Centre for Doctoral Training in Fuel Cells and their Fuels

Newsletter
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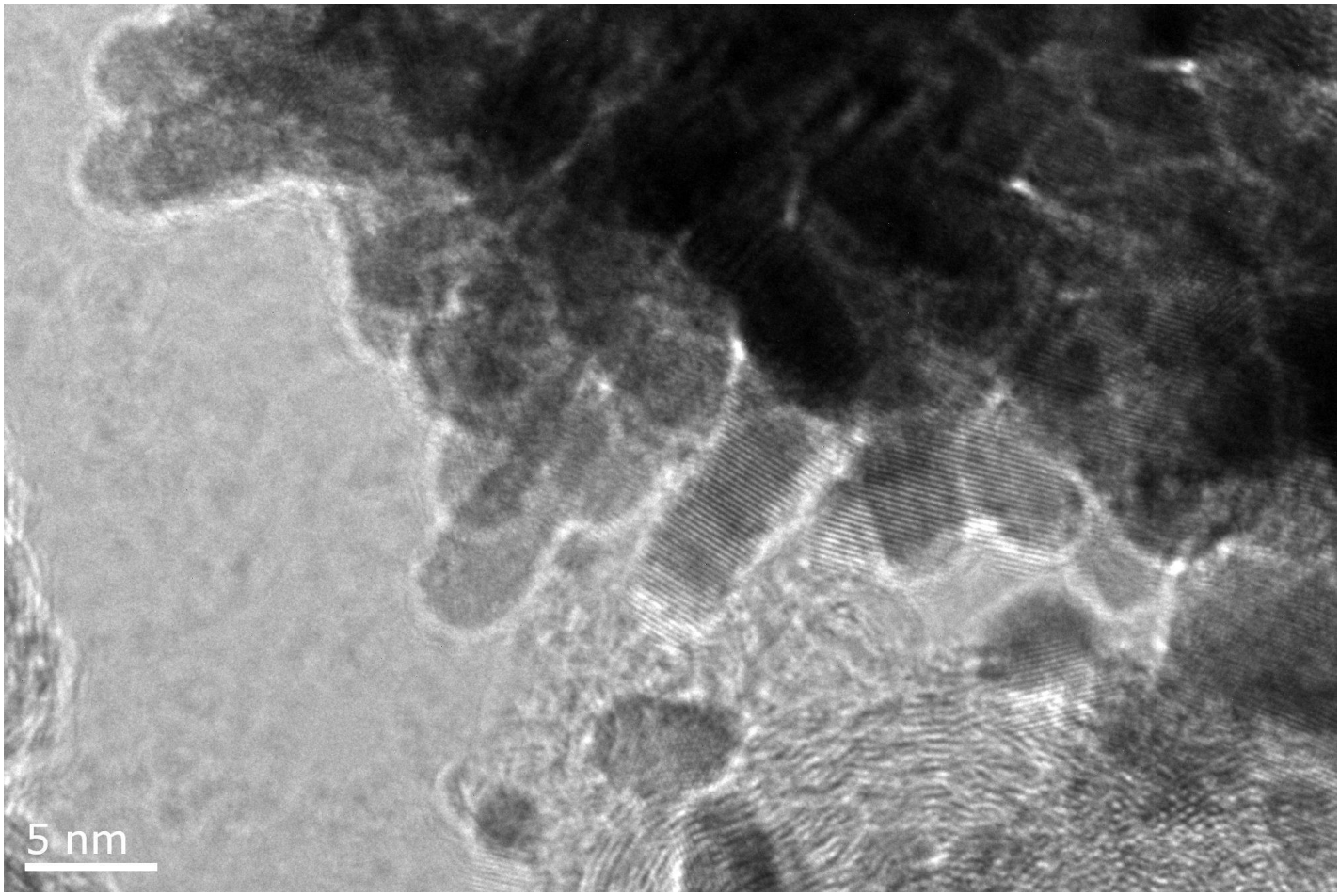

hfc-cdt-editors@
contacts.bham.ac.uk

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CDT Fuel Cells and
their Fuels

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Welcome

Welcome to the October 2016 edition of the newsletter for the Engineering and Physical Sciences Research Council funded Centre for Doctoral Training in Fuel Cells and their Fuels which is a research partnership between the Universities of Birmingham, Nottingham, Loughborough, Imperial College London and University College London.

This newsletter was compiled by University of Birmingham Co-Ordinators James Walker and Aimee Jackson with contributions from Site Editors Daniel Smith (University of Nottingham), and Sharleigh Talbot (Loughborough University). The editors are grateful to Project Officer John Hooper for his assistance. Readers can contact the editors with comments and contributions at:

hfc-cdt-editors@contacts.bham.ac.uk

Top: Aimee and James.

Bottom: Sharleigh and Daniel.

Thanks to Pete Mardle for our cover image: platinum nanowires. Highlights in this edition include an insight into the recent conferences and a round-up of public outreach activities from across our network.

Contents

Events & Activities	Page 3
Outreach	Page 6
Interview the Industrialist	Page 7
Announcements	Page 10
Publications	Page 11

What Have We Been Up To?

Lucerne 2016

The CDT is always well represented at the European Fuel Cell Forum in Lucerne and this year was no different. Chaired by Nigel Brandon, Imperial College London site director, the event brought together researchers with interests in solid oxide fuel cells and electrolysers from across the world. There were 300+ contributions focusing on key areas of SOFC and SOE development, such as state of the art materials and novel characterisation techniques. The CDT made 3 contributions: 2 posters by Melissa and Graham and an oral presentation by Lois.

A highlight for Lois was the presentation from David Hart, director of E4Tech, who opened the conference with a summary on the state of the fuel cell industry. Reassuringly, figures for the number of megawatts of fuel cells shipped are at an all-time high. Readers can access the Fuel Cell Industry Review online.

Our colleagues enjoyed the famous Lucerne boat party.

International Workshop of Nitride Semiconductors in Orlando, Florida

Loughborough University's Andrew McInnes and Diana Mehta recently attended the International Workshop on Nitride Semiconductors in Orlando, Florida. Despite Hurricane Matthew's arrival in Florida coinciding with Andrew's visit, he managed to enjoy the huge range of talks which showcased the applications for nitrides in solar cells, LEDs and sensor applications. A particular highlight for Andrew was a keynote talk by Zetian Mi from McGill University entitled 'High Efficiency Solar Fuels Generation by III-Nitride Nanostructures,' as this aligned to his interest in III-nitride seminconductors for solar water splitting

III Nitride fans assemble at the conference venue.

ISE, The Hague

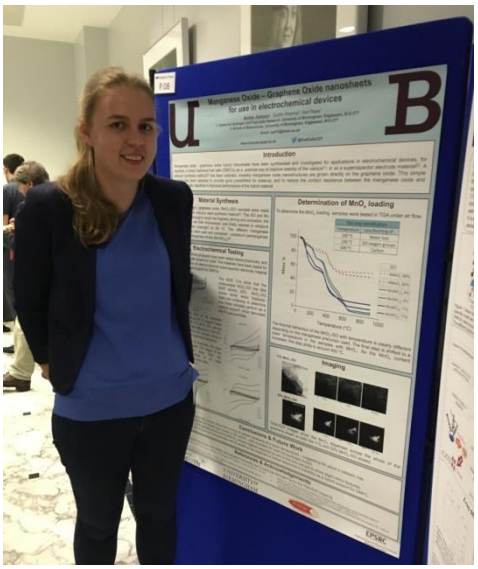
Daniel Escalera López from Birmingham went to the 67th Annual Meeting of the International Society of Electrochemistry between the 21st and 26th August 2016 at the “World Forum” in The Hague, the Netherlands.

The scenery at the conference was wind-erful!

With 1600 attendees and a wide range of symposia, all trending topics in electrochemistry were covered. The symposia which most related to research performed within the CDT were the “Novel Materials and Devices for Energy Conversion and Storage” and “Physical and Interfacial Electrochemistry” sessions. A particular highlight was the talk of Fabio Dognini and Arco Bergmann, of TU Berlin, who presented NiFe and cobalt oxide as novel catalysts for the oxygen evolution reaction.

Daniel’s poster, titled “Magnetron-sputtered Ni-doped MoS2 nanoclusters for the hydrogen evolution reaction” attracted the attention of several attendees and he enjoyed fruitful discussions. We’re delighted to hear that research conducted in Birmingham was so well received at such a prestigious conference.

IOP Nanoparticles



Aimee presenting her poster

This summer, Birmingham’s Aimee and James went down to London to the Institute of Physics’s ‘Nanoparticle Characterisation – Challenges in the Community’ workshop. In the plush surroundings of the IOP’s Portland Place headquarters, the conference brought together industrial and academic researchers working in all

areas of nanoparticle characterisation. The day consisted of talks from invited speakers, and there was a poster session for students.

There were several recurring themes throughout the day, with a focus on the need for greater clarity and more rigorous standards in the definitions used in all aspects of the nanosciences. Further discussions centred on technique development needs, and on highlighting the scope for complementary measurements. An interesting study undertaken by the National Physical Laboratory made clear the need for greater standardisation by demonstrating huge discrepancies in XPS spectra captured for the same materials in geographically separate labs.

CINF Summer School

In August, Birmingham PhD students Laura Allerston, Daniel Escalera Lopez, Pete Mardle and James Walker attended the Danish Technical University's CINF Summer School on 'Reactivity of Nanoparticles for More Efficient and Sustainable Energy Conversion'. The venue for the summer school was the Kysthusene holiday park in northern Denmark, and many of the week's events took place along the Baltic coast. On the final evening, attendees enjoyed a memorable finale in the form of a bonfire under a serenely clear sky, just in time for the Perseid meteor shower.

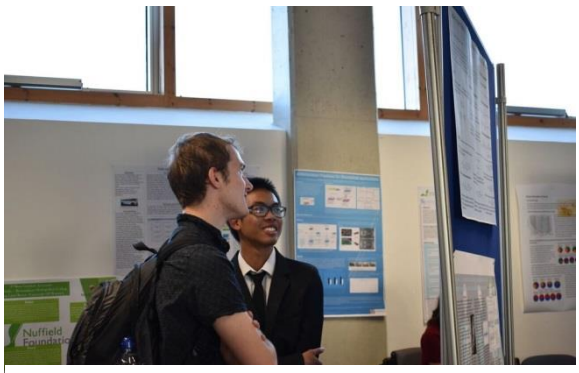
From left: Daniel, Pete, James & Laura enjoying the amusements at Tivoli Park.

The summer school brought together leading nanochemists, electrochemists and experts in heterogeneous catalysis for a series of lectures on recent developments in the field. Particular highlights were lectures on novel electrochemical techniques by Nenad Markovic of the Argonne National Laboratory and in-situ studies of nanoparticle growth by Bo Brummerstadt Inversen from Aarhus University. There were three poster sessions throughout the week and all four of our students took the opportunity to present their work. Constructive discussions during the poster session have given them lots of new ideas to take forward in their research.

Outreach Activities

Nuffield Placement

Over the summer, Birmingham second year Peter Mardle supervised two college students on a Nuffield Foundation research placement. They spent some time in the lab learning about ex-situ and in-situ methods of characterising PEMFC catalysts. In doing so they were able to investigate the effect of platinum oxide formation on the activity of platinum based catalysts.



Pete is thrilled by the Nuffield students' work.

After the project they both submitted reports and presented a scientific poster at a Nuffield Foundation celebration event at the University of Coventry, where they achieved a gold award for their placements. By undertaking this project the two students gained hands-on experience in a research environment while learning about the role that PEMFCs can play in a sustainable energy future.

Worlds Collide

In September, Birmingham's Aimee, Alan and James attended an interdisciplinary public engagement workshop, 'Worlds Collide' at Birmingham Open Media. The event was organised by the University of Birmingham's Public Engagement with Research Committee and aimed to bring together researchers and artists working in the city to discuss possible collaborations, with the promise of funding available to seed projects. All three enjoyed the event and are hatching various plans for upcoming activities.

Interview the Industrialist

For this edition we caught up with an ex-PhD student of the Birmingham group, Phil Hamilton, who is now working as a Business Development Engineer with Teer Coatings Ltd, a Miba AG company. Teer Coatings Ltd is a specialist Physical Vapour Deposition (PVD) coatings company which develops coating deposition equipment and provides coating services, and Phil's role has straddled both the R&D and Business Development departments. While at the University of Birmingham, Phil completed an EPSRC CASE-funded PhD which was sponsored by his current employers. CASE Awards, or rather Industrial Cooperative Awards in Science and Technology fund PhD studentships where businesses take the lead in arranging projects with industrial significance, and by the sounds of things, Phil's research had real and tangible impact. We sent Phil some questions to find out about his PhD experience and if he had any wisdom to share with those of us just embarking on our PhD careers.

JW: Thanks for taking the time to talk to us Phil. First of all, what did you work on in your PhD and can you pinpoint any research highlights?

PH: My work investigated the suitability of thin film, single and multi-layered coatings, by a Physical Vapour Deposition (PVD) process for metallic PEMFC bipolar plates. Due to the multifunctional nature of this component, the coatings needed to have both low interfacial contact resistance and chemical stability under fuel cell operating conditions. It was great to be able to develop and characterise coatings which were measurably better than the imcumbents.

JW: And more generally, any particular highs and lows of your PhD experience?

PH: One of the worst moments was very shortly after starting my PhD, when it emerged that the original company that was supposed to be sponsoring me had a change in management and decided they no longer want to sponsor a student to work on bipolar plate materials. This was a real disappointment, as industrial sponsorship was one of the primary reasons I chose to do this particular PhD. Conversely, one of the best moments was subsequently getting new sponsorship in my 2nd year for the remainder of my PhD. I really valued the industrial input and advice, and to know that the work I was doing was industrially relevant and made a tangible

difference to their business.

JW: How do you think your PhD experience has impacted your career? Any significant take homes?

PH: As my industrial sponsor offered me a job after my PhD, it has been really satisfying to be able to take the technical knowledge gained from my PhD straight in to industry. It's been great working with others who are at the forefront of the technology to find that they are also wrestling with the same questions (and occasionally to provide some answers!). I think a couple of important skills I learned during my PhD were firstly the importance of taking responsibility/ownership for getting things done – in my case I had pretty limited support from three sequential primary supervisors over the course of my PhD due to unforeseeable circumstances which really meant I had to 'drive' the project. Secondly I learned the importance of networking – I worked with three different companies over the course of my PhD and subsequently was in the right place at the right time, when one of them was fortunately looking to sponsor a student.

JW: What does your current role involve?

PH: I've been at my current company for about 4 years now and my role has straddled both the R&D and Business Development departments. For the first couple of years, I was the technical lead on Innovate UK and EU FCH-JU funded projects which involved coating development, characterisation and validation with external partners including ITM Power, Intelligent Energy, Tata Steel, ElringKlinger and Fronius. I've also had the opportunity to travel globally to exhibit and present at international conferences/trade fairs and directly work with many automotive OEMs, tier 1-2 suppliers and research institutes. From the business development perspective, I've been monitoring the wider political, economic, social and technological factors affecting the development and deployment of electric/electrified vehicles (EVs, HEVs, PHEVs and FCEVs). More recently, I've broadened out to look at other coating applications for strategic automotive technologies and have worked to identify relevant funding for collaborative development projects and submit proposals.

JW: Great to hear from you Phil, thanks! One final question; if you could give one piece of advice to your PhD student self, what would that be?

PH: It goes without saying that everybody's PhD journey is unique and very much depends on their particular situation - group, topic, supervisors etc. From my perspective, it would have been helpful to remember that things rarely go according to plan, but that's ok (or at least not the end of the world!). What's more important is how you deal with them. Keep on going and work out how you can use those situations to your advantage or what you can learn from them – it could well turn out that these 'obstacles' become foundational to, or at the very least helpfully shape, the broader narrative of your thesis. I also think it's a great idea to start drafting your thesis as soon as possible, this allows you to see more clearly where the 'holes' are and helps keep you focused on the end goal over the course of your PhD.

Thanks again to Phil for his insight! We're hoping to make this a regular feature so if you know of any interesting alumni that you'd be interested in hearing from, let us know!

Achievements & Announcements

Congratulations to our University of Nottingham colleagues on the opening of their shiny new GlaxoSmithKline Carbon Neutral Laboratory for Sustainable Chemistry. We're all looking forward to visiting!

Thanks to Daniel Smith for sending this picture of the new lab.

We're also delighted to acknowledge awards received by some of our Loughborough cohort, and to announce some changes in the student representation panel for this year.

Congratulations to -

Jake Walls (Loughborough University)

- Best 2nd year poster prize at the 5th Loughborough Science Matters conference.

and Andrew McInnes (Loughborough University)

- Best poster prize in the Loughborough Graduate School conference Energy Research Challenge.

And best wishes in their new roles to -

Alan Stephen (University of Birmingham)

- New CDT Rep.

Pete Mardle (University of Birmingham)

- New Birmingham Student Rep.

Ashkan Kavei (Imperial College London)

- New Imperial College Student Rep.

Graham Stevenson (Imperial College London)

- New Imperial College Newsletter Editor.

Publications

1. Burch, H.; Isaacs, M.; Wilson, K.; Palmer, R.; Rees, N., Electrocatalytic regeneration of atmospherically aged MoS 2 nanostructures via solution-phase sulfidation. RSC Advances, 2016, 6 (32), 26689-26695.

2. Escalera-López, D.; Niu, Y.; Yin, J.; Cooke, K.; Rees, N. V.; Palmer, R. E., Enhancement of the Hydrogen Evolution Reaction from Ni-MoS2 Hybrid Nanoclusters. ACS Catalysis, 2016, 6 (9), 6008-6017. http://dx.doi.org/10.1021/acscatal.6b01274

3. Fletcher, T.; Thring, R. H.; Watkinson, M.; Staffell, I., Comparison of Fuel Consumption and Fuel Cell Degradation Using an Optimised Controller. ECS Transactions, 2016, 71 (1), 85-97. http://ecst.ecsdl.org/content/71/1/85.abstract

4. Goodwin, S. E.; Walsh, D. A., Hydrogen Electrooxidation under Conditions of High Mass Transport in Room-Temperature Ionic Liquids and the Role of Underpotential-Deposited Hydrogen. The Journal of Physical Chemistry C, 2016, 120 (21), 11498-11507. http://dx.doi.org/10.1021/acs.jpcc.6b01592

5. Robbs, P. H.; Rees, N. V., Nanoparticle electrochemistry. Physical Chemistry Chemical Physics, 2016, 18 (36), 24812-24819.

6. Whiteley, M.; Dunnett, S.; Jackson, L., Failure mode and effect analysis, and fault tree analysis of polymer electrolyte membrane fuel cells. International Journal of Hydrogen Energy, 2016, 41 (2), 1187-1202.

7. Rhodri, J.; Brown, L. D.; Neville, T. P; Millichamp, J; Finegan, D. P.; Heenan, T. M. M.; Brett, D. J. L.; Shearing, P. R., Design of a miniature flow cell for in situ x-ray imaging of redox flow batteries. Journal of Physics D: Applied Physics, 2016, 49 (43), 434002.

Closing Remarks & Caption Competition

Don't forget to let John Hooper (J.C.Hooper@bham.ac.uk) know about any conferences that you attend using the CDT Event Questionnaire.

We'll close this edition with a caption competition. The picture comes from Birmingham's Daniel, James, Laura and Pete's visit to Denmark for the CINF Summer School. The summer school gala dinner was held within Copenhagen's famous Tivoli amusement park and attendees were encouraged to take advantage of the theme park rides available. Suffice to say James was less keen on this idea than Pete! Send your captions to to the editors at hfc-cdt-editors@contacts.bham.ac.uk.

That's all for this issue - thanks for reading! Any comments, captions or contributions to the next edition can be sent to the editors at hfc-cdt-editors@contacts.bham.ac.uk or tweet us at @FuelCellsCDT. You'll also find us on Facebook as 'Fuel Cells and their Fuels CDT'.