



Propulsion Futures Beacon Newsletter

Welcome to the latest Propulsion Futures Beacon Newsletter where we share our news and achievements towards sustainable materials and technologies for greener and more electric transport systems.

News

Beacon invests in equipment for PEMC Building

Although completion of the new Power Electronics Machines Centre (PEMC) building has been slowed by Covid-19, the Propulsion Futures Beacon continues to work closely with the team to invest in equipment.

Central to realising our vision for a unique, testing facility for high power rating propulsion activities, the new PEMC will boast a 5-Megawatt supply, delivered to projects in unique high capacity, high flexibility mechanical and electrical systems. With access to high voltage AC (alternating current) and DC (direct current), the purpose-built facility is designed to cater for industrial requirements in machines testing and the future needs of electrified propulsion, including but not limited to aerospace, automotive, traction and marine.



Universities: Working towards Net Zero Aviation



Discover more about The University of Nottingham's extensive involvement and key successes in the Clean Sky aviation programme in the latest edition of the Clean Sky Skyline magazine.

The article explains the University of Nottingham's range of research collaboration in several major aerospace demonstrator platforms, including Rolls-Royce UltraFan, Leonardo future turboprop and Safran next generation turboprop. Read more here: bit.ly/37EN62X

H2020 Clean Sky II grant awarded

Dr Mark Jabbal and project team have been awarded a H2020 Clean Sky II grant in collaboration with the Institute of Aviation, Poland, starting 1st July, on aerodynamic flow control technology to enable more efficient UHBR (ultra high bypass ratio) engines on large passenger aircraft. Total project award = 898k Euros, (UoN 485k Euros) cordis.europa.eu/project/id/887092.

For further information please contact [Dr Mark Jabbal](#), Assistant Professor in Aerospace Engineering, Faculty of Engineering.

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approaches and applications

Beacon member, Dr Jeremy Titman, has been awarded £481k by the Engineering and Physical Sciences Research Council (EPSRC) to realise the potential impact of Dynamic Nuclear Polarisation (DNP), by developing new approaches to sample preparation.

This aspect of the proposed research will inform progress in the design of new materials by our research collaborators from within Nottingham and support the commercial development of new technologies by our partners from the industrial sector. This will be conducted alongside external partners Johnson Matthey and L'Oreal.

Summary of project details can be found at: <https://bit.ly/2YJNRUf>

For further information please contact [Dr Jeremy Titman](#), Associate Professor and Reader in Magnetic Resonance, School of Chemistry.



Engineering exploiting new opportunities in Aviation

Find out how the University of Nottingham, part of the UK Aerospace Research Consortium (UK-ARC), is helping overcome technological challenges to the electrification of aircraft and the new manufacturing processes it requires in this interesting article in [New Electronics Magazine](#) with Professor Chris Gerada, Professor of Electrical Machines.

Nottingham involvement in the EU Graphene Flagship has been extended from April 2020 - March 2023

The Graphene Flagship is tasked with bringing together academic and industrial researchers to take graphene from the realm of academic laboratories into European society. The core consortium consists of over 150 academic and industrial research groups in 23 countries. To find out more about this project visit the [website](#).

For further information please contact [Prof Amalia Patanè](#), Professor of Physics, School of Physics and Astronomy.

Two New Bids submitted to Driving the Electric Revolution (DER) programme

Within the Beacon, we have recently submitted two bids into DER equipment calls:



1. Manufacturing and Scale up of Power Electronics, Dr Mark Johnson
Equipment for an enhanced facility to demonstrate new manufacturing approaches for power electronic modules to take full advantage of the faster switching, higher voltage and higher temperature capability of Wide Band Gap (WBG) and advanced Silicon devices. £2.3m supported by 22 industrial partners from across the seven sectors.

2. Manufacturing and Scale up of Electrical Motor Drives, Prof. Chris Gerada
Request for investment in facilities to develop and manufacture electrical machines and other electromagnetic components able to operate at higher frequencies, taking advantage of the widespread adoption of Wide Band Gap devices (WBG) and new converter topologies - £3m supported by 40 industrial partners from across the seven sectors.

For further information please contact [Dr Hitendra Hirani](#), EU Programme Manager.

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recognised as one of top 50 women in Engineering



This fellowship is a prestigious award for early career researchers to undertake a significant piece of publishable work. During her previous Daphne Jackson Fellowship, Xuanli investigated a series of quasicrystal materials for application in hydrogen storage.

In this fellowship, Xuanli will focus on developing a highly novel electronically controlled hydrogen storage system based on quasicrystals to enable room temperature hydrogen storage suitable for use in vehicles. Xuanli is also interested in fundamental research to investigate the interaction between hydrogen and storage materials, and reaction mechanisms using in-situ techniques such as neutron diffraction, XAS, NP-XPS.

In June, Xuanli was also recognised as one of the Top 50 Women in Engineering for 2020 by the [Women's Engineering Society](#) (WES). Read [more here](#).

Successful Awards for Research into Ammonia Fuelled Engine Technologies

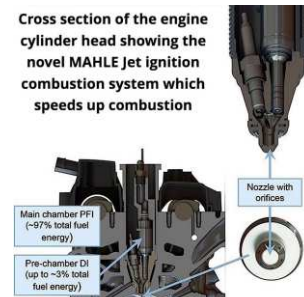
Sustainable Heavy Duty Truck, Marine and Rail Transport

A 3 year (£1.3m) EPSRC programme led by Nottingham with Newcastle and Reading universities to understand the potential best use of ammonia internal combustion engines in marine and heavy-duty ground transport. The work will consider minimising energy demand across the full life cycle and will interact with the green ammonia production plant at Rutherford.

Advanced Zero Emission Ammonia Engines for Future Marine Applications

A 12 month project funded by MarRI UK (£97k) and led by Nottingham with industrial partners MAHLE Powertrain and Shell to compare dual fuel (diesel or biodiesel pilot) and jet ignition ammonia internal combustion engine technologies as a means to enabling high engine thermal efficiency with ultra low or zero NOx emissions for future marine applications.

For further information please contact [Prof Alasdair Cairns](#), Chair in Automotive Propulsion, Faculty of Engineering.

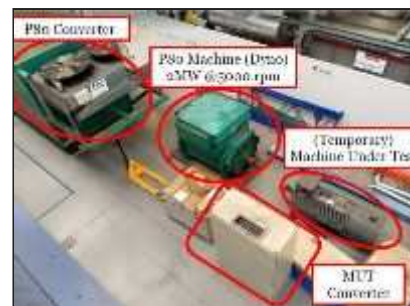


Examples of Scientific Outputs

Continued Progress on Electrical FAN Test Facility with Move into Aerospace Technology Centre

The investigation on the physic failure for electrical machines' insulation has moved from the analysis of thermal aging at constant and variable temperatures to the partial discharge inception mechanism. The research activity on insulation thermal deterioration led to the journal paper entitled "A Time-Saving Approach for the Thermal Lifetime Evaluation of Low Voltage Electrical Machines" published on Institute of Electrical and Electronics Engineers (IEEE) Transaction on industrial electronics. The accelerated aging test campaign on Type II insulation has been designed and started with the aim of studying and evaluating the impact of low-pressure environment (i.e. high altitude) on partial discharge inception and consequent insulation degradation.

Regarding the test-bench facility for testing propulsion electrical machines, the main components have been moved to the Aerospace Technology Centre (ATC) and a Research Fellow is organising and supervising the commissioning.



For further information please contact [Dr Paolo Giangrande](#), Senior Research Fellow, Faculty of Engineering.



We are delighted to welcome Dr Jessica Pereira to the Beacon as Research Fellow in Organic Materials for Energy Generation and Storage.

Working in GSK Carbon Neutral Laboratory for Sustainable Chemistry, Jessica will focus on the fabrication of transparent conductive electrodes for application in organic material devices for energy generation and storage.

Beacon Members reflect on the impact of COVID-19

Dr Nicholas Pearce, Research Fellow, School of Chemistry



As a mostly experimental chemist, the closure of the University in response to the pandemic meant I needed to rethink my working – access to a lab is important for a lot of what I do and I can't fit an Nuclear Magnetic Resonance spectrometer in my living room (even if I was allowed to try). With that said, Nottingham does have a history of chemical discoveries taking place at home; the roots of ibuprofen famously began in a West Bridgford house belonging to Stuart Adams. As tempting as it was to try and replicate this achievement, in the end I decided it would be best to leave my kitchen just for food preparation and instead I focussed on writing up the work I had already done. The ongoing nature of lab work seems to create a lot

of distractions from writing it all up, so I actually found it refreshing to have a lot of time to get on top of my data, and to try and organise it into something publishable.

Sharing the lockdown experience with my co-workers has been both inspiring and uplifting: despite the separation we've still managed to stay in (virtual) touch for plenty of our usual social events, from quizzes and board games to film nights and coffee breaks. Amongst all the fun, there has even been time to fit in some chemistry-related discussions, with colleagues sharing their newly acquired software skills as well as getting the research group together for seminars about crystallography or reaction mechanisms. Whilst eventually returning to the lab will be vital to progressing my research, the time away has ended up being a valuable opportunity to supplement my practical experience with some new skills and was the perfect chance to get reacquainted with old data.

Dr Alexander Kibler, Research Fellow, School of Chemistry

Personally, the arrival COVID-19 had come at a bad time considering I started my PostDoc in late 2019. As a synthetic chemist and a lab enthusiast with a new field to explore, I was initially dismayed; having not long finished writing a thesis, the idea of becoming deskbound again was daunting. Initially, acclimatising to this new way of working was difficult, mostly due to lessened social interaction and the unhindered temptation to snack...however, this new undistracted and introspective way of working has given me the opportunity to prepare manuscripts, re-evaluate data and develop new research ideas, ready to return to the lab with a renewed fervour and focus.



Examples of Recent Publications

Design of van der Waals interfaces for broad-spectrum optoelectronics

Nature Materials, <https://go.nature.com/3heU1nL>

Interlayer Band-to-Band Tunneling and Negative Differential Resistance in van der Waals BP/InSe Field-Effect Transistors

Advanced Functional Materials, <https://bit.ly/3dW1Cps>

Per-Alkoxy-pillar[5]arenes as Electron Donors: Electrochemical Properties of Dimethoxy-Pillar[5]arene and Its Corresponding Rotaxane

MDPI Journal, <https://bit.ly/2AVTTcc>

Influence of molecular design on radical spin multiplicity: characterisation of BODIPY dyad and triad radical anions

Physical Chemistry Chemical Physics, <https://rsc.li/2XTdLpe>

Dewar Benzeoids Discovered in Carbon Nanobelts

The Journal of Physical Chemistry Letters, <https://bit.ly/3dTGwb1>

[Subscribe](#)[Past Issues](#)[Translate ▼](#)**Highly modulated supported triazolium-based ionic liquids: direct control of the electronic environment on Cu nanoparticles**Nanoscale Advances <https://bit.ly/3hgT3r3>**Catalytic Semi-Water–Gas Shift Reaction: A Simple Green Path to Formic Acid Fuel**ChemSusChem, <https://bit.ly/3hjNGY7>**Large non-thermal contribution to picosecond strain pulse generation using the photo-induced phase transition in VO₂**Nature Communication, <https://bit.ly/2Uye9I1>**Progress towards the UK's net-zero goal must be measured correctly,**Renewable Energy World, <https://bit.ly/3cSVRHE>**Why medium-duration energy storage is vital for 'net zero' UK**Institution of Mechanical Engineers, <https://bit.ly/2A8Geg>**Best Practice for Evaluating Electrocatalysts for Hydrogen Economy**ACS Applied Materials & Interfaces, <https://bit.ly/2BAGbfi>

Events

Collaboration and interaction continue to be core principles for the Beacon, to support this we have evolved our monthly Seminars into shorter weekly Webinars each Wednesday at 12.30pm. Join the webinars: [here](#).

Upcoming schedule:**1 July** Electrolytes and interfaces in next-generation batteries, Dr Lee Johnson, School of Chemistry**8 July** Molecular metal oxides for hybrid energy materials, Dr Graham Newton, School of Chemistry**15 July** Ionic liquid electrolytes for energy conversion and storage, Dr Darren Walsh, School of Chemistry**22 July** Sustainable Hydrogen CDT presentations (2x speakers TBC)**29 July** Sustainable Hydrogen CDT presentations (2x speakers TBC)**August** We will take a break from sessions throughout August**September: Industry and Academic Forum**

The Beacon will start a new virtual Industry and Academic Forum with a kick off session on 2nd September. The purpose of this Forum is to create an environment that brings researchers from academia and industry together to discuss the development of research, encourage new collaborations and establish new relationships. Through a series of sessions led by our [Vision leads](#) we will showcase research and infrastructure capabilities within the University and host discussions and presentations from experts from both within the University and in Industry.

Further details will be circulated closer to the date. To express an interest in attending the event, please contact EZ-PF-Beacon@nottingham.ac.uk.

External Speakers

The Beacon continues to host external speakers, albeit in a virtual environment.

9th July, 4pm. Our next guest speaker will be Dr Gerry Agnew, Senior Research Fellow at University of St Andrews on . His topic will be '*De-carbonising transport with electrochemical systems – fuel cells and electrolyser and their hybrids*'. To attend email EZ-PF-Beacon@nottingham.ac.uk.

Biography: Gerry has spent the last 23 years working on fuel cell and electrolyser hybrids. He was the initiating founder of the spin-out that later became LG Fuel Cell Systems Inc and spent most of his career in Rolls-Royce companies where he cofounded the fuel cell business in 2002 and was technical lead through JVs with Singapore and Korean giant LG until 2015. This programme culminated in a successful field test of a 250kW fuel cell - gas turbine hybrid system in Ohio in 2018 running at 62% DC efficiency at full power.

Gerry is now enjoying the freedom of a portfolio career including a Non-executive Directorship at AFC Energy plc and a part time Senior Research Fellow position at the University of St Andrews. He also sits on the Advisory Board of fuel cell engineering start-up Arcola energy. He holds a degree and PhD in



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Previous Speakers

'Ammonia in Future Propulsion and its Alternatives'

In April we were delighted to host a popular presentation given by Dr Mike Mason, chaired by Professor Seamus Garvey. Listen back on YouTube.

Why Focus on Aviation?

- Aviation – crack this most difficult challenge and the others fall into place
- Shipping – huge, but easier than aviation with similar solutions
- The rest – multiple solutions



13 July 2019 – 205,000 flights recorded in 24 hours

Research Development and Collaboration



The Beacon in Propulsion Futures is constantly looking to support new ideas and innovation in science and engineering to drive the discovery and translation of new materials, new components and new technologies for future, greener, propulsion systems in mobile applications. The [Beacon Executive Board](#) is made up of members from the faculties of Engineering and Science. The board members are [David Grant](#), [Mikiel Galea](#), [David Amabilino](#), [Amalia Patané](#), [Chris Gerada](#), [Seamus Garvey](#), [Richard Wheatley](#), [Frank Kirkland](#). You can contact our Head of Operations, [Romina Davoudi](#), or any of the Executive Board to discuss ideas. The Executive

Board meets every three weeks and works hard to turn around ideas, suggest proposals and provide feedback to support your ambitions in this area.

Thank you for reading this newsletter.

David Grant, Director of Propulsion Futures Beacon

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