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# Electrochemistry right at your fingertips

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Nowadays, more and more people have daily contact with electrochemistry, though they may not know it. The Lithium-battery you have in your mobile phone, your mp3 player, even your electric car runs on electrochemistry. Look down your arm, that gold or silver-plated jewelry is created with electrochemistry, as is the organic light-omitting diode (or OLED as it's more commonly known) that displays in your mobile phone, e-book, tablet and TV. This science used to measure the sugar levels in your blood, to treat cancer and to protect metal structures from corrosion—in short, electrochemistry is all around us.

As demand increases, electrochemical science gains more attention from industry. In particular, businesses are exploring the use of electrochemistry for energy applications. With the growing concern about climate change and $CO_2$ emissions, there is a shift in focus to alternative "green" energy sources: wind, solar, Lithium-air (Li-air) batteries, and fuel cells. Not surprisingly, electrochemistry is involved in three of these clean energy technologies.

**The search for longer life**

But in order for these alternative technologies to see large-scale commercial uptake, their energy efficiency and cost effectiveness needs to be improved. Take, for example, the electric car: A great innovation undoubtedly, but the impact of these vehicles is limited because the current clean-energy technologies – whether Li-air batteries or fuel cells – are inefficient and too expensive. New developments in electrochemical technologies are needed to meet the demands of industry, and the public.

Extensive and intensive studies are being carried out in the development of fuel cells and Li-air batteries in order to make them cost-competitive devices for automotive as well as stationary applications. One approach is to make fuel cells and Li-air batteries cheaper and lighter by efficiently using the precious metals in the catalyst so that the same catalytic activity can be achieved with a lower amount of precious metal.

Another major concern is the durability of the fuel cells and Li-air batteries. The life-cycle of the fuel cell can be enhanced by replacing the commonly used carbon support materials with a more durable support. And at the same time, the durability of Li-air batteries can be improved by addressing its non-conductive discharge products.

**Electrochemists to the rescue**

Fortunately, there are a great many people looking into solving the limitations for fuel cell and Li-air batteries, myself included. In particular, I focus on the design of new, highly-functional, ORR-efficient nanomaterials for use in Polymer Electrolyte Fuel Cells (PEFCs) and Li-air batteries. I will attempt to achieve this by developing a molecular-level understanding of the electrochemical reactions in well-defined surfaces

The United Kingdom has a long and noble electrochemical tradition. She has produced famous electrochemists like William Cruickshank, inventor of the Trough battery, Humphry Davy, of Davy lamp fame, John Frederic Daniell, who gave the world the Daniell cell, and William Grove, who produced the first fuel cell in 1839. In fact, the sculpture of one of history's most famous electrochemists welcomes us every day we enter the University of Birmingham—UK-born and bred, Michael Faraday.

A deep fundamental comprehension of reaction mechanisms and a true understanding of physicochemical properties of electrodes are necessary to solve the limitations of Li-air batteries and fuel cells, and help to foster in the alternative energy revolution. The Birmingham fellowship will allow me to further the depth of my knowledge in electrochemistry and to recruit a team of researchers to help explore the field. Together we intend to contribute significant improvements to the development of electrochemical technologies based on sustainable energy resources.

And if we are successful, we hope that everyone will soon be using phones with batteries that last weeks rather than days, and driving around in electric cars that run for as long as (or even further than) a tank of petrol. We really are putting electrochemistry-aided products into your hands, and making so good that you will need never put them down.

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