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Academic Year 2018-19

UNIVERSITY OF BIRMINGHAM

METALLURGY AND MATERIALS

Research Newsletter

In this issue:

Welcome to your new research newsletter

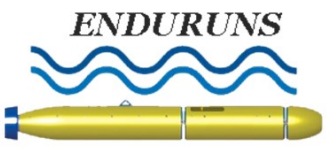
The purpose of this newsletter is to share information and promote key research and research-associated activities that have taken place within the School. The newsletter will be distributed on a quarterly basis; contributions and ideas are welcomed from all members of staff. If you have any feedback or items that you would like to share in future editions you can do so by emailing Hanshan Dong (Director of Research) at H.Dong.20@bham.ac.uk and James Keatley (Research Administrator) at J.Keatley@bham.ac.uk.

This edition of the newsletter features news, items and information from the current academic year (between August and December 2018).

New Grants

Congratulations to the following people who have recently been awarded new externally funded research grants (between August and December):

ENDURUNS (*PI Dr Mayorkinos Papaelias*)



The ENDURUNS initiative is an €8.8M 4-year H2020 project comprising 18 partners from the EU and Korea that seeks to develop and demonstrate a long-endurance sea-surveying autonomous unmanned vehicle with gliding capability powered by a hydrogen fuel cell. The project is supported financially by the European Commission (RIA) and the Korean Government. Dr Mayorkinos Papaelias is the Scientific Coordinator responsible for the technical agenda of the project; Professor David Book, Professor Gerard Fernando and Dr Phil Atkins are also involved in the various research tasks of this project. Follow @projectENDURUNS to keep up-to-date on the progress of the project.

Run–flat System Improvement (*PI Dr Mike Jenkins*)

Knowledge Transfer Partnership (KTP) in association with Westley Plastics Limited, running from September 2018 to December 2020.

Research for Technology on In-Service Inspection of Axle* (*PI Mayorkinos Papaelias*)

Carried out in collaboration with Electronic, Electrical and Systems Engineering this project will run until August 2019.

*Limited details available due to project restrictions.

Did you know?

There are over 90 active grants within the School with a combined award value of over £47,000,000.

An Introduction to...ReLib

The Faraday Institution-funded Recycling of Lithium Ion Batteries (ReLib) project is one of four Faraday *Fast Start* projects. Project manager Tony Hartwell shares with us the rationale behind the project and what it aims to achieve.

The UK Government has made a legal commitment to reduce greenhouse gas emissions (GHG) by at least 80% by 2050, compared to 1990 levels. However, although an overall reduction of 43% had been achieved at the end of 2017, emissions from the transport sector remained flat. This sector is now the largest source of GHG emissions in the UK (28% of all emissions in 2017, with cars accounting for more than half of this). Sales of ultra-low emission vehicles are being promoted and there are plans to phase out sales of new vehicles powered by fossil fuels by 2040.

In collaboration with partners at seven other institutions and with its industrial partners, the University of Birmingham is leading the ReLiB Project funded by the Faraday Institution. This multi-disciplinary project is evaluating and developing:-

- Robotic systems for determining the status of used battery packs from electric vehicles (EVs) for optimising second-life applications and the safe dismantling of battery packs for recycling.
- The physical, chemical and biochemical processes that could be used for recovering materials from end-of-life EV batteries.
- The policy and legal frameworks that should be applied in the UK to promote the development of an efficient infrastructure for managing end-of-life EV batteries.

The aims of ReLiB project address a conclusion of the BEIS Select Committee report "Electric Vehicles – Driving the Transition" (October 2018); "**Second life battery applications, EV end of life disposal and battery recycling are nascent areas that could offer significant industrial opportunities*. We recommend that the Government explores the potential value of these to the UK and take a lead in developing those that are promising, before other countries gain a competitive edge."***

A dedicated ReLib website with further details about the project is due to be launched in early 2019. For further information you can contact Project Manager Tony Hartwell (A.P.hartwell@bham.ac.uk) or Project Coordinator Amina Benyahia (A.Benyahia@bham.ac.uk).

Publication News

EPS Paper of the Month

Congratulations to Dr Andrew Morris on winning the latest *EPS Paper of the Month* for his paper 'Optical absorption driven by dynamical symmetry breaking in indium oxide', published in Physical Review B.

When highlighting the paper's importance, Andrew explained that, "In essence, most simulations don't include the effect of temperature on the lattice. Once you do this, the optical excitations of the systems change, since the "hot" crystal is vibrating and has a lower symmetry that its 0 K static model. Transitions between states that were forbidden in the high symmetry case are now allowed. Our theory predicts a tail on the optical absorption, which matches with experiment. We are better able to predict the band gap of important materials from flat panel displays to solar cells".

You can access the paper here.

If you would like to submit a paper for consideration for Paper of the Month you can do so by emailing the paper and a short description of its significance to Hanshan Dong.

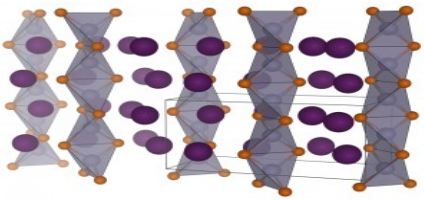
Publications

Since the 1st August 2018 there have been more than 40 different journal articles published or e-published ahead of print by colleagues from across the School (as authors or co-authors). These have been published in journals including *Acta Materialia*, *Corrosion Science*, *Scripta Materiala*, *Journal of Alloys and Compounds* and *Intermetallics*.

Conferences and Events

See below for information about selected conferences and events (previous and upcoming) that colleagues from across the School have participated in, hosted or organised this academic year.

Materials Simulation and Modelling Discussion Group (MSMDG)



MSMDG is an informal discussion group within the College of Engineering and Physical Sciences. They are interested in all aspects of materials modelling, and as such, define "material" as broadly as possible. The group are both theorists and experimentalists and model materials at all length scales.

MSMDG meets fortnightly at 3pm on a Thursday afternoon. There is a low-volume mailing list for advertising meetings and other relevant activities. Please email Andrew Morris a.j.morris.1@bham.ac.uk to join the list. All (including undergraduates) welcome. https://more.bham.ac.uk/msmdg/

CrEAM Network Efficient Extraction and Recycling Technologies Meeting

At the start of 2018 the Birmingham Centre for Strategic Elements and Critical Materials successfully secured EPSRC funding to create a network dedicated to understanding how to safeguard UK industry against potential shortages of strategic and critical elements.

The network will provide a forum to bring together specialists from across the entire UK supply chain in critical materials to create a coherent '*UK Element Strategy*' document for UK government, including policy and funding recommendations to ensure a responsible, secure and environmentally efficient supply of critical materials vital to UK industry.

On Tuesday 13th November the CrEAM Network held their first broad scope meeting on Efficient Extraction and Recycling Technologies at Edgbaston Park Hotel. The event hosted speakers from across the supply chain of critical materials covering a broad spectrum of separation techniques from robotic, chemical, biological and short loop recycling processes for primary and secondary materials. The Network and the meeting were introduced by the Principal Investigator Allan Walton and Co-Investigator Frances Wall.

A networking workshop followed the talks where four main themes were discussed:

- What supply chains currently exist; where are the gaps?
- Where are research centres of excellence for extraction, processing, recycling of critical materials in the UK?
- What and where are the challenges for the extraction, processing, recycling of critical materials?
- How can the legal framework or business models be changed to promote the efficient extraction and recycling of critical materials?

The day triggered many discussions and as a result, smaller more focussed meetings are being planned for 2019. The next broad scope on Responsible Supply Chains and Supply Chain Logistics is planned for May 2019.

Visit http://creamnetwork.org.uk or email cream@contacts.bham.ac.uk for further information.

Conferences and Events Continued

The 16th International Symposium on Metal-Hydrogen Systems (MH2018)

MH2018 organized by South China University of Technology (SCUT) took place in Guangzhou, China from the 28th October to the 2nd of November 2018. The conference was very successful with more than 400 participants from across the globe in attendance. The conference created a platform for academic and industrial participants to present and discuss the latest advances in the field, focusing on both the fundamental science of metal-hydrogen systems and their application for renewable energy storage devices.

Hydrogen Materials Group participants gave two talks and two poster presentations, both on the fundamental science of the metal-hydrogen storage systems and the applications of metal hydrides and metallic alloys for hydrogen compression and purification. The conference provided an excellent opportunity to discuss the latest progress on the application of metal hydrides for energy storage which is the focus of one of the recently commenced projects in the Hydrogen Materials Group, funded by EPSRC. As a result, collaboration with the University of New South Wales, Australia was established for the development of energy storage materials.

REF Outputs - 100 Words Drop-in Workshop , Wednesday 9th January, 13:00-14:30, Room 2C30

This workshop provides an informal opportunity for you to write and optimise your accompanying 100-word statements for your REF outputs. Bring along your drafts to receive feedback, work with peers and have time and space to refine your statements ready to go onto Pure. Please make sure that you bring your draft statements with you on the day, or bring a laptop or tablet so that you can access Pure. The workshop is designed for people to work on their own statements rather than being a presentation or lecture about them.

REF 2021 Research Excellence Framework

UK Magnetic Society's 31st Ewing Event

Members of the Magnetic Materials Group recently attended the UK Magnetic Society's 31st Ewing event at the Manchester Museum of Science and Industry.

Robert Llewellyn (shown left with Lydia Pickering, Alex Campbell and Oliver Brooks) presented the Ewing Lecture. His talk was about the rapid rise in electric vehicles, something which he is very passionate about, and he spoke of his experience driving all sorts of electric vehicles as part of his long running YouTube channel; "Fully Charged".

Seminar by Dr Katerina Christofidou, University of Cambridge Rolls-Royce UTC, 8th Jan 2pm 2C30

As jet engines are continuously evolving to provide improved efficiencies combined with reduced environmental and acoustic emissions, new high temperature superalloy compositions tailored to these new service conditions are required. However, alloy design is a complicated task necessitating an in depth understanding of component requirements, physical metallurgy, the effects of chemistry on a multitude of properties as well as the impact of manufacturing and processing on the underlying material microstructures. In this seminar, two examples at different stages of the alloy development process will be presented; the design of a polycrystalline Ni-based superalloy for turbine disc applications, and the development and understanding of high γ′ fraction superalloys manufactured through laser powder bed fusion methods. In the first instance, experimental results of the microstructural stability and alloy properties will be discussed, in particular as relating to the effect of Nb additions in Ni-based superalloys comprising elevated concentrations of Co. In addition, the use of synchrotron and neutron diffraction methods in obtaining valuable insights for alloy design will be presented with regards to obtaining the γ/γ′ lattice misfits at elevated temperatures as well as in understanding how the load partitioning to the two different phases may be affected as a function of temperature and alloy chemistry. Furthermore, the additive manufacturing example will be used to illustrate the challenges faced at the early stages of alloy development and the importance of a thorough understanding of the material through different stages of post-processing. Experimental results, using SEM-EDX, EBSD, XRD, STEM and RUS, showing the microstructural evolution of alloy CM247LC and a no-carbon variant will be presented and the implications towards future alloy development will be discussed.

New Staff

Welcome to the following members of staff who have recently joined the School:

Professor Emma Kendrick, Chair of Energy Materials

Emma is a materials chemist whose research focuses on new battery materials and technologies. Prior to joining us, she was Chief Technologist in energy storage at Sharp Laboratories of Europe Ltd (SLE) where she established the energy storage research and development program in sodium ion batteries and then she moved to WMG where she focused on developing new lithium-ion and sodium-ion battery technologies, that can be manufactured and tested at a scale that is industrially meaningful. Her office is in 2B04.

Dr Alexander (Sandy) Knowles, Lecturer in Nuclear Materials and EUROfusion Research Grant Holder

Sandy is an experimental metallurgist focussed on the design & development of new alloys for extreme environments, including nuclear fusion, fission and aerospace gas turbines.

He is a forerunner in the development of new “bcc superalloys”. Unlike current γ-γ’ nickel superalloys, β-β’ bcc superalloys make use of a bcc tungsten, titanium or steel matrix, with their higher melting points, for increased operating temperatures. This work, as well as his work on commercial alloys and ‘high entropy alloys’ (HEAs), is supported by Culham Centre for Fusion Energy (CCFE), TIMET and Roll-Royce plc.

Mr Jacob Gates, Electro Mechanical Technician

Jacob has knowledge and experience in the analysis, design and manufacture of digital and analogue circuits as well as in-depth knowledge and practical aptitude in precision mechanical engineering and design, with a background in research for manufacturing. Jacob is based in office 1C07 with other technical staff, and you will often find him in the mechanical workshop.

Dr Ruth Craven, REF and Impact Development Officer

Ruth is the new REF and Impact Development Officer for Metallurgy & Materials, Chemical Engineering and Engineering. Ruth previously worked in the NHS and prior to that completed her PhD in Medical & Biological Engineering at the University of Leeds.

Ruth’s primary job is coordinating the single REF submission for Engineering (UOA12) for REF2021 and is involved all aspects of the REF submission; outputs, impact case studies and the environment statement. Ruth works closely with James Keatley, the Planning Office, as well as the Heads of School and is happy to field any questions regarding REF. Ruth is based in the School of Metallurgy and Materials on a Tuesday and Wednesday in room 1B29 and can be contacted by email at r.craven@bham.ac.uk or on extension 45237.

Dr Ilija Rašović, Lecturer in Engineering & Physical Sciences (dual role)

Ilija has joined us having completed a DPhil in the Materials Department at Oxford on fullerenes for medical applications and their inclusion in supramolecular systems such as rotaxanes. During this time he won international prizes for oral and written communication of his work, and he gave extensive time and effort to outreach and access initiatives.

At Birmingham, Ilija has a split 50/50 role across the Liberal Arts and Natural Sciences (LANS) programme and the entirety of EPS. He is the EPS Lead for LANS and is keen to include Met & Mat in the course. His focus for EPS is on Science Communication very broadly. As such, he is involved in communication courses and workshops across the college for undergrads, PGRs and academics. He is actively seeking researchers to collaborate with so, if you have any questions regarding improving communication of your research via any medium, feel free to call Ilija (58472/45237) or drop him an email (i.rasovic@bham.ac.uk).

Introduction to our new Research Fellows

Each edition of the newsletter will feature an introduction to a new Research Fellow within the School. This month we hear from Dr Lydia Pickering, Postdoctoral Research Fellow in the Magnetic Materials Group.

Funded through the Horizon 2020 NEOHIRE project, my work involves recycling end of life NdFeB permanent magnets from direct drive wind turbine generators using the hydrogen decrepitation process and helping to develop novel, more efficient, resin-bonded permanent magnets. My research to date has largely involved metal-hydrogen interactions, which was the focus of my PhD in the department from 2009-2013. I have spent the last two and a half years working on scaling up and optimising the production of metal hydrides (materials which are able to reversibly store hydrogen) from small laboratory sized samples (< 20g) to large, commercial sized batches (~ 12 kg) for fuel cell powered mining vehicles at HySA Systems in Cape Town, South Africa. Outside of work my interests include travelling, music & playing squash.

Meet the Team

EPS Research Support Team

EPS Research Support are your first point of contact for pre-award research support. They can help with all aspects of grant proposal preparation, development and submission. This includes:

Proposal preparation and submission

- Costing and pricing, including liaising with collaborating institutions.
- Securing internal approvals.
- Help draft non-technical aspects of the proposal (e.g. Pathways to Impact, Justification of resources).
- Help secure and draft letters of support (internal and external).
- Proofreading and layman reviews of proposals.
- Processing of pre-award contracts, e.g. NDAs and collaboration agreements.

Information dissemination and advice on sources of funding

- EPSRC
- STFC
- Other RCs under UKRI, including Innovate UK and Research England
- Royal Society
- RAEng
- The British Academy
- Leverhulme Trust

EPSRC Engineering and Physical Sciences Research Council

ROYAL ACADEMY OF ENGINEERING

LEVERHULME TRUST

The team also offer training and workshops on a wide variety of topics, including grant writing, mock panels, data management, introduction to impact, working with industry, specific schemes and calls, and introductions to grant writing and fellowships for early-career researchers.

Key contacts

Don't hesitate to get in touch if you would like further information from the team on how they can help with any of the above.

- Dr Paul Reay, Head of Research Support (for training and general queries): p.reay@bham.ac.uk / 42216
- Padma Reddy, Research and Business Development Manager (for costings and support with grant writing and submission): p.reddy@cs.bham.ac.uk / 07990787429

If you would like to apply for funding please contact Neringa Collier: n.collier@bham.ac.uk / 58995 (Mon-Thu).

Future Editions

Ideas, suggestions and contributions for future editions of the Metallurgy and Materials Research newsletter are invited from all members of staff. Please contact James Keatley (j.keatley@bham.ac.uk) with any suggestions or relevant items that you would like to submit.