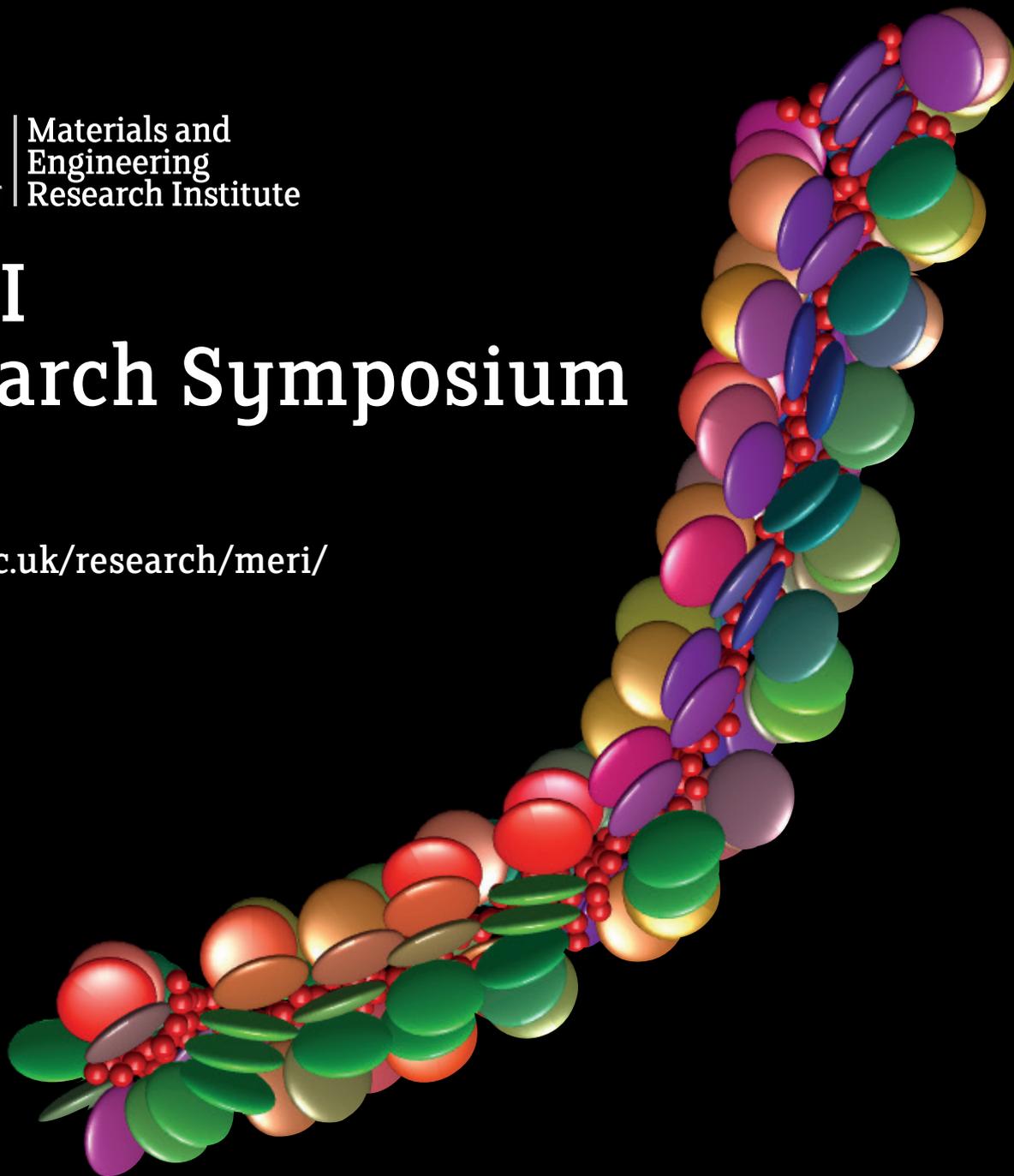


**Sheffield
Hallam
University** | Materials and
Engineering
Research Institute

MERI Research Symposium 2016

www.shu.ac.uk/research/meri/



Welcome

It gives me great pleasure to welcome you all to the 6th Annual Materials and Engineering Research Institute (MERI) Research Symposium. This year, for the first time, we are also publishing extended abstracts from all of the presentations made at the symposium.

For many of our postgraduate researchers this will be the first time that they have experienced the process of writing a research article for publication and receiving feedback from a panel of expert referees. I hope this has been a positive and supportive experience for them and that it will equip them to approach external journals and conferences with confidence in the future as their careers develop and flourish.

Since last year's symposium we have been fortunate to have welcomed a number of high profile VIP visitors to our newly refurbished research laboratories. The feedback, without exception, from all of these has been how impressed our visitors have been with the quality of the facilities, the expertise of the staff, the commitment and enthusiasm of the

PGR's and how far reaching and "cutting edge" the research activities are.

As always, this year's symposium brings together colleagues from across MERI and the Department of Engineering and Mathematics. I hope it will provide an opportunity for staff, who are either active researchers or who are interested in engaging in research, to meet in a supportive, collaborative environment to discuss current research projects, research proposals and act as a catalyst for new ideas.

I do hope that you enjoy the event.



A handwritten signature in black ink, appearing to read 'Alan J Smith'.

Professor Alan J Smith
CEng, CSci, FIMMM, PhD
Director, Materials and
Engineering Research Institute

Cover image: Smarties Snake

This image shows a double helix which has freely self-assembled in a molecular dynamics simulation of a mixture of simple disc-shaped and spherical particles. Small molecules form tubular, twisted and fibrous structures in numerous natural and manufactured systems - our simulations show how such structures grow and can be controlled.

Winning image by Alireza Dastan (MERI PhD Student)

DAY ONE - Tuesday 17th May

Time	Location	Event	Title	Speaker
9.30	Cantor 9130	Welcome		Prof Alan Smith
Session 1 - Chair Prof Chris Breen				
9.40	Cantor 9130	Talk 1	The role of engineering design in robotics	Dr Giuseppe Carbone
10.00	Cantor 9130	Talk 2	Analysis of bone vibration signals in order to screen fracture	Ridita Ali
10.20	Cantor 9130	Talk 3	The effects of d' metal ion doping on the optical properties and structure of soda lime silica glasses for photovoltaic applications	Ben Allsopp
10.40	Cantor 9130	Talk 4	Time series analysis and macroeconomic effects of oil price fluctuations in Nigeria	Rabia Awidan
11.00	Cantor Atrium	Break		
Session 2 - Chair Dr Nick Farmilo				
11.20	Cantor 9130	Talk 5	Development of the information fractal system to implement JIT inventory concept based on centralised VMI in the supply network	Ramin Bahadori
11.40	Cantor 9130	Talk 6	Influence of deposition parameters on defect growth in CrN/NbN coatings produced by combined HIPIMS and UBM technique	Barnali Biswas
12.00	Cantor 9130	Talk 7	Heat recovery in the food industry	Dr Peter Weston
12.20	Cantor 9130	Talk 8	Development of computer simulations of the emergent non-Newtonian viscosity behaviour of emulsions	Kallum Burgin
12.40	Cantor 9130	Talk 9	Piezoelectric-to-electrostrictive crossover in promising photovoltaic ceramics $(1-x)\text{KNbO}_3-x(\text{Ba}_{0.5}\text{Bi}_{0.5})(\text{Nb}_{0.5}\text{Zn}_{0.5})\text{O}_3$	Cristina Pascual Gonzalez
13.00	Cantor Atrium	Lunch and poster viewing session		
Session 3 - Chair Prof I M Dharmadasa				
14.00	Cantor 9130	Talk 10	Computer simulation of fibre self-assembly: the effect of seeding	Alireza Dastan
14.20	Cantor 9130	Talk 11	Simulation enabled framework for improving supply chain performance	Mukhtar Elbereqli
14.40	Cantor 9130	Talk 12	Test rig for ultrasonic monitoring of accelerated corrosion of steel samples	Dr Alexander Kalashnikov
15.00	Cantor 9130	Talk 13	Development of an intelligent robotic rein for haptic control and interaction with mobile machines	Musstafa Elyounss
15.20	Cantor 9130	Talk 14	The effect of composition on the physical and mechanical properties of injectable hydrogels	Abdusalam Essa
15.40	Cantor 9130	Talk 15	Effect of microwave curing on bond strength of patch repair with concrete substrate	Shahriar Abubakri
16.00-18.00	Break until Professorial Lecture (poster judging for Judging Panel)			
18.00	Cantor Atrium	Refreshments prior to the Professorial Lecture		
18.30	Cantor 9130	Inaugural Professorial Lecture (places must be booked for this event)	Light, colour, displays and the science behind the screen	Prof Wayne Cranton
19.30	Cantor Atrium	Wine and nibbles		
20.15		Close		

DAY TWO - Wednesday 18th May

Time	Location	Event	Title	Speaker
Session 4 - Chair Prof Doug Cleaver				
9.40	Cantor 9130	Talk 1	The journey to the uncanny valley of robotics through culture, age and religion	Enohor Igbeyi
10.00	Cantor 9130	Talk 2	The building performance gap – some Sheffield case studies	Dr Holly Castleton
10.20	Cantor 9130	Talk 3	A new class of ionogels as electrolyte for solid-state supercapacitors	Ronak Janani
10.40	Cantor 9130	Talk 4	On the road towards self-organising robots	Alexander Lukash
11.00	Cantor Atrium	Break		
Session 5 - Chair Prof Papken Hovsepian				
11.20	Cantor 9130	Talk 5	Key factors affecting the corrosion protection performance of sol-gel coating on mild steel	Abubakar Mohammed
11.40	Cantor 9130	Talk 6	Magnetic fault current limiter	Asmaiel Ramadan
12.00	Cantor 9130	Talk 7	Design of an innovative building configuration	Dr Michele Trancossi
12.20	Cantor 9130	Talk 8	Inertial measurement techniques for analysing patterns of human movement	Harriet Nwaizu
12.40	Cantor 9130	Talk 9	Life after a PhD – Entering the world of Additive Manufacturing	Dr Emma Ashcroft
13.00	Cantor Atrium	Lunch and poster viewing session		
Session 6 - Chair Dr Reza Saatchi				
14.00	Cantor 9130	Talk 10	Next generation solar cells based on electrodeposited semiconductors	Ayotunde Ojo
14.20	Cantor 9130	Talk 11	Using mössbauer spectroscopy to develop improvised catalysts and batteries	Alex Scrimshire
14.40	Cantor 9130	Talk 12	Durability properties of an alkali activated cementitious material	Olalekan Ojedokun
15.00	Cantor 9130	Talk 13	Design strategy of microstructured material spray processing for optimal function preservation	Dr Bipro Dubey
15.20	Cantor 9130	Break		
Session 7 - Chair Dr David Asquith				
15.40	Cantor 9130	Talk 14	Lead-free piezoelectrics for actuators	Dr Antonio Feteira
16.00	Cantor 9130	Talk 15	Renewable power generation opportunities in Malaysia	Dr Feroz Kabir
16.00	Cantor 9130	Close of event and prizes		



GIUSEPPE CARBONE

Senior Lecturer
Centre for Automation and Robotics Research

The Role of Engineering Design in Robotics

Nowadays, robotic systems can be seen as a wide integration of multiple disciplines including, among others, mechanics, electronics, computer science, control and measurement theory. Some of the above disciplines have been quickly evolving in the last decades giving great impulse to the growth of Robotics. Nevertheless, mechanics and engineering design still play a key role for achieving novel generations of robots aiming at new challenging applications, for example, in the emerging fields of service robotics. Accordingly, some examples will be outlined to clarify the significance of mechanics and engineering design in Robotics also by focusing at low-cost user-friendly solutions.



RIDITA ALI

Supervisor: Dr L Alboul
Centre for Automation and Robotics Research

Analysis of bone vibration signals in order to screen fracture

A non-invasive system has been developed to distinguish between fracture and sprain in human bone(s). A computer controlled small tapper was used to induce bone vibrations and a piezoelectric sensor was placed on wrists to detect the signals. The vibration data were processed and results were assessed using a combination of methods on 13 participants with 3 having confirmed (by X-ray) wrist fractures. The injury types for all cases were determined accurately using Fuzzy C-Means Cluster Analysis. A larger recruitment of patients is needed for evaluating the accuracy of the techniques used.

Mini Profile

CARBONE Giuseppe has received his PhD from University of Cassino and South Latium, Italy. He has carried out several periods of research abroad such as in Germany, Japan, Spain, and China. His research interests include stiffness of multibody robotic systems, robotic hands and grippers, mechatronic designs, design of experimental test-beds. He has published more than 250 peer reviewed papers on the above-mentioned topics.

Mini Profile

Ridita's research interests are on applications of electronic systems in the medical field. In addition, she serves as an Associate Lecturer and is an active member of the IET.



BENJAMIN ALLSOPP

Supervisor: Dr P Bingham
Consultancy

The effects of d^0 metal ion doping on the optical properties and structure of soda lime silica glasses for photovoltaic applications

A series of $\text{Na}_2\text{O-SiO}_2\text{-CaO}$ glasses containing low doping concentrations (0-0.2 mol%) of d^0 transition metal oxides was prepared by a melt quenching technique. Such materials may be suitable material for photovoltaic applications as they have been demonstrated to fluoresce under excitation from UV light to give intense visible emissions. Initial analyses using UV-Vis-NIR optical absorption spectroscopy and fluorescence spectroscopy, in conjunction with FT-IR and Raman spectroscopy, XRF and XRD, have been used to investigate the optical and structural properties of these glasses. Initial results will be presented here.



R. H. AWIDAN

Supervisor: Dr P Ezepue
Centre for Automation and Robotics Research

Time series analysis and macroeconomic effects of oil price fluctuations in Nigeria

Oil price is a vital indicator of economic development for the economies of different countries especially, oil-producing countries like Nigeria. Since the oil crisis in 1973 energy and oil prices have usually fluctuated more than prices of other commodities. Oil price fluctuations (also referred to as volatility) influence investors' decisions in oil-related investments, including portfolio allocations and risk management.

This research investigates the dynamic behaviour of crude oil prices and the link between oil price and selected macroeconomic indicators in Nigeria over the period 1999-2014,

which encompasses some banking and financial reforms starting from 2004 and the 2007-2008 global financial crisis, uses appropriate time series and econometric models to accurately understand, model, and predict oil price fluctuations in different parts of a study period.

Mini Profile

My research consists of development of new glass compositions with enhanced optical properties for the PV module industry. I graduated from the University of Huddersfield with first class honours in an MChem degree in 2014.

Mini Profile

I have a Masters in Statistics from Tripoli University – Libya. My doctoral research is focused on statistical modeling by relying on time-series analysis techniques.



RAMIN BAHADORI

Supervisor: Prof. S Saad
Centre for Automation and Robotics Research

Development of the information fractal system to implement JIT inventory concept based on centralised VMI in the supply network

The aim of this research is to implement Just-in-time (JIT) inventory concept in the supply network using centralised Vendor-Managed-Inventory (VMI) based on a new proposed Information Fractal System (IFS). The new IFS consists of top level fractal, mainly to represent manufacturers information and the bottom level fractal to represent the centralised VMI's information. Each information fractal structure consists of five functional models namely; observer, analyser, resolver, organizer and reporter. The Proposed IFS and its mathematical presentation are implemented in a hypothetical supply network and validated using Supply Chain

GURU Software. The results demonstrated that the application of the proposed IFS facilitated the determination of the optimum replenishment stock cycle and the optimum delivery frequency and most importantly achieving the lowest logistic cost.



BARNALI BISWAS

Supervisor: Prof P Hovsepian
Thin Films Research Centre

Influence of deposition parameters on defect growth in CrN/NbN coatings produced by combined HIPIMS and UBM technique

The enhanced corrosion and wear resistance properties of CrN/NbN nano-scale multilayer PVD coating made it a potential candidate for both industrial and biomedical devices. However, it has been shown that the coating surface morphology was never perfect; pin-holes, pores and nodular defects were observed. These growth defects cause serious problems in the mentioned applications.

In this study several analytical techniques (XRD, SEM, AFM, OM, FIB, Potentiodynamic polarisation measurement) were employed to investigate the coating defect density as a function of the deposition parameters (time, bias

voltage and deposition pressure). The results have been used for the first time to create a comprehensive classification of the different types of imperfections most commonly observed on a coating surface and link this to coating performance.



Mini Profile

Ramin was born in Shiraz, Iran and received his BS in Industrial Management from PGU, IRAN and MSc degrees in Logistics and Supply Chain Management from SHU, UK in 2010 and 2014 respectively. His research interest is the development of frameworks for configuring fractal supply network and logistics capabilities.



Mini Profile

I have an MSc Degree in Physics from Indian Institute of Technology Guwahati where I also worked as a research fellow. Since May 2014, I am studying a PhD in the area of PVD coatings.



DR PETER WESTON

Postdoctoral Research Assistant
Polymers, Nanocomposites and Modelling Research Centre

Heat recovery in the food industry

Improving energy efficiency is a key driver for the food industry to promote both economic growth and environmental performance. Every day, recoverable waste heat from ovens and fryers is simply exhausted and lost to atmosphere. This talk highlights the potential opportunities for recovering waste heat, reviews existing technologies and explains the issues which make the challenge more difficult than it may sound.



KALLUM BURGIN

Supervisor: Dr T Spencer
Polymers, Nanocomposites and Modelling Research Centre

Development of computer simulations of the emergent non-Newtonian viscosity behaviour of emulsions

Computational models have been developed to allow emulsion flow simulations conducive to the study of their rheology. Emulsions exhibit complex flowing behaviour, including shear and concentration dependant viscosities. Explicitly modelling the particulate behaviour of the emulsion we have been able to determine the viscosity and self-diffusivity of such fluids which enables the development and evaluation of accurate macroscale models. These models are of keen interest to the food industry due to the widespread use of emulsions in products such as mayonnaise, milk, and beer. By developing more accurate models for

these fluids, greater control over them can be exerted during design and manufacture, not only increasing efficiency but providing more consistent end products



Mini Profile

Peter was awarded a PhD from the University of Sheffield in 2014 for his work on tar destruction in biomass gasification. He then worked as a consultant in the bioenergy and energy from waste sectors before joining the National Centre of Excellence for Food Engineering at Sheffield Hallam. His current work is focussed on developing advanced heat recovery systems for the food industry.



Mini Profile

I am a second year PhD student at MERI having previously got my Maths degree at SHU too. My research concerns computer simulations of fluid flow. I enjoy travelling, games, and all kinds of technology.



CRISTINA PASCUAL-GONZÁLEZ

Supervisor: Dr A Feteira
Structural Materials and Integrity Research Centre

Piezoelectric-to-electrostrictive crossover in promising photovoltaic ceramics



Ferroelectric KNbO_3 -based materials have attracted attention due to their potential use in photovoltaic applications. First principle calculations predicted ferroelectricity in $0.75\text{KNbO}_3-0.25(\text{Ba}_{0.5}\text{Bi}_{0.5})(\text{Zn}_{0.5}\text{Nb}_{0.5})\text{O}_3$. The $(1-x)\text{KNbO}_3-x(\text{Ba}_{0.5}\text{Bi}_{0.5})(\text{Nb}_{0.5}\text{Zn}_{0.5})\text{O}_3$ ($0 \leq x \leq 0.25$) solid solution was prepared and a piezoelectric-to-electrostrictive crossover was observed around $x=0.05$. An electrostriction coefficient of $0.04\text{ m}^2/\text{C}^2$ was measured for $x=0.15$. A band gap of 3 eV was measured for $x=0.25$, however this composition is neither ferroelectric nor polar.



ALIREZA DASTAN

Supervisor: Prof. D Cleaver
Polymers, Nanocomposites and Modelling Research Centre

Computer simulation of fibre self-assembly: the effect of seeding

There are many real-world systems in which the spontaneous formation of fibres plays a key role. Among these, the self-assembly of amyloid fibres is believed to be key to the onset of certain degenerative diseases. Here, we particularly focused on the effect that introducing a small template or seed has on the temperature dependence of the fibre self-assembly from discotic building blocks. The results from molecular dynamics simulations showed that the fibre-formation temperature is raised by the presence of a seed which can act as a template for the aggregation. This is consistent with other researchers' findings which link onset of some

infectious diseases to the ingestion of amyloid fibres.



Mini Profile

I am a full time PhD student at Sheffield Hallam University. My research interests are in ferroelectric materials for solar energy harvesting. I was awarded a BSc in Physics from the Universidad Complutense de Madrid (Spain) and an MSc in Fuels and Renewable Energies for the Future (Spain).



Mini Profile

Born and grew up in Fasa, a small city in the South of Iran, and graduated in Mechanical Engineering (BSc. and MSc.) from my home country. I have always been fascinated by computers and I came to the UK in 2014 to do a PhD and see what else I can take out from silicon chips!



MUKHTAR ALI ELBEREGLI

Supervisor: Prof. T Perera
Centre for Automation and Robotics Research

Simulation enabled framework for improving supply chain performance

Supply chain design is a complex process and often multiple solutions exist as different supply chain capabilities can be used to meet customer demand.

In 2009 Roland Berger Strategy Consultants reported that 40% of 234 companies have wrong priorities in Efficiency vs. Responsiveness. Moreover in 2014 PwC & APICS indicated that 76% of 500 supply chain executives pointed sustainability as an important aspect in their companies.

Therefore, this research aims to design and develop an integrated and simulation enabled framework involving efficiency, responsiveness

and sustainability dimensions to improve the design of supply chain using Supply Chain Guru software.



DR ALEXANDER KALASHNIKOV

Senior Lecturer
Structural Materials and Integrity Research Centre

Test rig for ultrasonic monitoring of accelerated corrosion of steel samples

Design and experimental evaluation of a test rig for ultrasonic monitoring of steel samples are presented. In order to accelerate and quantify corrosion, the monitored sample acts as an anode in a typical constant current electroplating setup. An Arduino-compatible microcontroller is used to log the relevant voltage and current values to an SD card, and high accuracy ultrasonic waveform acquisition instrument is used to record the echo waveforms. Experimental assessment of the designed rig confirmed that the rig met the design objectives and could be used for experimental studies of accelerated corrosion in steel samples.



Mini Profile

My research focuses on design and development of an integrated and simulation enabled framework involving efficiency, responsiveness, and sustainability dimensions to improve the design of supply chain.



Mini Profile

Before joining Sheffield Hallam University as a senior lecturer in embedded systems, Dr Alexander Kalashnikov (DSc SMIEEE PhD) worked at Odessa National Polytechnic University (USSR then Ukraine), Loughborough University and Nottingham University. His research interests include ultrasonic instrumentation and internet of things (IoT). The reported project is being developed in collaboration with colleagues from Nottingham University.



MUSSTAFAMIR ELYOUNNSS

Supervisor: Dr A Holloway
Centre for Automation and Robotics Research

Development of an intelligent robotic rein for haptic control and interaction with mobile machines

The rescue services face numerous challenges while entering and exploring dangerous environments in low or no visibility conditions and often without meaningful auditory and visual feedback. In such situations, fire-fighters may have to rely solely on their own immediate haptic feedback in order to make their way in and out of a burning building by running their hands along the wall as a means of navigation. Consequently the development of technology and machinery (robots) to support exploration and aid navigation would provide a significant benefit to the search and rescue operation. This project will investigate how to design a haptic robotic rein, inspired by the

previous studies of the communication between people with impaired visibility/blind and guide dogs



ABDUSALAM SAAD ESSA

Supervisor: Prof. C Sammon
Polymers, Nanocomposites and Modelling Research Centre

The effect of composition on the physical and mechanical properties of injectable hydrogels

Injectable hydrogels are an attractive proposition for the regeneration of a broad range of tissue types within the body. Work in MERI has been undertaken to develop a range of injectable hydrogels based on pNIPAM-Laponite nanocomposites incorporating a different copolymers. It is understood that successful regeneration of tissue depends on a number of synergistic factors, one of which is the mechanical properties of the hydrogel matrix. In this study we have examined the effect of hydrogel composition on mechanical properties, intrinsic porosity, alongside hydration and dehydration behaviour by modifying the crosslink density, the copolymer type and concentration.



Mini Profile

I have worked in many higher institutes as a lecturer assistant, and now I teach in the high institute of engineering professions Tripoli-Libya



Mini Profile

I am a lecturer, I did my masters at Libyan academy. My hobby is writing short stories, which may help me to create a nice interesting story about hydrogel.



SHAHRIAR ABUBAKRI

Supervisor: Prof. P Mangat
Structural Materials and Integrity Research Centre

Effect of microwave curing on bond strength of patch repair with concrete substrate

This paper investigates the effect of microwave curing on the bond strength between commercial repair materials and a concrete substrate after 28 days age. The investigation was carried out at different ambient temperatures to simulate the variation of the temperature on construction sites. The bond between repair and substrate were assessed by conducting an indirect tensile splitting test. Results show that microwave curing can be successfully used to cure concrete and patch repair without negative effects on the repair/substrate interfacial bond strength at 28 days age. In addition, it provides significantly higher bond strength for repair carried out at freezing temperatures.



PROF WAYNE CRANTON

Assistant Dean, Research, for the Faculty of Arts, Computing, Engineering and Sciences
Thin Films Research Centre

Light, colour, displays and the science behind the screen

The electronic display has become our primary interface for work, entertainment and communication. Through the screens of our smartphones, tablets, desktop computers, e-books and interactive televisions, we are increasingly dependent upon the performance of visual display interfaces to undertake our daily tasks, communicate with each other and to consume information and entertainment.

Drawing on his own anomalous perception of colour as an example, Wayne Cranton will discuss how the science of light and its interaction with materials has been used to develop technologies for display systems and how this relates to the capabilities

of human vision and perception. The lecture will explore some of the key areas investigated by Wayne and his collaborators over the past 20 years, including light emitting thin films, display device engineering, and novel techniques for the next generation of transparent and flexible electronics.



Mini Profile

I graduated with MEng Mechanical Engineering degree from Sheffield Hallam University. My research interest is in microwave curing of concrete repair.



Mini Profile

Wayne Cranton is the Assistant Dean, Research, for the Faculty of Arts, Computing, Engineering and Sciences at Sheffield Hallam University. His research is concerned with the study of thin film materials for electronic displays, sensors, and light emitting devices. This has involved a number of collaborative applied research and development programmes on the deposition and processing of phosphors, dielectrics, and metal oxide semiconductors, with recent emphasis on the localised photonic processing of materials for low temperature fabrication of flexible electronics and displays. Additional research includes the characterisation of visual interfaces.



ENOHOR O IGBEYI

Supervisor: Dr L Alboul
Centre for Automation and Robotics Research

The journey to the uncanny valley of robotics through culture, age and religion

This research is intended as a step-by-step introduction into the underlying factors behind these reactions by focusing on the psychology of the uncanny valley and discussing what psychological principles might underlie its existence. With this in place we can look at falling into the uncanny valley not from the usual perspective of ever more realistic artefacts, but instead from the viewpoint of how normal human activity (Frank E Pollick, 2014) (being factors that tailor our ways of existence culture, age and religion) might be modulated to fall into the same uncanny valley.



DR HOLLY CASTLETON

Lecturer in Mechanical Engineering
Polymers, Nanocomposites and Modelling Research Centre

The building performance gap – some Sheffield case studies

An overview of my recent research into building energy performance, with a focus on two 'low carbon' office buildings in Sheffield in the context of the 'building performance gap'. In the majority of cases when (if) a new building is revisited/monitored after it is completed and handed over to the client – it consumes considerably more energy than was predicted before it was operational. Clearly this is an issue that needs to be addressed if we are to realise energy and carbon reduction targets.

Mini Profile

Having a natural affinity for situations / products that seem impossible, I found myself being constantly inquisitive about the uncanny phenomenon.

Mini Profile

I joined the Department of Engineering and Maths about 6 months ago, from Sheffield School of Architecture (SSoA) at the University of Sheffield where I taught environmental design and was a member of the lighting research team. I used to work as a building services engineer and my PhD research was in building energy performance and prediction.



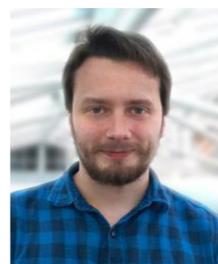
RONAK JANANI

Supervisor: Dr H Wang
Structural Materials and Integrity Research Centre

A new class of ionogels as electrolyte for solid-state supercapacitors

Liquid electrolytes (aqueous, organic and ionic liquids) have been widely utilized in supercapacitors and batteries due to their high ionic conductivity and transference number. However, safety concerns resulting from their leakage and explosive nature (in some cases) caused an extensive call for research on the development of solid electrolytes. Ionogels are ionic liquid encapsulated inside a quasi-solid/solid matrix. High mechanical stability and ionic conductivity are the characteristics of an ideal ionogel. In this work, we aim to investigate the application of a new class of ionogels in comparison with the conventional

ionogels for electrochemical double-layer capacitors (EDLCs).



ALEXANDER LUKASH

Supervisor: Dr L Alboul
Centre for Automation and Robotics Research

On the road towards self-organising robots

Swarm behaviour, observed in bees, fish, and birds has always fascinated the human eye. Recently, scientists have turned to modelling to gain a deeper understanding of how this behaviour emerges. Such studies led to the branching of a new field in robotics research, swarm robotics, which is characterised by using numerous simple, inexpensive mobile robots governed by simple rules. This talk will cover recent developments in swarm intelligence and present some novel approaches on how to form self-organising teams of robots, together with their potential applications in real-world situations.

Mini Profile

Born and raised in Tehran. With a background in electronics and nanotechnology, I have a great interest in studying electrochemical characteristic of materials. My PhD at MERI is focused on all solid-state double layer supercapacitors.

Mini Profile

Born in small and cosy Chişinău, Moldova; MSc in physics from Dubna University, Russia. PhD student with research interests in swarm robotics and self-organisation. Fanatic about teaching and robots—surely nothing can go wrong?



ABUBAKAR MOHAMMED

Supervisor: Dr H Wang
Structural Materials and Integrity Research Centre

Key factors affecting the corrosion protection performance of sol-gel coating on mild steel

The deposition of a barrier layer such as a coating can provide corrosion protection of steel by preventing the aggressive environment from coming in contact with the material. Sol-gel derived hybrid coating presents one of the most viable pre-treatments alternative to the toxic chromate. In this study, TEOS and MPTMS were used as precursors for sol-gel coating on mild steel substrate. The factors affecting the performance of sol-gel such as ageing, curing temperature, hydrolysis time, thickness, multilayer and immersion time was assessed by Tafel analysis, PDS, visual inspection, SEM and EIS in aerated 3.5 wt.% NaCl solution at ambient

temperature. The results reveal that these factors affect the sol-gel performance significantly.



ASMAIEL GIUMA RAMADAN

Supervisor: Dr F Al-Naemi
Centre for Automation and Robotics Research

Magnetic fault current limiter

The aim of this research is to design and test a magnetic fault current limiter to limit the fault current in a power distribution system. Neodymium Iron Boron is used as a permanent magnet, which is the main source of excitation to keep the non-oriented silicon steel iron core in magnetic saturation state. During the normal operation of the device the saturated core offers low impedance to the grid and during the fault state the core inherently rushed to high impedance state that limits the high short circuit current.

Mini Profile

Abubakar studied BEng (Mechanical Engineering) and MSc (Mechanical Engineering) at Federal University of Technology Minna, Nigeria and University College London respectively. He is currently a Postgraduate Researcher at SHU with an interest in corrosion and scale protection of oil and gas pipelines using sol-gel coating technology..

Mini Profile

Born in Tarhuna city in Libya, gained an MSc in Electrical Engineering from Tripoli University, Libya. I enjoy working as part of a team and can communicate information and ideas to others in an understandable manner. My present career aim is to work in the area of power distribution system.



DR MICHELE TRANCOSSI

Senior Lecturer
Centre for Automation and Robotics Research

Design of an innovative building configuration

The authors have synthesised a design approach by a critical approach to construction law. Bottom-up design is based on an unconstrained model of the system and its governing laws. The optimisation of the ideal processes allows to produce multiple and evolutionary configurations with high energy efficiency of a system. This paper presents an example relating to the optimisation of a building that opens the road to new designs of walls and windows in the direction of an energy self-sufficient building by low energy sources. The related building concept can achieve complete energy self-sufficiency by a particular design of the wall that allows using geothermal water and solar thermal energy.



HARRIET NWAIZU

Supervisor: Dr R Saatchi
Centre for Automation and Robotics Research

Inertial measurement techniques for analysing patterns of human movement

The purpose of this study is to develop and assess techniques that allow inertia measurement units (IMUs) to be used to monitor patterns of human movement. A variety of methods such as visual assessment and optical detection are currently used but these approaches are either subjective or require the tests to be performed in a laboratory using sophisticated set ups.

A novel wavelet packet based approach to fuse accelerometer and gyroscope signals has been developed and its effectiveness is compared with the conventional complementary filter method.

The proposed technique gave better results than the commonly used complementary filter.

Mini Profile

Dr Michele Trancossi has obtained a Mechanical Engineering degree at the University of Parma (IT) and a PHD in Industrial Engineering at the University of Modena (IT). He is working as senior lecturer at SHU and has been honored of being nominated external supervisor for PhD projects at University of Beira Interior (PT). He is author of more than 60 scientific papers, 20 of which on scientific journals. He is interested in energy related research, with particular attention to aeronautic and vehicles, buildings and industrial processes. Other fields of expertise relate to solar and photovoltaic energy, fluid dynamics and heat transfer. A Professional Engineer in Italy he is member of different standardization committees inside ASTM and SAE. He is also member of technical committees inside SAE and ASME. He has worked on 3 EU FP7 projects supporting coordination activities in two of them.

Mini Profile

PhD student at Sheffield Hallam University with research focus on human movement science and development of techniques to accurately measure human movement and balance.



DR EMMA ASHCROFT

Section Manager - Laser Additive Manufacturing
TWI

Life after a PhD – Entering the world of Additive Manufacturing

A presentation on my career after my PhD at SHU working for TWI and my involvement in the research and development of Additive Manufacturing.



Mini Profile

Emma Ashcroft is Section Manager for TWI's Laser Additive Manufacturing activity and has worked in the field of additive manufacturing for the past 8 years, with previous experience in laser welding and hybrid techniques. Emma has been involved in a number of UK and European collaborative research programs and including project coordinator roles for FP7 projects (IMPALA and Sniffles). Emma is active in promoting the advancement of Additive Manufacturing processes; Selective Laser Melting, Laser Metal Deposition.



AYOTUNDE OJO

Supervisor: Prof. I M Dharmadasa
Thin Films Research Centre

Next generation solar cells based on electrodeposited semiconductors

Due to the increasing global energy demand and the adverse effects of the non-renewable energy sources, research into alternative and renewable energy sources have been necessitated. Amongst other renewable energy sources, solar energy is more abundant. Harnessing such energy requires technology such as photovoltaics (PV) and the concentrated solar power (CSP). With emphasis on PV, current solar cells under research and development utilise mainly one absorber layer with limited photon harvesting capabilities. To effectively harness the solar radiated photons, a multi-layer graded bandgap solar cell is required. My work is

based on the electrodeposition and optimisation of multi-layer graded bandgap semiconductor materials with an enhanced photon to electron conversion efficiency. 18% solar cell device efficiency has been achieved.



Mini Profile

I am Ojo Ayotunde, I studied Mechanical engineering (BEng) and Engineering and Management (MSc) in Ekiti State University, Nigeria and Sheffield Hallam University, UK respectively. I am a full-time PhD student in SHU and I am working on the optimisation of CdTe-based solar cells.

It's been interesting being a researcher in SHU/MERI with the available range of equipment and fantastic supervisory team.



ALEX SCRIMSHIRE

Supervisor: Dr P Bingham
Structural Materials and Integrity Research Centre

Using mössbauer spectroscopy to develop improved catalysts and batteries

In the search for next generation battery and catalyst materials, improving the understanding of current materials is key. In this project, a number of application-based, iron-containing materials have been selected to investigate different aspects of their functionality through thorough ⁵⁷Fe Mössbauer spectroscopic studies. Materials involved in this project include iron carbides for Fischer-Tropsch synthesis, rare-earth orthoferrite perovskites as vehicle emission catalysts and lithium iron phosphate as rechargeable battery cathodes. By focusing on the iron environment within these materials, we aim to improve the understanding of how these

materials function in service, and therefore how to make them more effective.



Mini Profile

A full-time Graduate Teaching Assistant PhD student co-sponsored by Johnson Matthey plc, I graduated from SHU with BSc (Hons) in Forensic Engineering with a year's experience in an active iron foundry.



OLALEKAN OLAYINKA OJEDOKUN

Supervisor: Prof. P Mangat
Structural Materials and Integrity Research Centre

Durability properties of an alkali activated cementitious material

The production of Portland cement which is used to manufacture concrete is one of the most carbon dioxide producing industries. The search for more sustainable construction materials requires the replacement of Portland cement in concrete. The use of industrial alkalis with industrial pozzolanic materials offers a promising alternative to cement and is an important area of current research. Alkali activated cementitious concrete (AAC Concrete) is a relatively new technology with little understanding of its durability characteristics over a long period of time. There are limited applications of alkali activated concrete because

of lack of knowledge of its structural behaviour when subjected to prolonged exposure to corrosion initiators such as chloride ions, sulphate and carbonation which are encountered in the field.



Mini Profile

My research focus is on 'Durability Properties of Alkali Activated Cementitious Materials' with much emphasis on the corrosion of steel, carbonation, and chloride profile in alkali activated materials.



DR BIPRO DUBEY

Lecturer
Centre for Automation and Robotics Research

Design strategy of microstructured material spray processing for optimal function preservation

The design criteria of spray processing to tailor morphology of simple or double emulsion based fluid systems with different nozzle geometries under various process conditions have been studied. Accordingly, the structural changes of simple (SE) and double emulsions (DE) during spraying were quantified for different designs of the twin-fluid atomization nozzles. The results show that the emulsion flow inside the nozzle as well as in the spray have separate big impact on the resulting product structure due to the respective flow stresses acting. Increasing the exceed critical flow stresses can lead to an additional significant dispersing impact of the

dispersed fluid phases and as a consequence decreasing of encapsulation capacity.



DR ANTONIO FETEIRA

Reader in Materials Engineering
Structural Materials and Integrity Research Centre

Lead-free piezoelectrics for actuators

Hazardous lead has been successfully replaced in a number of materials such as paints, solder and in a variety of electronic components in order to comply with environmental and health legislation. Piezoelectrics use in actuators for micropositioning are still exempt from this ban on lead, but only until a successful replacement for Lead-Zirconate-Titanate (PZT) is made available. We have been investigating two families of lead-free piezoceramics. Our results in terms of piezoelectric performance and lifetime for those two families will be presented.

Mini Profile

Bipro Dubey joined as a lecturer at SHU in June 2015. He had obtained his PhD at ETH Zurich (Switzerland) followed by postdoctoral experiences at ETH Zurich and Procter & Gamble (UK). His research interests are incorporated with the National Centre of Excellence for Food Engineering (NCFE) and Materials and Engineering Research Institute (MERI) at SHU on Formulation Engineering, Process Engineering, and Food/Material Structuring. The research focuses on the impact of the process (Bio-/Chemical/ Mechanical treatment) on food structures, and way to adjust the specific properties of a healthy food by understanding the process-structure-property relationship, and developing new process concepts that directly improve the state-of-the-art in food structuring.



DR FEROUZ KABIR

Senior Lecturer
Polymers, Nanocomposites and Modelling Research Centre

Renewable power generation opportunities in Malaysia

The government of Malaysia is keen to encourage energy independence through sustainable power generation with a balanced portfolio of electricity generation using non-renewable and renewable resources. In 2011, the government introduced Feed-in-Tariff which allows electricity producers to sell renewable electricity to power utilities at a fixed premium price.

A techno-economic (simulation) analysis on a 10 MW installed capacity biomass based power plant shows that a total project investment is 31.45 MMUS\$. The cost of electricity production is 10.43¢/kWh. Sensitivity analysis shows that

plant efficiency, capital and feedstock costs are vital in profit making. All cost data are in 2015 US\$ value.

Mini Profile

I joined Sheffield Hallam University in January 2016, having previously spent one year as a lecturer at Aston University and five years as Associate Professor at the University of Nottingham, Malaysia Campus. Prior to that, I spent more than 15 years working at Iowa State University, BUET, Georgia Institute of Technology, University of Toronto, University of New Brunswick, University of Sherbrooke and Zia Fertilizer Co. Ltd. as visiting scientist, associate and assistant professor, consultant, research fellow, postdoctoral fellow and process engineer.

My research interest is biomass characterization, pre-treatment, reforming and upgrading to fine chemicals, fibres, bio-chars and fuels via (catalytic and non-catalytic) aqueous, supercritical and thermos-chemical processes including pyrolysis and gasification, process development and techno-economics

Mini Profile

Dr Feteira is currently a Reader in Materials Engineering. His research is focused in advanced functional ceramics for electronics. His publications accrued more than 1500 citations and his current h-index is 21.

POSTERS- Cantor Atrium

Thank you to the following students who are presenting posters:



HISHAM F. ABU-ALI

Supervisor: Prof. A Nabok
Thin Films Research Centre

Inhibition biosensor based on bacteria for environmental pollution detection using optical and electrochemical measurements



ALI MADLOOL AL-JAWDAH

Supervisor: Prof. A Nabok
Thin Films Research Centre

Biosensor based on optical planar waveguide



ALI GHANIM AL-RUBAYE

Supervisor: Prof. A Nabok
Thin Films Research Centre

Ellipsometric and morphological study of nanostructured gold films for LSPR sensing applications.



HADI AL-SAGUR

Supervisor: Dr A Hassan
Thin Films Research Centre

Fabrication of a novel glucose sensor based on lanthanide phthalocyanine/reduced graphene oxide conducting hydrogel



FATMA ALI SAAD ALWAFI

Supervisor: Dr L Alboul
Centre for Automation and Robotics Research

Social graphs and their applications to robotics



Mini Profile

I'm Hisham Abu-Ali, lecturer in Molecular Biology, Biotechnology and Genetic Engineering Lessons & Labs. Lecturer in Biology Department – College of Science, University of Basrah. Currently I'm doing a PhD in MERI about Bacteria based-Biosensor.



Mini Profile

I'm Ali Madlool, lecturer in the University of Babylon, Department of Physics, College of Sciences, Iraq. I have a master's degree in Applied Nuclear Physics 1991. I am doing a PhD in Optoelectronic (Biosensor).



Mini Profile

I'm Ali Ghanim Al-Rubaye, lecturer in Southern Technical University, Environmental Pollution Research unit in Iraq; I have a master's degree in Environmental and Water Resources 2002. I am doing a PhD in Materials (Biosensor).



Mini Profile

Hadi Al-sagur is a PhD student at MERI. I'm working on developing electrochemical glucose biosensors. Also, I'm a lecturer in the Physiology & Medical Physics Department, Thi Qar University, College of Medicine in Iraq. I do volunteering work with a charity called Diabetes UK. Playing basketball, attending the fitness centre, cycling, and camping are the things I most like.



Mini Profile

I am Fatma Alwafi, Lecturer in Sirt University, College of Science, Mathematics Department in Libya; I have a master's degree in Mathematics Science 2010. I am married with 3 children. I am doing a PhD in Mathematics.



GEORGIA CHRISTOPOULOU

Supervisor: Dr P Bingham
Consultancy

Understanding the in- service behaviour of a novel fibre insulation material.



OLLY DUNCAN

Supervisor: Dr A Alderson
Polymers, Nanocomposites and Modelling Research Centre

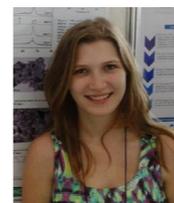
Making difference-tailored properties through variable compression.



EMAN ELBUAISHI

Supervisor: Dr O'Flaherty
Structural Materials and Integrity Research Centre

Shrinkage and creep of alkali-activated cementitious materials



CAROLINA ELICKER

Supervisor: Dr A Feteira
Structural Materials and Integrity Research Centre

Potassium niobate for photovoltaic devices



Mini Profile

My name is Georgia and I am currently in my first year of my MPhil in Materials Engineering. I was awarded a BSc in Physics from University of Patras (Greece) in 2012. I had undertaken research experience with the Royal Metrological Institute of Belgium and professional experience with Orraon S.A company.



Mini Profile

I am a PhD student developing auxetic foams (a new and exciting type of foam) for sporting protective equipment. I come from near Aberdeen in Scotland and moved to Sheffield to study the MSc in Sports Engineering at Sheffield Hallam University last year (following on from a Bachelor's degree in Mechanical Engineering at Strathclyde University). My interest in protective equipment in sports comes from snowboarding and mountain biking.



Mini Profile

I am Eman Elbuaishi, I have a Bachelor's degree in Civil Engineering (2000) and a Master's degree in Construction Engineering (2004) from Tripoli University, Libya. Currently, I am a PhD student in the Materials and Engineering Institute (MERI). My research aims to provide valuable data on the creep and shrinkage behaviour of alkali-activated cementitious materials as the most promising and environmental concrete binder alternative to ordinary Portland cement.



Mini Profile

PhD student in Materials Science and Engineering at Universidade Federal de Pelotas (Pelotas, RS, Brazil). Currently in collaborative period at Sheffield Hallam University sponsored by Science without Borders Program (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq, Brazil).



IBRAHIM ELOMARI

Supervisor: Dr F O'Flaherty
Structural Materials and Integrity Research Centre

Effect of cathodic protection on deteriorated pre-stressed concrete structures



EMMA LOUISE HENDRY

Supervisor: Prof. A Smith
Structural Materials and Integrity Research Centre

Friction Stir Welding as a Repair Method for Aircraft Materials



HAIDER KHALIL IBRAHIM

Supervisor: Dr N Anani
Centre for Automation and Robotics Research

Modelling of photovoltaic cell/ module /array and methods of parameters' extraction



HASSAN JUDAH

Supervisor: Prof C Sammon
Polymers, Nanocomposites and Modelling Research Centre

The development of different polymer/clay based hydrogels



FARAJ JABBAR KHALAF

Supervisor: Dr F O'Flaherty
Structural Materials and Integrity Research Centre

New kind of lightweight polymer nonocomposite building

Mini Profile

I am Ibrahim Elomari, Lecturer at Az Zawia University, Faculty of Engineering, Civil Engineering Department, Libya. I have an MSc in International Construction Management and Engineering, Leeds, UK. I am doing a Ph.D. in MERI. I am married and like table tennis and football.

Mini Profile

I am a part-time PhD student in MERI and work full-time as a Materials Scientist for the Ministry of Defence.

Mini Profile

My name is Haider K. Ibrahim. I am an assistant teacher in the Technical College of Basrah, Iraq. My fields of interest are power systems, electric machines and power electronics. I am doing PhD in solar energy (photovoltaic systems)

Mini Profile

Hi. I am a mechanical engineer interested in materials, trying to develop polymer/clay based nano-composite hydrogels which will "hopefully" help in medical applications. I play football, and love writing, Arabic calligraphy and photography

Mini Profile

I am Faraj Jabbar Khalaf, lecturer in Al-Anbar university, Engineering College in civil department. I have a BSc from law college in Iraq. I was a manager and partner of an engineering consultancy company since 2004; I was head of the administration council of Nama establishment for human development. I am interested in reading human development and scientific studies. I am currently doing my PhD in SHU in structural engineering (analysis of lightweight polymer nanocomposite domes) which is my area of interest.



QINGBO MENG

Supervisor: Dr H Zhang
Centre for Automation and Robotics Research

Advanced control methods and applications, such as ohmic heating or milk nutrition control, on food industry.



KHALID RMYADH MUHAMMED

Supervisor: Dr P Bingham
Structural Materials and Integrity Research Centre

The electrical and physical properties of Pb-free piezoelectric ceramic materials.



MAGDI MUSSA

Supervisor: Dr H Wang
Structural Materials and Integrity Research Centre

The Effect of adding fluoro-alkylsilane (PFOTS) to hybrid sol-gel coating on anti-corrosion & self cleaning properties on aluminium alloy AA2024 T3.



OLUWASEUN OLUWAFEMI

Supervisor: Dr Q Luo
Structural Materials and Integrity Research Centre

Effect of DC pulsed plasma nitriding on the corrosion and wear properties of type 304 austenitic stainless steel.



MOHAMMED SALEH

Supervisor: Dr R Saatchi
Centre for Automation and Robotics Research

Development of artificial intelligence technique to predict likelihood of survival following an injury

Mini Profile

My name is Qingbo Meng, a first year PhD student in MERI, Sheffield Hallam University. I graduated from Coventry University and got a Master's degree in 2014, I joined SHU in November 2015. Now I am doing research on advanced control methods and applications on real industry, such as ohmic heating and milk producing process control.

Mini Profile

My name is Khalid Rmyadh Muhammed, I was nominated by the Higher Committee for Education Development in Iraq (HCED-Iraq) to study a Ph.D. in materials engineering at MERI, Sheffield Hallam University, my Ph.D. research focuses on lead-free piezoelectric ceramic and glass-ceramic materials under the supervision of Dr. Paul A. Bingham.

Mini Profile

An experienced Integrity & Certification Senior Engineer at Eni Oil & Gas B.V. Libyan branch (Eni production Unit). Currently working on developing new hybrid coatings to reduce corrosion and antifouling effect on aluminium and other metals alloys for aerospace and marine application using sol-gel technology

Mini Profile

I am Oluwaseun Tope Oluwafemi, a Metallurgical Engineer at the Federal Ministry of Mines and Steel Development, Abuja, Nigeria. I obtained a Master's Degree in Corrosion Control Engineering from the University of Manchester. I am married with two lovely children and I love sports. And, I am doing a PhD. in Materials (Austenitic Stainless Steel).

Mini Profile

I am Mohammed Saleh, Libyan, lecturer in Omar Al Mukhtar University, College of Science, Computing Department in Libya; I have a master's in IT since 2008. I am married with 3 children and like horse riding, reading and surfing the internet. I am doing PhD in computing (Artificial Intelligence).



MIRJAM SKOF

Supervisor: Dr H Wang
Structural Materials and Integrity Research Centre

The influence of processing conditions on the formation of indium-free transparent conductive oxides using the sol-gel method



Mini Profile

My name is Mirjam Skof. I received a Master's Degree in Advanced Material Sciences at the University of Technology Graz, Austria in 2014. My personal interests include walking, climbing and books. I am currently based in Cambridge, where I am doing a PhD in Transparent Conductive Oxides.



PETER ROBERT STACEY

Supervisor: Prof. C Sammon
Polymers, Nanocomposites and Modelling Research Centre

Use of Raman spectroscopy for the measurement of respirable crystalline silica in air – initial results



Mini Profile

I am a senior scientist working at the Health and Safety Laboratory in Buxton researching solutions to better monitor exposure to hazardous substances and help improve the health of workers. I am current doing a PhD at the Materials Engineering Research Institute at Hallam.

VOTING FOR YOUR FAVOURITE POSTERS

1. What is a QR Code?

A QR Code (it stands for 'Quick Response') is a mobile phone readable barcode that can store website URLs. There will be a QR code to scan in order to vote for your favourite poster on display during the MERI Research Symposium - you may only vote for 1 poster.

2. How does it work?

You can scan the code using your Android or Smartphone, you will be directed to a voting page, where you vote for your favourite poster.

3. Where can I get a scanner application?

Most phones will have a barcode scanner as an App, you will need to download the App to your phone. When the App is launched and placed over the code it will scan the code and direct you to the voting page.

4. The result?

The public vote will close at 2pm on Wednesday 18th May (day 2) and the result will determine the prize winners. Prize giving will be held at 4.20pm on the same day.

PRIZES

Prizes in the form of vouchers will be awarded in the following categories:

- Best PhD student talk - 1st prize
- Best PhD student talk - 2nd prize
- Best PhD student talk - 3rd prize
- Best PhD student poster - Judges vote
- Best PhD student poster - Public vote
- Best undergraduate poster

Prizes will be presented by Professor Roger Eccleston Pro Vice-Chancellor for the Faculty of Arts, Computing, Engineering and Sciences (ACES).



Mini Profile

Professor Roger Eccleston joined Sheffield Hallam in September 2012. Professor Eccleston worked previously at the University from 2004 - 2007 as director of the Materials and Engineering Research Institute (MERI). He returned to Sheffield Hallam from his most recent role as Dean of the School of Science and Technology at Nottingham Trent University. Prior to this, Professor Eccleston was Director of Technology at the Sciences and Technology Facilities Council (STFC) where he led the Technology Unit, providing engineering and technology services to major UK science projects and facilities, including the Large Hadron Collider. He is an alumnus of Sheffield Hallam, having studied applied science at Sheffield City Polytechnic. He also has a PhD in physics from the University of Warwick.

These prizes have been generously donated by our sponsor:

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Presentation Judges

Prof. Alan Smith, Dr Lyuba Alboul, Dr Kathy Doherty, Prof. Doug Cleaver, Prof. Alexei Nabok

Poster Judges

Dr David Asquith, Dr Torsten Schenkel, Dr Antonio Feteira, Dr Karen Vernon-Parry, Dr Paul Bingham, Prof. Dharme Dharmadasa, Dr Aseel Hasan

Thanks to the members of the planning committee:

Alan Smith (Chair), Lyuba Alboul, David Asquith, Antonio Feteira, Gail Hallewell and Clare Mills Roberts



FLAG KEY

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Because of this shared vision and commitment we value the research and consultancy relationship that we are developing with Sheffield Hallam University and MERI.

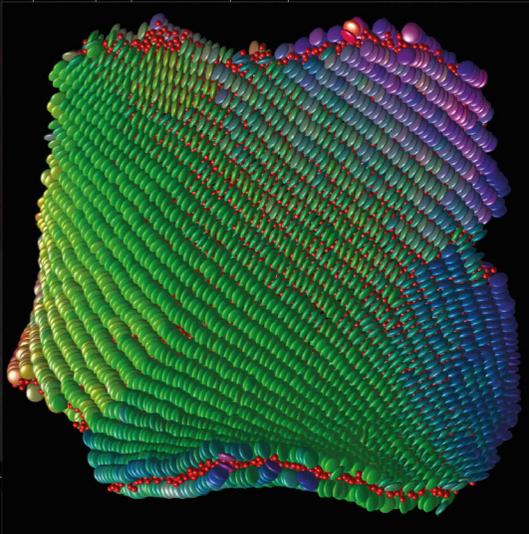
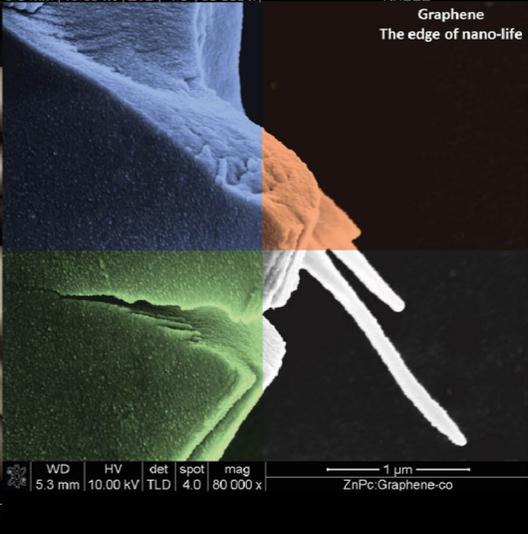
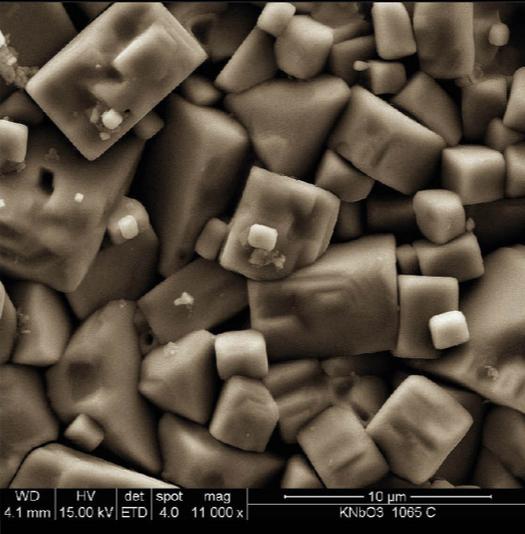
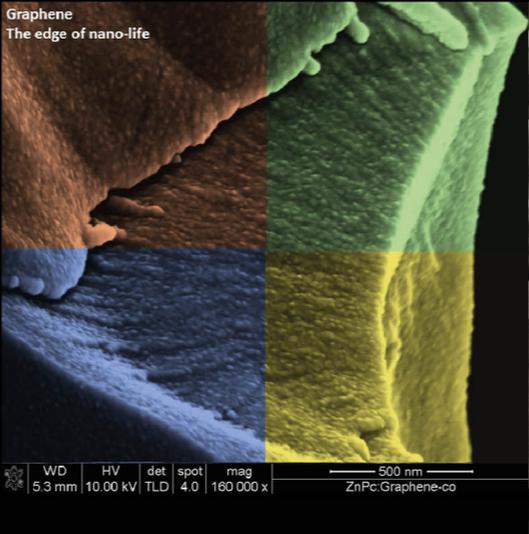
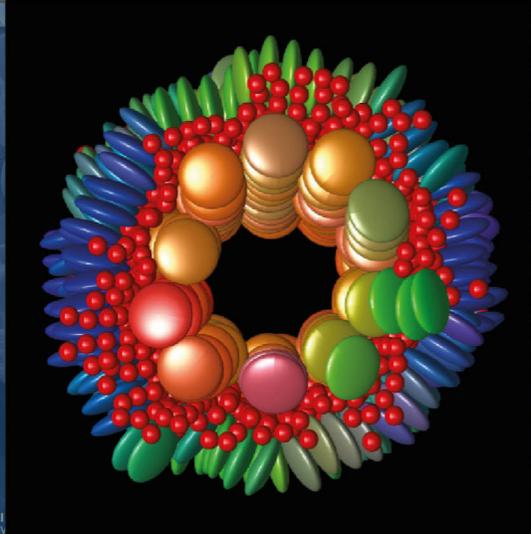
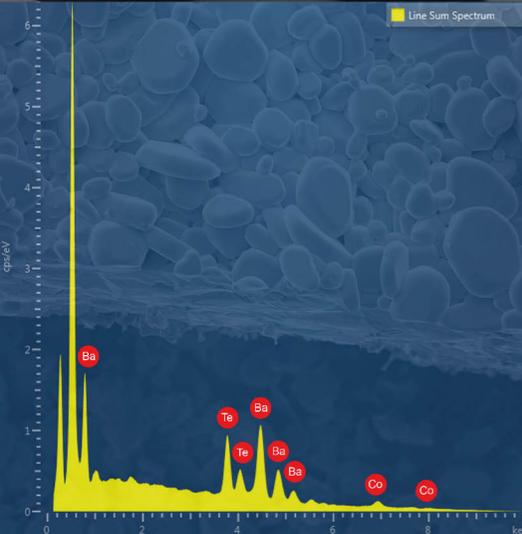
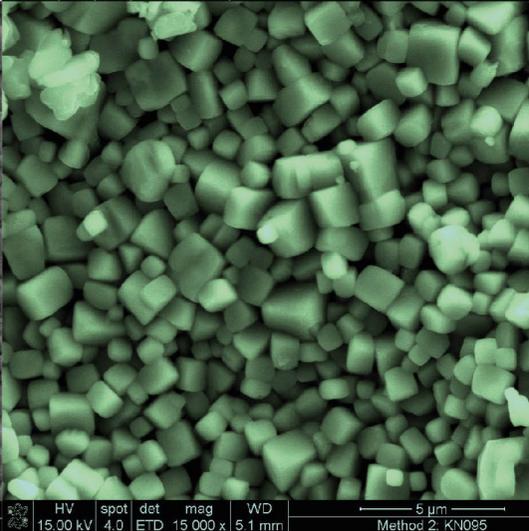
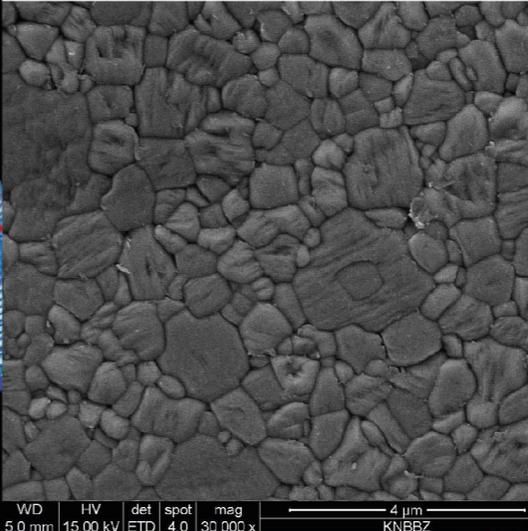
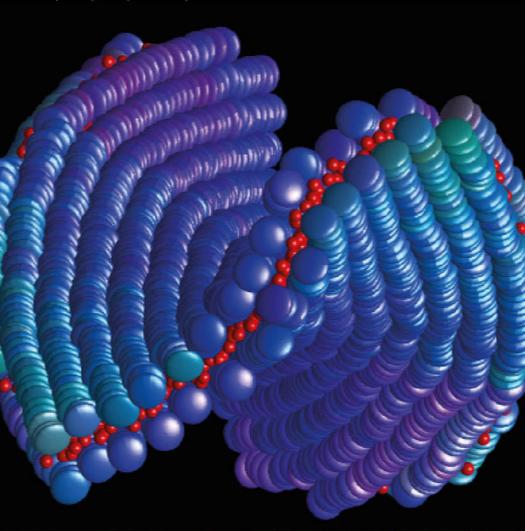
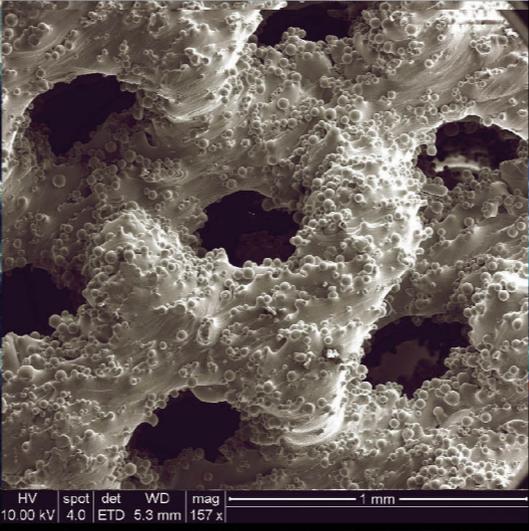
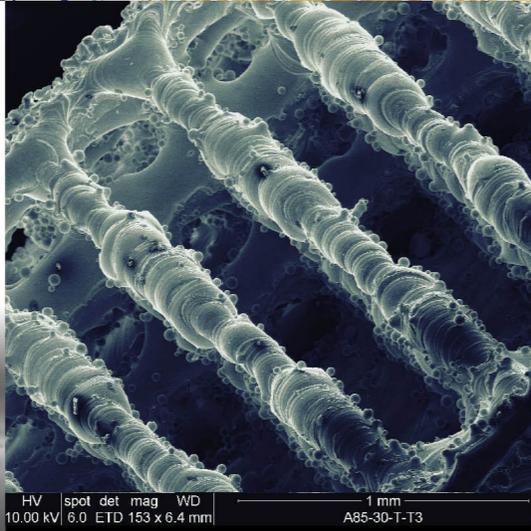
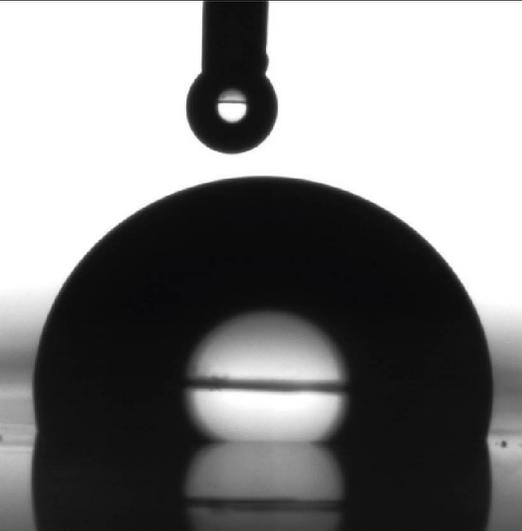
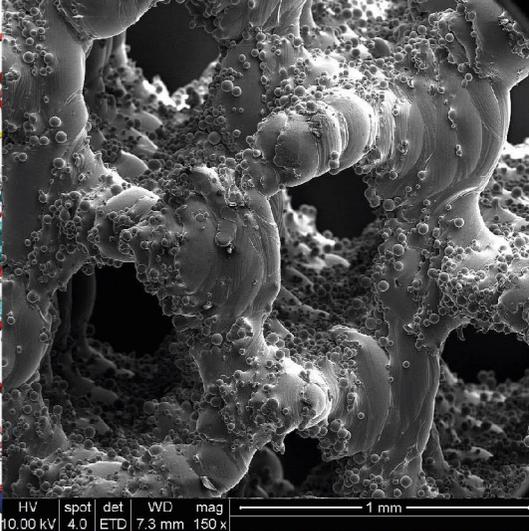
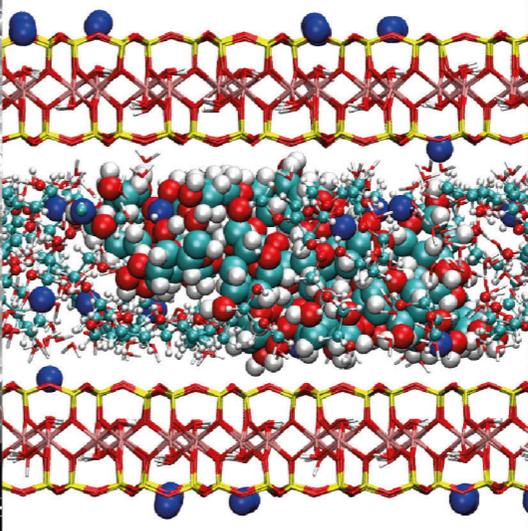
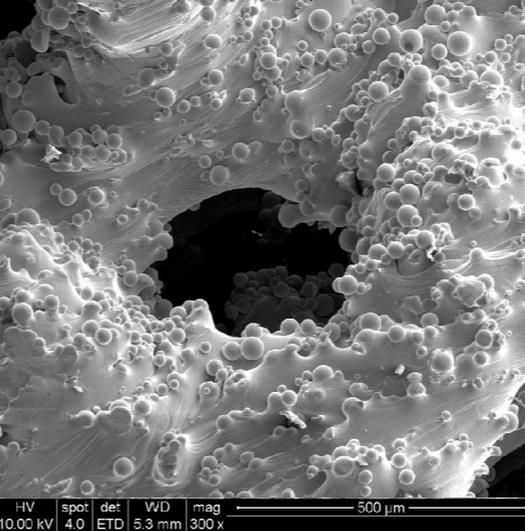
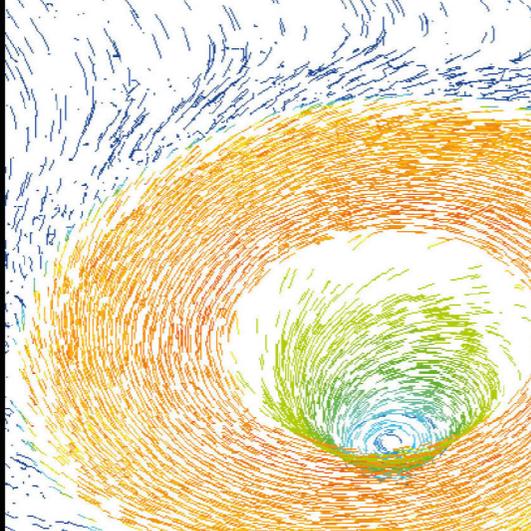
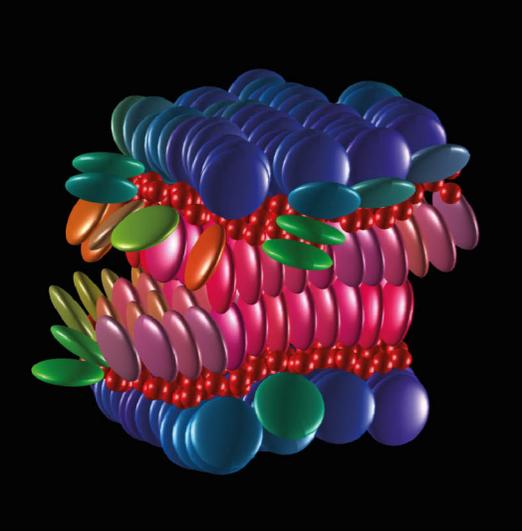
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HV 10.00 kV spot 4.0 det ETD WD 5.3 mm mag 300 x

HV 10.00 kV spot 4.0 det ETD WD 7.3 mm mag 150 x

HV 10.00 kV spot 6.0 det ETD mag 153 x WD 6.4 mm A85-30-T-T3

HV 10.00 kV spot 4.0 det ETD WD 5.3 mm mag 157 x

WD 5.0 mm HV 15.00 kV det ETD spot 4.0 mag 30 000 x

HV 15.00 kV spot 4.0 det ETD mag 15 000 x WD 5.1 mm Method 2: KN095

WD 5.3 mm HV 10.00 kV det TLD spot 4.0 mag 160 000 x

WD 4.1 mm HV 15.00 kV det ETD spot 4.0 mag 11 000 x

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