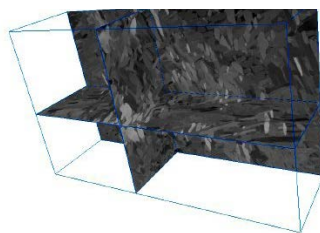


SIMFUEL and Alpha-Active Material Manufacturing and Characterisation Facility

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MANCHESTER
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3D BSE images of Zr-Nb Alloy

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Uranium glovebox suite for sample production and preparation

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Spark Plasma Sintering Furnace with attached glovebox

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The SIMFUEL and Alpha-Active Material Manufacturing and Characterisation Facility, located in the Henry Royce Hub Building at the University of Manchester, is a world-leading laboratory for the manufacture and characterisation of a range of alpha-active nuclear materials. The NNUF facility consists of a FIB/SEM coupled to an inert atmosphere glovebox and a TEM dedicated to handling alpha-active materials.

The facility is based within the Nuclear Fuel Centre of Excellence (NFCE) which gives users access to a wide range of sample manufacture, preparation, and characterisation techniques, including for samples containing uranium, thorium or higher actinides. This allows academic and industry users access to sample preparation and atom-scale microscopy to support research and technical problems across the nuclear fuel cycle, without the need to transfer material on and off nuclear licenced sites.

The complete range of equipment is operated as a user facility through NNUF(2) and the Henry Royce Institute, providing a manufacturing, characterisation, and testing suite that can be used in combination with other NNUF facilities (e.g. the **Dalton Cumbrian Facility**) to perform beginning-to-end of life studies of nuclear fuel materials.

FIB/SEM – Helios 5 CX with Glovebox Autoloader

The FIB/SEM is capable of electron and Ga ion beam imaging and milling of materials for the preparation of lamellae for further TEM analysis. This allows the preparation of site-specific areas as well as the ability to dramatically size reduce samples for further TEM analysis so they can be handled more easily or be sent to other institutes. The FIB/SEM is adapted for alpha-active material workflow, with a retractable sputter shield and is coupled to an inert atmosphere glovebox so the complete workflow can be undertaken without exposure of the user to alpha-active material. The facility is also capable of inert gas/vacuum transfer of the sample from the glovebox to the TEM to avoid exposure of the user to material and avoid exposure of the sample to air.

The microscope is equipped with EDS and EBSD which allows for chemical and crystallographic orientation/phase mapping. This allows the user to take FIB lamellae from specific regions in terms of chemistry or grain orientation. It is possible to perform BSE imaging, EDS and EBSD mapping with FIB milling to create and reconstruct 3D images.

- Electron column – 200 V - 30 kV Schottky FEG-SEM
- FIB column – 500 V - 30 kV Gallium ion Column
- EDS – Oxford Instruments 170 mm² Ultimex
- EBSD – Oxford Instruments Symmetry detector
- Glovebox transfer for complete inert atmosphere contained workflow.

TEM – Talos F200i

The TEM is equipped with an X-FEG capable of operating in TEM and STEM modes. This permits the study of nanoscale features which is crucial for the study of nuclear fuel materials through their life-cycle and is capable of lattice and atomic level resolution alongside electron diffraction analysis. It is equipped with dual-EDS detectors and EELS which can be used to determine chemical composition and oxidation states. A range of holders are available for the analysis of samples at temperatures from ambient to liquid nitrogen, as well as surface tomography and 3D reconstruction.

- X-FEG electron source, 80-200 kV
- Dual EDS detectors (2 x 100 mm²)
- Gatan Continuum ER image filter
- Tomography holder and reconstruction software
- Cryogenic holder
- Inert gas/vacuum transfer holder to allow fully contained workflow.

Contact details

Please email reyes.palacios@manchester.ac.uk to discuss your potential project.

Availability

The SIMFUEL and Alpha-Active Material Manufacturing and Characterisation Facility is currently under development. Please consult <https://www.nnuf.ac.uk/simfuel-and-alpha-active-material-manufacturing-and-characterisation-facility> for the latest information.