UKAEA

Materials Research Facility

an ‘easy access’ hot-cell and analysis facility

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• Introduction
• Materials Research Facility layout
• Processes and research
• Methodology
• Future developments
• Conclusions
History

A Review of the Civil Nuclear R&D Landscape in the UK

Nuclear Energy Research and Development Roadmap: ‘Future Pathways, 2013’

Low activities
- University of Manchester
- Imperial College London
- Lancaster University
- University of Oxford

Medium activities
- Dalton Cumbria Facility
- UK Atomic Energy Authority

High activities
- National Nuclear Laboratory

~50 MBq

3.75 TBq (Co^{60})

HOT-LABS 2016
Materials Research Facility

Building

Hot-cell line

Research Rooms
MRF building houses

- The hot-cell line (Receiving Cell and 3 hot-cells)
- Two Research Room lines, (5 research rooms per line)
- A beryllium workshop (glove box lines for Beryllium research)
- A Tritium workshop with Thermal Desorption Spectroscopy (TDS) and other tritium capabilities (glove box line).
The hot-cell line
- Designed and build by Aquila.
- Maximum activity up to 3.75 TBq (Co$^{60}$)
- Sample reduction and fabrication
- To go into active operations beginning 2017
The Research Room lines
• Currently in design and build phase
• Maximum activity up to 3.75 GBq (Co\textsuperscript{60}) per cell
• 5 Rooms per line (2 large and 3 small rooms)
• 2 small rooms can be converted into one large room
• Each cell can be operated independently
• Commissioning take place in QA2 2017
Hot-Cell operations

Receiving Cell:
Max. Transport Flask
10 Tonnes

Gas contained inner boxes:
Max. activity of sample in each cell – 3.75TBq of cobalt-60.
Back doors operating on Air-skates
Interface Operations

Hot-Cell 3: Transport Trolley loading

Transport Trolley Docking station:
Research Rooms: Max. activity of sample in each cell – 3.75GBq of cobalt-60

Flexibility: Moveable walls could allow cells to accommodate small or large instruments
Current Hot-cell equipment

• Sample fabrication
  – Cutting
  – Grinding
  – Polishing

• Sample embedding
  – Hot Press
  – Cold resin

• Sample evaluation
  – Optical microscopy
Current Research Rooms equipment

• Scanning Electron Microscopy (SEM)
  – EDX,
  – EBSD,
  – TKD
• Focussed Ion Beam (FIB)
• Nano Indentator
• Atomic Force Microscopy (AFM)
• 10 kN Tensile tester
• (XRF)
MRF – Future equipment

• Mechanical testing suite
  – micro-hardness;
  – static, fatigue, impact testing
  – fracture toughness testing

• Thermo-physical testing suite
  – Dilatometry
  – Thermal conductivity / diffusivity
  – DSC / TGA
  – Gas pycnometer

• Improved sample preparation
  – EDM
  – Electro-polishing
  – TEM disk preparation
MRF - Typical Process

1. Receipt sample & store
2. Transfer sample to shielded plant
3. Cut
4. Polish
5. Clean & Mount
6. Transfer to FIB
7. Operate FIB
8. Transfer to nano indenter
9. Operate nano indenter
10. Store sample for re use/dispose samples off site/return samples

- Shielded Activity
- Focused Ion Beam
- Or transferred to university
- Limited and temporary storage (Culham’s inventory for a non-licensed site)
MRF – Future installations

2 additional hot-cells
- Interchangeable boxes
  - Fitting in hot-cell
  - Fitting in Research Rooms
  - To be used as glove box

1 additional Research Room line with 5 more rooms

Beryllium glovebox line
Use of the MRF?

• Focus on both Fission and Fusion research
• Relative easy access (no licenced site)
• Cooperation between NNUF partners
• Development of new techniques with focus at micro- and macro-sized specimens
• We welcome visiting scientists to execute their own research
• Open for industry and users for both specimen fabrication and research
Conclusion

- UKAEA is working on nuclear readiness for the coming decades.
  - 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.
  - Serve research on activated materials from other fields, such as accelerators.