Diamond Active Materials Laboratory

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Delivering new opportunities for active materials research at Diamond Light Source: an Active Materials Laboratory.

Understanding structural change in materials due to operation and radiation damage is a major challenge for the nuclear industry. Scientific research is essential to provide evidence and support in decision-making, for instance when reviewing ageing infrastructure and making decisions to extend its lifetime or when designing brand new nuclear facilities. Diamond, the UK's national synchrotron science facility, already offers analytical instruments for active materials research. The construction of a new dedicated Active Materials Laboratory building will significantly improve the capabilities for researchers ranging from those involved in construction materials for nuclear energy facilities to waste management.

The new Active Materials Laboratory

The new building will have both wet and dry laboratories equipped for handling a wide range of active materials. There will also be a counting room for active materials to be characterised and a secure storage as appropriate.

Overhead view of Diamond Light Source

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The dry laboratory will house an argon glove box with an inbuilt microscope. This will enable sample cells, such as a bespoke cell for use in a loading rig on I12, to be assembled on-site before being taken in appropriate containment to a beamline. There will also be a fume hood containing a furnace so samples can be treated offline before being studied on a beamline.

The wet laboratory will house an argon glove box for handling samples that need to be kept dry and oxygen-free such as molten salts, a Coy anaerobic chamber for handling wet anaerobic samples, a fume hood, a centrifuge, and chemical store cupboards for common solvents and acids.

Callum Robinson, University of Manchester PhD student, demonstrating the loading of a sample containing uranium onto Diamond's I20-scanning beamline

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Beamline I12 and DIAD are investing in *in situ* loading rigs with tension, compression and cyclic capability. These will have a 10 kN capacity for time-resolved tomography and imaging. This 10 kN load capacity was specified to accommodate the broadest possible range of user requirements, from soft biomaterials and polymers to high strength engineering alloys. Bespoke cells are being procured to safely contain samples to go in the I12 rig. This rig will be fitted out with a furnace to enable *in situ* testing of active material under controlled environments at temperatures up to at least 800°C.

New possibilities for users

With the new laboratory, users will be able to manipulate and prepare (very) active and also relatively shortlived samples to study them at Diamond. Users will be able to do experiments at Diamond that were previously impossible in the UK. Being able to load samples into suitable sample cells means that active materials properties can be studied under temperatures and particular atmospheres. It is necessary to understand the impact of prolonged radiation on the mechanical performance of a range of materials such as graphite and Zircaloy used in fission and fusion facilities.

Understanding the corrosion impact on radionuclide behaviour in encapsulated or enclosed form is vital in understanding the state of our current waste stockpile and making the most economical choices in its handling and disposal. Understanding the future behaviour of the UK's proposed geological disposal facility requires intimate knowledge of the interaction of radionuclides with the materials used in the construction of the facility. Furthermore, being able to run long-term experiments on site for sampling at suitable intervals and also the ability to prepare solutions on-site and manage the samples post-experiment for further non-synchrotron study will add crucial capability.

Contact details

Please contact the Diamond Industrial Liaison Office (**https://www.diamond.ac.uk/industry.html**) at **industry@diamond.ac.uk**.

Availability

The Diamond Active Materials Laboratory is currently planned to open in September 2021. Please consult **https://www.nnuf.ac.uk/diamond-active-materials-laboratory** for the latest information.