UKAEA Materials Research Facility, Growing into Mature Levels

Monica Jong, Steven Van Boxel, Otto Caretta, Martin O'Brien

UKAEA, Culham Science Centre,
Abingdon, OX14 3DB, United Kingdom

Corresponding author: Monica Jong <monica.jong@ukaea.uk>

Abstract

The Materials Research Facility (MRF) is designed to test irradiated materials for both the Fusion and Fission materials development programs and will be used by Culham Centre for Fusion Energy (also part of UKAEA) as well as industry and academia. In May 2016 UKAEA opened the MRF, a new purpose-built research facility which allows researchers from UKAEA, academia, industry and other organisations to investigate post-irradiation properties of both materials in service in today's nuclear power stations and candidate materials for use in future fission and fusion power stations. The new facility bridges the gap between activity levels that can be handled at university or industrial laboratories and activity levels that require large facilities at nuclear licensed sites.

With the MRF, the UKAEA is working on nuclear readiness for the coming decades. It aims to achieve the following goals: Serve both Fission and Fusion research with input to future reactor types as well as existing reactor types. Invest in the development of test methods for micro- and macro-sized specimens as well as in international acceptance of those methods. Work actively to create a change in nuclear materials research by focusing on size reduction.

The MRF has the capability to receive and process activated materials with a maximum activity up to 3.75 TBq Co^{60} (or equivalent). The MRF hot-cell line (a receiving cell and three interconnected hot-cells), provides downsizing, mounting and polish samples. Samples can either be transferred to one of the research rooms for on-site experiments or be transferred to an external partner or customer. Three lines of research room lines with in total 12 shielded rooms to operate with samples with a maximum activity of 3.75 GBq Co60 (or equivalent). In the research rooms, microscope techniques (as Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB), Atomic Force Microscopy (AFM) and Precision Ion-beam Polishing System (PIPS)), mechanical testing (static testing, high frequency fatigue and SEM in-situ testing) and thermo-physical techniques (Laserflash, Dilatometry and Simultaneous Thermo-gravimetric Analysis & Differential Scanning Calorimetry (TGA/DSC)) are available.

Furthermore, gloveboxes lines are installed to use for research on lower activity samples, e.g. for Sample preparation (cutting, polishing, electrolytical polishing), Tritium and Beryllium based research. A setup for Thermal Desorption Spectroscopy (TDS) and rigs for corrosion of tritium loaded materials and plasma behaviour at tritium and deuterium are being installed in the MRF.

In 2019-2023 the MRF is planning to increase its capabilities as follows:

- Almost double the facility from 2400 m^3 to 4000 m^3
- Advanced active sample preparation capabilities (EDM cutting, in-cell reconstitution, dimple grinding, electrolytical polishing, etcetera).
- Doubling the hot-cell capacity by the addition of two more hot-cells for increased flexibility by use off interchangeable inner containments.
- Increase the number of Research Rooms from 12 up to 24 for future scientific instruments.
- Additional equipment for microstructural, mechanical and physical characterization.
- Increase and develop the fracture mechanics capabilities, including sub-sized sample fabrication and reconstitution of samples for Master curve approach testing