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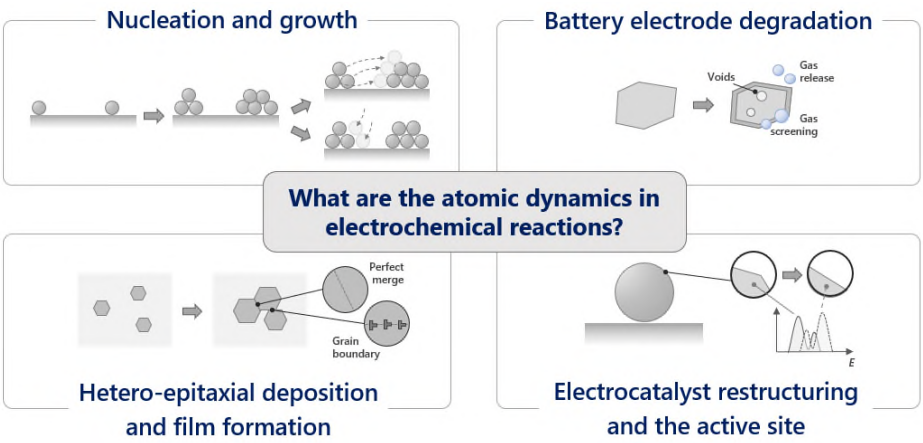
Imaging atomic-level electrochemistry in real-time using 2D material devices

AIDEChem
Atomic Imaging and Diagnosis of Electrochemical Materials

Funded project

Electrochemistry is the underpinning science that powers your mobile phone. And with the economies of scale the ubiquity of rechargeable lithium-ion batteries in mobiles brought, we have been able to expedite a rapid transition to an all-electric vehicle economy in the UK and many places around the world. While this illustrates the impact of what can be achieved with electrochemical technology, the need to fully decarbonise our economy demands that we realise further technologies across energy storage, chemical synthesis, and CO_2 conversion.

The fundamental challenge is that electrochemistry is complex; with a myriad chemical and material processes occurring at buried solid-liquid interfaces that undergo continuous dynamic changes. This makes the informed design of new electrochemical technologies exceptionally difficult. New experimental techniques are required that can diagnose these processes ***in situ***, that is capturing them as they occur in an operating environment.



We need a way to perform *in situ* atomic level imaging to answer these questions

This PhD project will develop a new approach for capturing atomic level electrochemical processes in situ by fabricating special electrochemical cells from two-dimensional materials like graphene. These "micro-batteries" will be able to be operated and imaged directly inside a transmission electron microscope (TEM), yielding an atomic resolution imaging facility able to expose these atomic to nanoscale processes as they occur. This has yet to be achieved.

You will be joining a new multi-million pound research project at Warwick University –AIDEChem– to unlock this potentially groundbreaking capability. As well as the teams in electron microscopy, modelling, and nanomaterials in Physics, you will work with partners in Chemistry and WMG departments, as well as in Oxford and internationally.

If you enjoy condensed matter physics, materials science, materials chemistry, and have a passion for addressing the grand challenge of climate change by the application of science, then this is the project for you.

If you are interested in this project you can contact me at **alex.w.robertson@warwick.ac.uk**.