

NUCLEAR MATERIALS

Research Area Leads:

Prof. Abbie Jones and Dr. Anna Widdowson

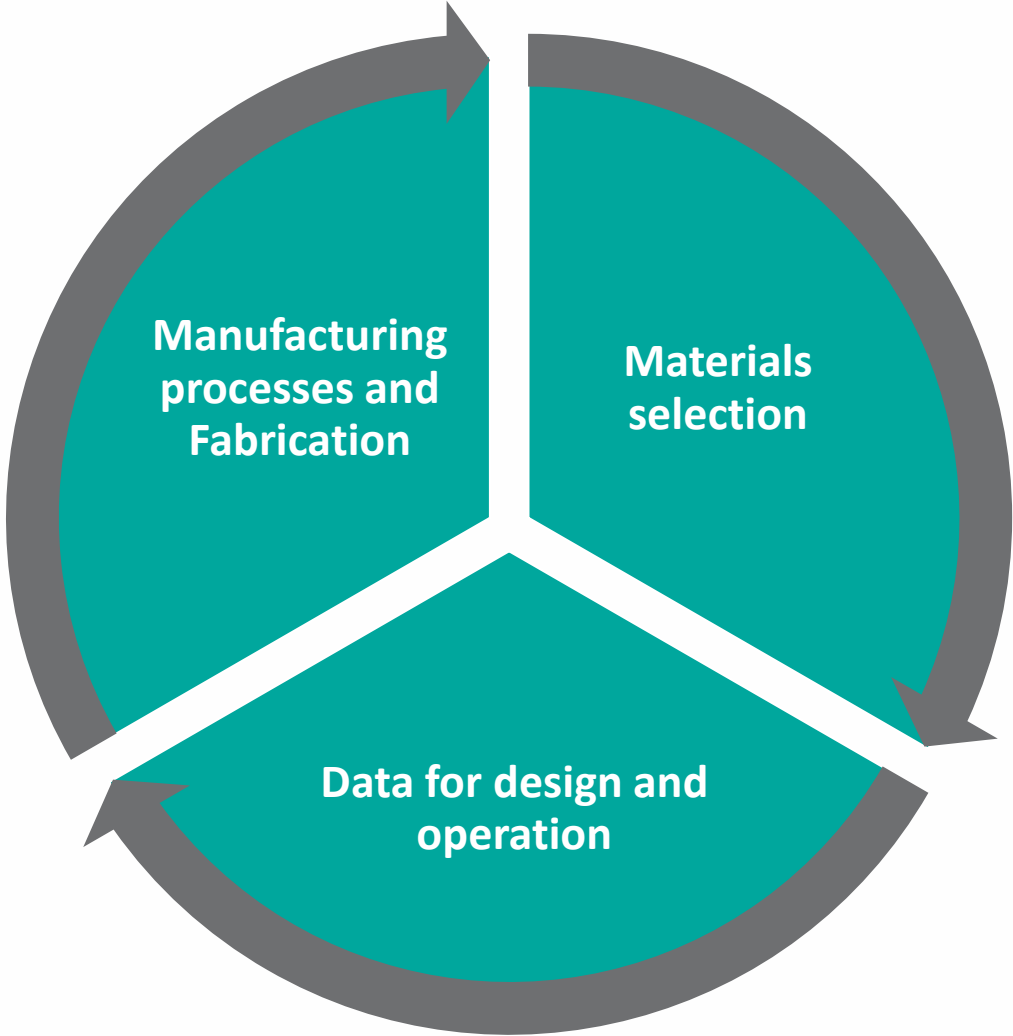
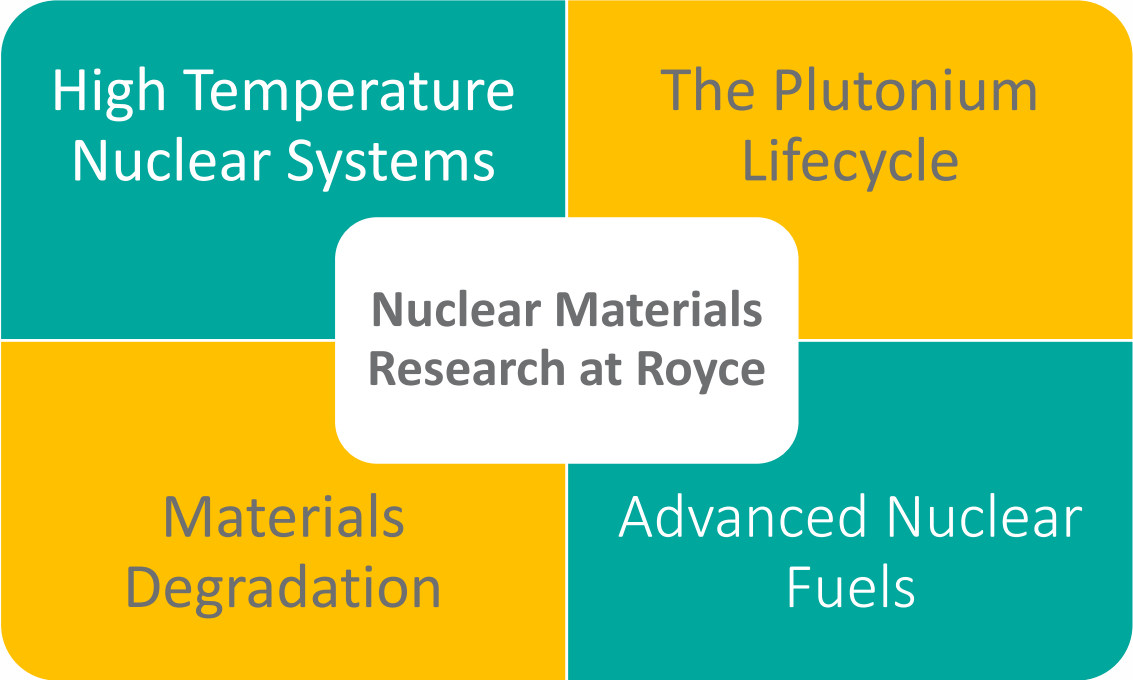
Research and Business Engagement Manager:

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NUCLEAR MATERIALS

Nuclear Materials Research



Nuclear Materials Partners & Technology Platforms

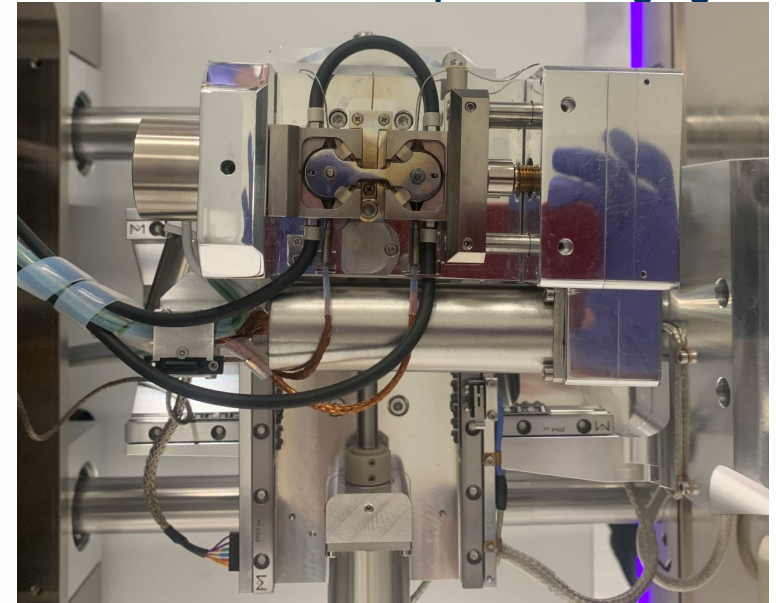
 <p>The University of Sheffield.</p>	 <p>The University of Manchester</p>	 <p>UK Atomic Energy Authority</p>	 <p>NATIONAL NUCLEAR LABORATORY</p>
<p><i>Advanced Characterisation to Understand Radiation Damage in Materials</i></p>	<p><i>Irradiation Environments (DCF)</i></p> <p><i>Fuels and Irradiated Materials Analysis (Hub)</i></p>	<p>Non-Actinide Irradiated Materials Handling, Characterisation, ^3H and Testing (MRF)</p>	<p>Irradiated Materials, Fuels and Actinides Handling and Characterisation</p>

ROYCE

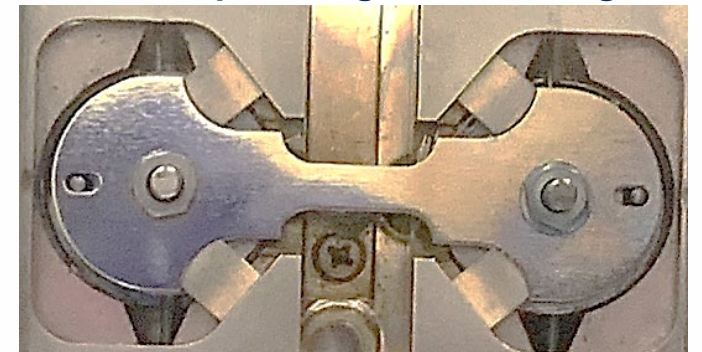
Technology Platform updates Irradiation Environments (DCF)

- Accelerator hall radiation shield enhancement
 - EMITS (Enhancing Materials Irradiations through Thoughtful Shielding) project (NNUF funded)
 - Dual-beam end station
 - Commissioning of the new EELS/SIMS system (Royce funded)
- A new facility to perform synergistic irradiation thermomechanical testing: in-situ tensile test rig
- New 5 year UKNIBC (UK National Ion Beam Centre) National Research Facility grant has been awarded to University of Manchester, University of Huddersfield and University of Surrey.

NewTec MT1000 adapted loading rig



Sample design and loading



Technology Platform updates

Fuels and Irradiated Materials Analysis (Hub)

NNUF 2 – Alpha active electron microscopy facility



Graphite and Irradiated Materials laboratory



Technology Platform updates Non-Actinide Irradiated Materials Handling, Characterisation, ^3H and Testing (MRF)

- UKAEA Fusion Foundation funded Hotcell extension in progress for delivery 2024
 - Incorporating in cell machining and testing capability
 - 20kN hydraulic load frame with high T capability to 900C with DIC and 1100C without
- Good facilities usage: 1300 total instrument days including internal UKAEA use during FY2022-23
- Irradiation campaign with ORNL HIFR
- NNUF2a funded PFIB, TEM, high vacuum DSC installed and commissioning
- UK certification of generic state 2 remote handling systems for high activity work

Royce Materials Challenge Accelerator Programme

Materials 4.0 Landscape:

University of Manchester (£97k):

- *“Enhanced Materials Production In Radiation Environments (EMPIRE)”*

Degradation in Structural Materials for Net-Zero Landscape:

University of Manchester (£66k):

- *“Understanding the degradation of nuclear graphite bricks and its impact on brick structural integrity”*

The bottom of the slide features a decorative graphic with a yellow and grey geometric shape on the left, transitioning into a teal shape on the right. The word "ROYCE" is written in large, white, bold, sans-serif capital letters across this graphic.

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Royce Materials Challenge Accelerator Programme

Fusion Materials Roadmap

UKAEA (x4 awards, total of £437k):

- *“A pilot study on solid-state diffusion bonding of tungsten to steel for the STEP divertor components”*
 - Achieved a high-strength joint between tungsten and steel (grade 91) using a very thin Nickel interlayer
 - The interlayer reduces residual stress and prevents oxidation during bonding in air, thus enhancing joint quality and reliability
 - The absence of oxide formation during diffusion bonding in air represents a significant success
- *“Characterisation of Industrially-Relevant ODS Steels for Fusion ”*
- *“Hybrid Approach to SiC/SiC Technologies and Engineering in Fusion (HASTE-F)”*
 - “Fusion-grade” composites produced achieving densities >95% in half the manufacturing time. Mechanical properties in some cases surpassed performance expected for “nuclear-grade” SiC/SiC
 - Invention disclosure has been submitted to the UKAEA IPMO, currently being fast-tracked filing a joint UKAEA-NCC (National Composites Centre) patent on HASTE-F
 - Successful demonstration of HASTE-F as a manufacturing technology has led to further £175k funding from NCC to scale-up the process
- *“Joining of SiC/SiC for Engineering Applications in Fusion (JOSEAF)”*
 - High-purity, SiC/SiC-to-SiC/SiC joints produced, demonstrating good strength at temperatures up to 800°C
 - W coatings applied to SiC/SiC composites via CVD:
 - CVD coatings >100 µm were found to debond during processing. CVD coatings <100 µm failed during thermal cycles (400-600°C)
 - Early trials on PVD W coatings on SiC/SiC show good adhesion after thermal cycles between 600-1000°C



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Researcher funded access for Royce facilities



- Open to all researchers:
 - Higher education institutions
 - Research technology organisations
 - Industry, including SMEs
- Funding available to support subsidised access
 - Schemes advertised through website, newsletters and social media
- Equipment database on website: www.royce.ac.uk
- General enquiries: info@royce.ac.uk



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