuit current density (JSC), Fill Factor and Efficiency) have been studied at 300 K and under "AM 1.5 spectrum and one sun" by varying the thickness of the buffer and absorption layers, and the operating temperature. We found that the photovoltaic parameters of the solar cells are affected by the thickness change. Increasing the operating temperature has shown a negative effect on the solar cell performance, and the efficiency for all structures has been decreased with increasing temperature. At the optimum simulation parameters for all solar cell structures (50 nm buffer layer, 2000 nm CZTS absorber layer and operating temperature of 300 K), efficiency of 28.41%, 28.32% and 28.43% has been achieved for CdS, CdSe and CdTe, respectively. The present results can be considered as an important guideline for the fabrication of high-efficiency CZTS solar cell.
M1-0121	Study of strength and deformation properties of the composite reinforcing bar from the continuous basalt fiber **Stupishin L.Yu.**, Emelyeanov S.G., Savelyeva E.V. and Moshkevich M.L. 305040, 50 Let Oktyabrya, Russia Abstract- Composite structures require the use of modern reinforcing materials combining high strength characteristics and resistance to aggressive influences with low weight. One of the promising materials for the production of reinforcing products is basalt roving. The high strength of the thread in combination with fragility imposes certain limitations on its placement in the material, and requires new approaches to the design of the reinforcing bar itself. The article investigates the strength characteristics of a composite reinforcing bar made of a basalt complex thread proposed by the authors. The features of the test procedure and the mechanical characteristics of the reinforcing material are described. The effectiveness of the applied test method developed in the process of testing reinforcing rods is shown. An increase in the tensile strength of a composite reinforcing bar based on basalt fiber is established in comparison with products from fiber and roving.

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