Annual Workshop

Lecture Theatre 22

Sir Robert Hadfield Building

University of Sheffield

1 September 2016

Programme

Alloy Design – A Resource Efficient Approach

This is an open meeting and anything discussed here is to be considered 'in the public domain'.

Programme

10.00 - 10.30 **Registration and coffee**

10.30 – 11.00 **Welcome & overview**

Professor Mark Rainforth

Professor of Materials Engineering, Department of Materials Science and Engineering, The University of Sheffield.

11.00 – 12.45 **Presentations**

"Substituting Rare Earth elements in magnets"
Professor Mark van Schilfgaarde
Department of Physics, King's College, London, UK

"Designing High Strength Magnesium Alloys"
Professor Joseph Robson
School of Materials, The University of Manchester, UK

"Exploiting diffusion multiples for efficient alloy design"

Dr Maria Teresa Pérez-Prado

IMDEA Materials Institute, Madrid, Spain.

12.45– 13.45 **LUNCH and Posters**

13.45 – 15.00 **Presentations**

“The development of iron-based hard facings for use in the nuclear industry”
Dr Dave Stewart
Materials, Chemistry and Corrosion, Rolls-Royce plc

"Design of steels through control of martensitic and maraging microstructures"
Dr Enrique Galindo-Nava
Department of Materials Science and Metallurgy, Cambridge University, UK

15.00 – 15.30 **Tea and coffee**

15.30 – 17.15 **Presentations**

“Designing titanium alloys for machinability”
Dr Martin Jackson,
Department of Materials Science and Engineering, University of Sheffield, UK

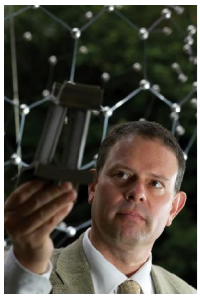
“Alloy design for Additive Manufacturing: Small variations in composition lead to strong changes in part properties”
Dr Eric Jägle
Max-Plank-Institut für Eisenforschung, Munich, Germany

"Life cycle analysis"
Prof Lenny Koh,
Director of Centre for Energy, Environment and Sustainability, Management School, University of Sheffield, UK

18.00 **Poster session and drinks**

Speakers

Welcome - Professor Mark Rainforth



After obtaining a 1st Class Honours degree from the University of Sheffield, Mark Rainforth initially followed an industrial career. He later joined the Department of Materials Science & Engineering in Sheffield from the University of Leeds in 1989 and rapidly established state-of-the-art facilities in electron microscopy and tribology. He is co-author of the book `Ceramic Microstructures´ with W E Lee, a winner of the Rosenhain Medal of the IoM3 and has recently finished his term as President of the Royal Microscopical Society.

His research centres on the high resolution characterisation of microstructures, in particular interfaces and surfaces. His research programmes are broadly based and cover metals, ceramics and coatings.

"Substituting Rare Earth elements in magnets"- Professor Mark van Schilfgaarde

Professor van Schilfgaarde is the head of the Theory & Simulation of Condensed Matter Group at King's College London. He completed his PhD at Stanford University in 1987. He is a fellow of the American Physical Society and sits on the executive boards of the Simons Foundation project on the many-electron problem and the Thomas Young Centre. Prior to joining King's College in 2011 he was a professor at Arizona State University in the USA.

His research interests are centered around the theory of electronic structure which is the key to understanding properties of materials at their most fundamental level, most notably the Quasiparticle Self-Consistent GW approximation.

"Designing High Strength Magnesium Alloys" - Professor Joseph Robson

Joe Robson graduated in Natural Sciences from the University of Cambridge in 1993, and obtained his PhD from the same institution in 1996. Since then he has worked at Cambridge, Swansea, and Manchester universities, and in 2003 was appointed to a Lectureship. Joe is a member of the Light Alloy Processing group with research interests that are focussed on microstructural evolution and control in industrial alloys, with an emphasis on modelling.

Current work involves the coupling of thermodynamic models, based on Calphad methods, to novel kinetic models, enabling the time and temperature dependence of the microstructure (particularly second phase particles) to be determined for complex industrial alloys and processes. Such an approach is being used to predict microstructure evolution

and subsequent effect on properties for a range of aluminium, magnesium, and zirconium alloys during processes such as hot rolling and welding. Applications for these materials include the automotive, aerospace, and nuclear industries.

"Exploiting diffusion multiples for efficient alloy design" - Dr Maria Teresa Pérez-Prado

Dr. Teresa Pérez Prado joined IMDEA Materials as Senior Researcher on September 1, 2008. She also heads the Research Program on Alloy Design, Processing and Development. Dr. Pérez-Prado was born in Asturias, Spain. She completed an MSc in Physics at the Complutense University in Madrid (UCM) in 1994. After a brief stay at Chemnitz University, Germany, she joined the National Centre for Metals Research (CENIM, CSIC) in Madrid, Spain, where she carried out her dissertation on the Study of the Deformation Mechanisms of Superplastic Aluminium Alloys by Texture Analysis. In 1998 she got a PhD degree in Physics from UCM. Part of her doctoral research was carried out at the Naval Postgraduate School in Monterey, California.

In 1998 Dr. Pérez Prado joined the University of California in San Diego (UCSD) as a Postgraduate Research Engineer, working on the measurement of residual stresses by convergent beam electron microscopy (CBED) and on the micro texture characterization of materials deformed at high strain rate. She was also hired as a consultant at Oregon State University. In 2001 she returned to CENIM, Madrid, where she worked as a Ramón y Cajal fellow on the processing and physical metallurgy of novel Mg alloys for light transportation. She was granted a Tenured Scientist position in 2004.

Dr. Pérez-Prado´s current research interests involve applied and fundamental work on the processing, characterization and mechanical behaviour of advanced metallic materials for automotive, energy and biomedical applications. She has co-authored 1 book and 100 papers in international peer-reviewed journals.

“The development of iron-based hard facings for use in the nuclear industry” - Dr Dave Stewart

"Design of steels through control of martensitic and maraging microstructures" - Dr Enrique Galindo-Nava

Dr Galindo-Nava’s research activities are centred on Computational Materials Science, particularly on developing mathematical tools for optimising mechanical properties and understanding damage mechanisms. He is working towards formulating microstructure-sensitive models for hydrogen embrittlement in ultra-high strength steel, which is well known to have disastrous effects. Understanding how the microstructure affects this mechanism is essential to mitigate embrittlement during operation. Additionally, his research covers alloy design for resource efficiency from the approach “Integrated Computational Materials Engineering”.

“Designing titanium alloys for machinability” - Dr Martin Jackson

After obtaining an M.Eng (First) from the University of Sheffield, Martin Jackson initially followed an aerospace materials career working for Rolls-Royce before studying for his PhD at Imperial College London – "predicting microstructural evolution during forging of Ti alloys (EPSRC/QinetiQ)". Between 2001 and 2005 he worked as a Research Associate at Imperial on projects such as "high strain rate superplasticity in Al alloys (EPSRC)" and "the production of Ti Alloys via the FFC Cambridge process (ONR/DARPA)". In 2005 he was awarded a Royal Academy of Engineering/EPSRC Research Fellowship and moved back to the department in 2008.

His research centres on the effect of solid state processes from upstream extraction technologies through to downstream finishing processes on microstructural evolution and mechanical properties in light alloys, and in particular Ti alloys.

A major research interest is to provide a step change in the economics of titanium based alloys through the development of non-melt consolidation routes.

“Alloy design for Additive Manufacturing: Small variations in composition lead to strong changes in part properties” - Dr Eric Jägle

Dr. Jägle is originally from Tuttlingen, a small town in the very south of Germany. He studied materials science at the University of Stuttgart, receiving a Dipl.-Eng. degree (=M.Eng.) in 2006. In 2006/2007 he spent on year at the University of Cambridge. In the M.Phil. course in Materials Modelling, he worked with H.K.D.H. Bhadeshia on simulating the origin of banding in hot-rolled steel. Afterwards, he returned to Stuttgart and started his Ph.D. at the Max-Planck-Institut für Metallforschung (= MPI for Metals Research) under the supervision of Prof. E. J. Mittemeijer. His work focused on the mesoscopic simulation of microstructure development during phase transformations, in particular during recrystallization. After receiving the Dr. rer. nat. (=Ph.D.) in 2011, he moved to the Max-Planck-Institut für Eisenforschung (=MPI for Iron Research) in Düsseldorf. There, he worked as post-doctoral researcher in the department of Prof. D. Raabe on Atom Probe Tomography analysis of electrical steels, precipitation transformations and mechanical alloying. In 2015 he became leader of a newly-formed group in the same department working on alloys for Additive Manufacturing.

"Life cycle analysis" - Prof Lenny Koh,

Professor Lenny Koh is the Founder and Director of the Centre for Energy, Environment & Sustainability (CEES), Advanced Resource Efficiency Centre (AREC), and Logistics & Supply Chain Management (LSCM) Research Centre at The University of Sheffield. She is an internationally renowned authority on supply chain management related to low carbon and sustainability. Her research is recognised for its scientific novelty and has generated major impacts for society, industry and government. Using interdisciplinary approaches, crossing supply chain management, information systems, energy, engineering, social sciences and science disciplines, her work contributes to the understanding and resolution of complex supply chain problems, which are caused by climate change and uncertainty. She has a high H-index (World number 2) and high research income generation, and has successfully pioneered and led many large scale, complex projects, funded by EPSRC, ESRC, EU, Innovate UK, Leverhulme Trust and other key funding bodies in the UK, Europe and internationally.

Delegates

Dr Tim Wilks	Magnesium Elektron Ltd
Mr Alan Scholes	Materials Processing Institute
Prof Richard Dashwood	Coventry University
Mr Matthew Thomas	Timet UK Ltd
Mr Arunansu Haldar	Tata Steel
Dr Sinan Al-Bermani	Sheffield Forgemasters
Dr Maria Teresa Pérez-Prado	IMDEA Materials
Dr Eric Jägle	Max-Planck-Institut für Eisenforschung
Dr Dave Stewart	Rolls-Royce plc
Prof Lenny Koh	University of Sheffield
Prof Joe Robson	Mancheser University
Prof Mark Rainforth	University of Sheffield
Prof Tony Paxton	Kings College London
Prof David Dye	Imperial College London
Prof Fionn Dunne	Imperial College London
Prof Mark van Schilfgaarde	Kings College London
Dr Pedro E.J. Rivera	Cambridge University
Prof Brad Wynne	University of Sheffield
Dr Russell Goodall	University of Sheffield
Prof Iain Todd	University of Sheffield
Dr Martin Jackson	University of Sheffield
Prof Ernesto Gonzalez	Uni Federal de Ouro Preto
Dr Lefteri Andritsos	Kings College London
Dr Enrique Galindo-Nava	Cambridge University
Dr Dikai Guan	University of Sheffield
Dr Junheng Gao	University of Sheffield
Dr Sam Tammas-Williams	University of Sheffield
Dr Guy Skinner	Kings College London
Dr Alexander Knowles	Imperial College London
Dr Peng Gong	University of Sheffield
Mr Pete Morris	Beta Technology
Dr Son Pham	Imperial College London

Dr Neil Jones	Rolls-Royce plc
Mr Mark Hull	
Mr Martin Watson	DNVGL
Dr Martin Strangwood	University of Birmingham
Mr Gordon Scott	GKN Aerospace
Dr Mahesh Kumar Mani	GKN Aerospace Limited
Miss Linda Squillaci	GKN Aerospace Services Ltd
Miss Lucy Smith	University of Sheffield
Miss Cynthia Traore	Swansea University
Mr Gautam Anand	University of Sheffield
Mr Xin Pan	University of Sheffield
Mr Zuheir Khulief	University of Sheffield
Miss Charlotte Boig	University of Sheffield
Mr Benjamin Jones	University of Sheffield
Mr Neil Harrison	University of Sheffield
Mr Mozart Queiroz	University of Sheffield
Mr Zhao Leong	University of Sheffield
Miss Haiyun Wang	University of Sheffield
Mr Andrew Patterson	University of Sheffield
Mr Righdan Namus	University of Sheffield
Mr Nick Weston	University of Sheffield
Dr Ben Thomas	University of Sheffield
Mr Oliver Hatt	University of Sheffield
Miss Sarah Smythe	University of Sheffield
Mr Andrew Burton	University of Sheffield
Miss Itzel Castillo Muller	University of Sheffield
Mr Shaun Earl	University of Sheffield
Mr Yuxing Cui	University of Sheffield
Mr Marco Galindo	University of Sheffield
Mr Priyanshu Bajaj	University of Sheffield
Miss Felicity Freeman	University of Sheffield
Mr Oluwole Adigun	University of Sheffield