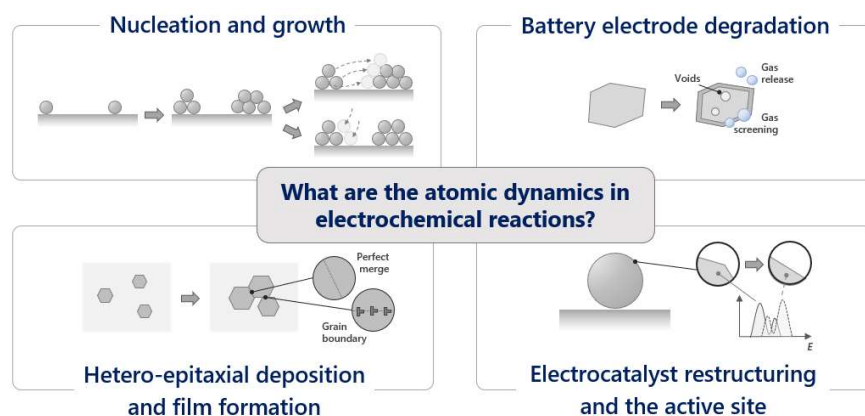


Imaging atomic-level electrochemistry in real-time using graphene-based devices

Funded project

Electrochemical processes and interactions are the heart of technologies that are essential for the green revolution, from batteries to electrocatalysis. The fundamental challenge is that electrochemistry is complex; with interwoven 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. This poses challenges, as characterisation at the highest level typical demands the sample is kept under vacuum, so that the probing radiation is not dispersed. Designing a technique that is vacuum-compatible, yet allows for studying the liquid-solid interface that we are interested in, is a major barrier.



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

For this PhD, you will join a team where we are developing a new approach for capturing atomic level electrochemical processes *in situ* by fabricating electrochemical cells from two-dimensional materials like graphene. These "micro-batteries" will be operated directly inside a transmission electron microscope (TEM), giving us an atomic resolution imaging capability able to expose these nanoscale electrochemical processes as they occur. You will use this technique to explore how energy materials, such as candidate next-generation Li-ion battery cathodes, degrade during use.

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 across the UK and internationally. You will get to learn how to prepare and characterise 2D materials, use state-of-the-art TEM facilities, and fabricate nano-devices using lithographic techniques.

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.