

Electrochemistry for a Sustainable Future 15th – 16th June

Workshop Report



Introduction

Electrochemistry is entering an exciting new era, rapidly emerging as one of the defining technologies underpinning the global transition to a sustainable future. While traditionally associated with rechargeable batteries and energy storage, the discipline is now driving innovation across an increasingly diverse range of applications, including carbon capture, green hydrogen production, water purification, sustainable chemical manufacturing, healthcare diagnostics, robotics and advanced sensing technologies. As governments and industries accelerate efforts towards net zero, electrochemistry is playing an increasingly important role in decarbonising energy, transport, manufacturing and agriculture, whilst enabling entirely new approaches to resource recovery and environmental protection.

Against this backdrop, the Electrochemistry for a Sustainable Future workshop brought together internationally recognised research leaders alongside emerging early career researchers from across the UK to explore the latest scientific advances, identify future challenges and discuss the opportunities that lie ahead for this rapidly evolving field.

Event Aims

The workshop aimed to foster creative discussion between established researchers and emerging academics, encouraging new perspectives on the scientific and technological challenges facing next-generation electrochemical systems. A further objective was to launch the Surrey Electrochemistry Network onto the national stage. Bringing together over 20 academics spanning two faculties and five schools, the Network showcases the

breadth of electrochemical research at the University of Surrey, providing a platform for interdisciplinary collaboration, strengthening links with industry and research institutions, and establishing Surrey as a leading centre for electrochemical innovation.

Organisers and the Surrey Electrochemistry Network

The workshop was organised by Dr Daniel Commandeur and Dr Hui Luo, Co-Chairs of the Surrey Electrochemistry Network, who coordinated the scientific programme, invited speakers and oversaw the organisation of the two-day event. Its success, however, reflected the collaborative efforts of the wider Surrey Electrochemistry Network, which brings together more than 20 academics and 10 postgraduate researchers from across the University.

Scientific sessions were expertly chaired by Professor Adrian Dobbs, Dr Bahman Amini Horri, Professor Carol Crean and Professor Bob Slade, facilitating engaging discussion throughout the workshop. Surrey researchers also made a significant contribution to the scientific programme, with presentations from Professor John Varcoe, Dr Lei Xing, Professor Qiong Cai, Dr Kai Yang, Dr Hui Luo and Dr Marina Ramirez Moreno, showcasing the University's breadth of expertise in electrochemical energy conversion, storage, sensing and sustainable manufacturing.

The programme also highlighted Surrey's commitment to developing future research leaders through presentations from postgraduate researchers James Scanlon and Kyriakos Almpandis, whose talks demonstrated the high quality and diversity of emerging electrochemical research. Together, these contributions showcased the strength of electrochemical research across five schools spanning two faculties, while the active participation of many other Network members fostered lively discussion, new collaborations and strengthened Surrey's position as a leading interdisciplinary centre for electrochemical research.

Event Themes

Over the two days, around 60 different participants joined, with around 50 on the first day, and over 30 attendees on the second.

Energy Conversion (15 June)

The workshop opened by exploring how electrochemistry is accelerating the transition towards net-zero energy systems. From bioelectrochemical technologies to advanced fuel cells and electrolyzers, the session highlighted the breadth of approaches being developed to convert renewable electricity into practical solutions for society.

Professor Ioannis Ieropoulos demonstrated the remarkable versatility of microbial fuel cells, illustrating how wastewater can be transformed into a source of renewable electricity while simultaneously treating waste and recovering valuable products. Through examples from the internationally recognised Pee Power® programme, he showed how bioelectrochemical systems can generate electricity, produce disinfectants and biofertilisers, and improve sanitation in both remote and urban environments.

Dr Mengnan Wang explored how engineering the microscopic pore architecture of catalyst layers can dramatically improve fuel cell performance. By tailoring carbon porosity, ion transport and local reaction environments can be optimised, resulting in more efficient oxygen reduction reactions and improved performance under practical operating conditions.

Together, the session demonstrated that successful energy conversion relies not only on novel materials, but equally on robust characterisation, standardisation and a deep understanding of electrochemical interfaces.



Energy Storage (15 June)

The afternoon focused on the rapid evolution of sustainable battery technologies, with speakers emphasising that future energy storage solutions must combine high performance with scalable manufacturing and circular resource use.

Professor Emma Kendrick presented an integrated vision for sustainable sodium-ion batteries, describing advances in cathode particle engineering alongside innovative recycling strategies. Her work demonstrated how improved electrode design can enhance battery lifetime while new recycling techniques, including the novel "ice-stripping" process, allow valuable electrode materials to be recovered without harsh chemicals or energy-intensive processing. Together, these developments offer a pathway towards truly circular battery manufacturing.

Dr Zhen Xu broadened the discussion beyond conventional batteries by introducing electrochemical capacitors capable of reversible carbon dioxide capture. By combining energy storage with carbon capture, these multifunctional devices illustrate how electrochemical technologies can simultaneously address climate change and energy storage challenges, opening exciting opportunities for integrated sustainable technologies.

Bridging both energy conversion and storage, Professor Gareth Hinds presented the National Physical Laboratory's work in developing internationally recognised measurement standards, predictive models and best-practice testing protocols. His talk highlighted the importance of reliable, reproducible electrochemical measurements in accelerating innovation and building confidence among researchers, manufacturers and investors alike.

Collectively, the session highlighted how innovations in materials science, manufacturing, recycling and measurement are converging to create more sustainable and resilient energy storage technologies.



Water Treatment and Sensing (16 June)

The second day shifted focus towards electrochemical technologies for environmental monitoring, healthcare and water treatment, illustrating how electrochemical sensors are increasingly moving beyond the laboratory into real-world applications.

Dr Lingcong Meng demonstrated how nano-engineered electrochemical interfaces can improve the selective detection of biological molecules. By combining microporous polymers with boron-doped diamond electrodes and nanopipette technologies, his work enables highly sensitive biomarker detection and offers promising routes towards earlier diagnosis of diseases such as ovarian cancer.

Professor Zhugen Yang showcased innovative origami-inspired paper microfluidic devices capable of rapid, low-cost pathogen detection in both clinical and environmental settings. Successfully deployed for wastewater surveillance during the COVID-19 pandemic, these portable sensors provide early warning of infectious diseases while also supporting broader monitoring of antimicrobial resistance and environmental health. Together, the talks illustrated the growing importance of electrochemical sensing for protecting both public health and the environment.

Electrosynthesis and Catalysis (16 June)

The final session demonstrated how electrochemistry is transforming chemical manufacturing through cleaner, more selective and energy-efficient synthetic routes powered by renewable electricity.

Dr Zeliha Ertekin presented electrochemically generated polyoxometalates as recyclable redox mediators for organic synthesis. Acting as molecular electron reservoirs, these compounds enable selective hydrogenation reactions under ambient conditions without hydrogen gas, precious metal catalysts or sacrificial reagents, providing a significantly more sustainable alternative to conventional chemical synthesis.



Professor Reshma Rao concluded the scientific programme by examining the atomic-scale mechanisms underpinning green hydrogen production and electrochemical biomass conversion. Using operando spectroscopic techniques to observe catalytic interfaces under working conditions, her research is revealing how catalyst surfaces evolve during reactions, enabling the rational design of earth-abundant materials for water electrolysis and the production of value-added chemicals from biomass. Her work demonstrated how fundamental mechanistic understanding can accelerate the development of sustainable electrocatalytic technologies.

Closing Remarks

Across two days, the workshop showcased the extraordinary diversity of modern electrochemistry, spanning renewable energy conversion, sustainable batteries, environmental sensing, wastewater treatment and green chemical synthesis. While the applications varied widely, a common thread emerged: electrochemistry is increasingly providing practical solutions to some of society's greatest environmental and technological challenges through the intelligent control of materials, interfaces and electrons.

As Professor Gareth Hinds remarked during his talk, "It's a very exciting time to be an Electrochemist." Judging by the breadth and quality of the research presented, few could disagree. And if there was one unexpected lesson from the workshop, it was that wastewater may well be the most versatile resource of all, capable of generating electricity, monitoring public health, recovering valuable materials and inspiring entirely new electrochemical technologies. It certainly left delegates looking at the humble sewer in a very different light.

Feedback and Perspectives

Feedback from both invited speakers and delegates was unanimously positive, with attendees highlighting the breadth of the scientific programme, the interdisciplinary nature of the discussions and the opportunities created for new collaborations. Several speakers commented on the unique combination of academia and industry represented at the workshop, as well as the strong participation of early career researchers. Many attendees expressed enthusiasm for future events, with one industrial delegate suggesting that the workshop should become an annual fixture.

Representative feedback included:

"The workshop provided an excellent platform for bringing together researchers across different areas of electrochemistry, fostering inspiring discussions and new collaborative opportunities."

Dr Zhen Xu, University of Manchester

"It was a great experience to hear about the latest exciting developments in electrochemistry, meet new people, and explore opportunities for future collaborations."

Dr Lingcong Meng, University of Edinburgh

"I particularly enjoyed the broad range of electrochemistry topics represented at the workshop... It was especially encouraging to see such strong participation from early-career researchers, which created a vibrant and collaborative atmosphere."

Dr Mengnan Wang, Exeter University

"We look forward to the next event... others at Ceres have already put themselves forward to attend."

Ceres Power

The workshop also generated considerable engagement on social media. Speakers praised the collaborative atmosphere, the breadth of electrochemical research showcased at the University of Surrey and the opportunities for networking. Several posts also recognised the excellent organisation of the event, with Professor Reshma Rao describing it as an "amazing" workshop and Dr Zeliha Ertekin thanking the organising committee for bringing together researchers from academia and industry to foster collaboration within the electrochemistry community.

Next Steps & Outcomes

The network in collaboration with the speakers of the conference will be writing two review papers based on our shared interest and targeting Q1 journals:

1. ***Electrochemistry Beyond Energy Storage: Integrated Platforms for Carbon Capture, Water Treatment and Resource Recovery***

Bringing together the themes from the second day, including electrosynthesis

2. ***Engineering Electrochemical Interfaces Across Length Scales: From Atomic Design to Reactor Performance***

Focusing on the links between fundamental electrochemistry, materials design, and reactor engineering.

Finally, to help crystallise the goals of the network, we are establishing a number of smaller, targeted working groups involving both Surrey researchers and our invited speakers to develop future grant proposals. Some potential themes include:

- **Electrosynthesis:** Frontier in operando methods to guide the development of new organic and inorganic synthetic reactions.
- **Water treatment:** Towards circular electrochemical systems for clean water and critical materials recovery.

Talks are already underway to prepare bids with new academic collaborators and industrial partners.

Acknowledgements

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