SHINing Light on Electrode Interfaces

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The performance and safety of batteries are affected by the side reactions and passivation layer at the electrode/electrolyte interface. Therefore, it is essential a better understanding of the reactions mechanisms that lead to surface layer formation and the chemistry within both lithium-ion and lithium-oxygen (Li-O2) batteries.

Surface-enhanced Raman spectroscopy (SERS) is a powerful technique used in operando conditions to investigate electrode surface interactions under potential control during battery cycling.

Since SERS has limitations in terms of substrate nature and morphology, shell isolated nanoparticle Raman spectroscopy (SHINERS) is an alternative technique for surface analysis. In this case Raman signal amplification comes from the gold core embedded in an ultrathin silica shell (SHINs) of the nanoparticles deposited on the electrode surface, and in principle any type of electrode substrate can be investigated.

Within this presentation I will demonstrate how these Raman techniques can be used to investigate oxygen reduction reaction (ORR) mechanisms in metal-oxygen cells and introduce how complementary techniques, such as surface enhanced infrared spectroscopy, assist in understanding the particular chemical environment at the electrode/electrolyte interface.

Biography

Laurence Hardwick is Professor of Electrochemistry and Director of the Stephenson Institute for Renewable Energy within the Department of Chemistry, University of Liverpool. He has a broad background in electrode materials, interface chemistry, and nanomaterials, with a particular focus on Raman spectroscopy and novel techniques. He has been interested in the development of high-performance rechargeable batteries, including lithium-ion and lithium-oxygen systems.
Chemistry at the University of Liverpool. He received his MChem in Chemistry in 2003 from the University of Southampton and PhD in Chemistry from ETH-Zurich in 2006. Before joining Liverpool in 2011, he spent his postdoctoral time working at the Lawrence Berkeley National Laboratory and at the University of St Andrews investigating Li-ion battery electrode degradation mechanisms, lithium diffusion pathways through carbon and the chemical and electrochemical processes in Li-air cells.

His recent work has focused on the development of advanced in situ electrochemical surface enhanced infrared and Raman methodologies that examine electrochemical reaction mechanisms on a variety of electrodes interfaces which assist in our understanding on the function of metal-air and Li-ion batteries.

**Location**
Barbara Strang Teaching Centre, Lecture Theatre 1.46

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