Studies of JET Materials: VR Capabilities and Plans

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- *VR participation in studies of JET PFMC since 1985.*
- *Over 160 publications on JET PFMC studies*
- *All classes of wall materials and probes.*

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

VR in SP-E: *Research potential*

4 accelerators:

- *5 MeV Tandetron*
- *350 keV Implanter*
- *170 keV Tandem (Micadas)*
- *0.2 – 10 keV Implanter*

IBA & IBMM Methods

RBS
NRA *wide range of reactions* } *standard* & *micro*
PIXE

ToF ERDA / HI-ERDA *(GIC detector)*
MEIS
LEIS
AMS

- **1250°C TDS with in-situ implantation & IBA**
- **Magnetrons, evaporation cells**
- **Sputter guns**
- **Clean room**
- **Dual beam spectro-photometry**
- **Profilometry**
- **Microscopy**
  - ***optical***
  - ***SEM***
  - ***FIB***
  - ***STEM***
  - ***AFM***

D-T neutron source: NESSA (June 2022)

Radiological certificate

All systems and methods have been used in PFM studies.

Continuous development and enhancement of research capabilities.

VR in SP-E: *Plans*

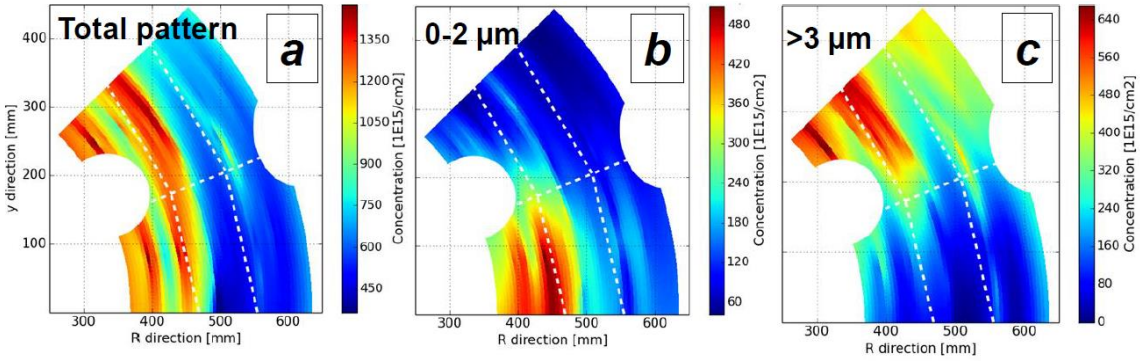
VR SP-E tasks in 2022 (as defined in PMP)

Characterization of JET plasma-facing and diagnostics components using IBA (HIERDA).

I. Samples sectioned at VTT from divertor Tiles 0 and 1:

- *Contents of all species (from H to W) in the surface layer up to the depth of 700 nm.*
- *Concentration ratios: **H/D**, **Be/O,** D/Be, D/C, **Be/C,** D/N, C/N, D/O, Be/N, etc up to 700 nm.*

More interesting would be IBA/NRA archaelogy through co-deposits to see layers from respective ILW periods.
(example from COMPASS)



II. Langmuir probes (LPs). Big potential for a scientific project.

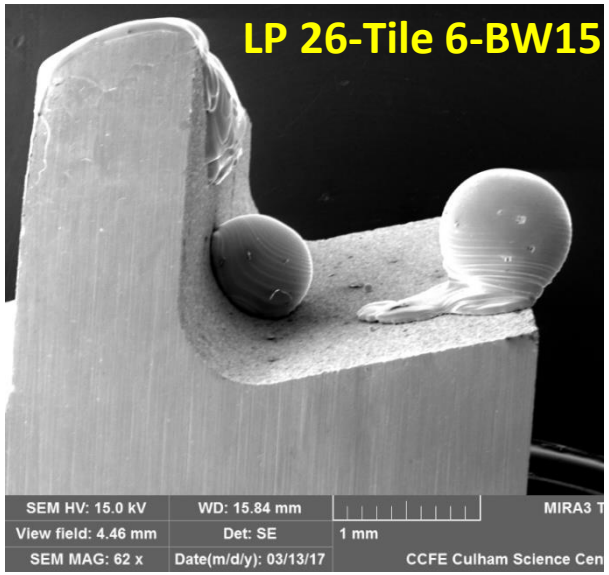
- The most relevant for studies are **Langmuir probes**; they have never been studied by IBA.
  - *Composition of deposits in various regions in the divertor, both on plasma-facing surface and in the gaps; most interesting in gaps between Tile 5 lamellae.*
  - *Composition of the damaged and molten zones.*
  - *Thermal desorption with in-situ IBA (probably cut samples are needed).*
- **Cooperation: CCFE – FZJ – IPPLM – VR to cover all material aspects.**

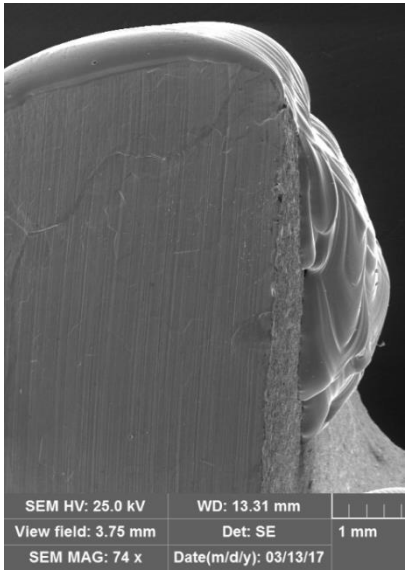
With 3 accelerator days the work plan must be realistic.

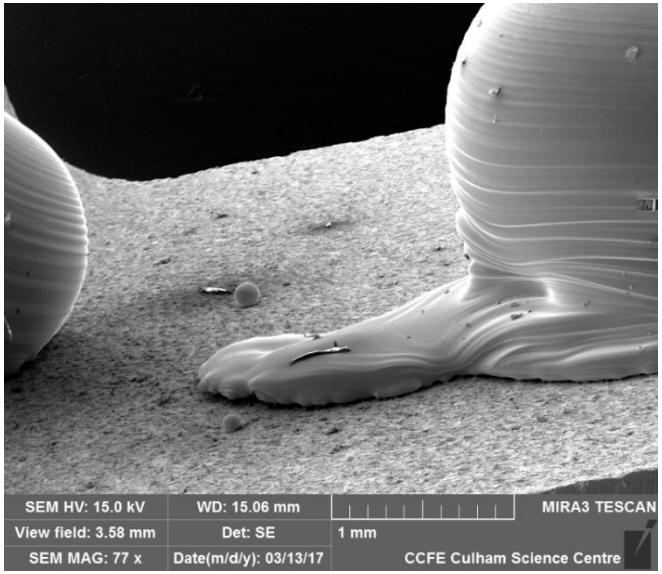
Langmuir Probes

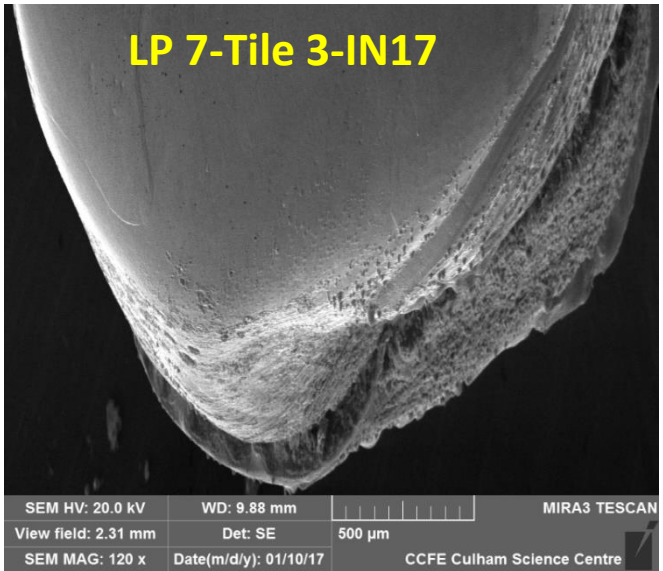
Until now only one paper (IPPLM) and some microscopy (CCFE) done for LPs.

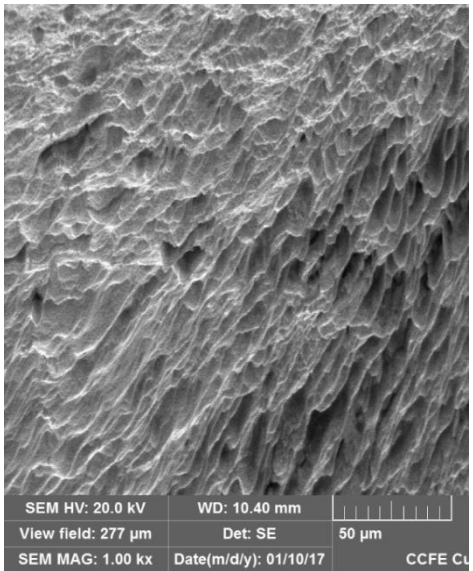
Tungsten Langmuir probes from JET-with the ITER-Like Wall: Assessment of mechanical properties by nano-indentation,
M. Spychalski, E. Fortuna-Zaleśna, J. Zdunek, M. Rubel, A. Widdowson ***Phys. Scr. 96 (2021) 124072*** https://iopscience.iop.org/article/10.1088/1402-4896/ac3dbb.

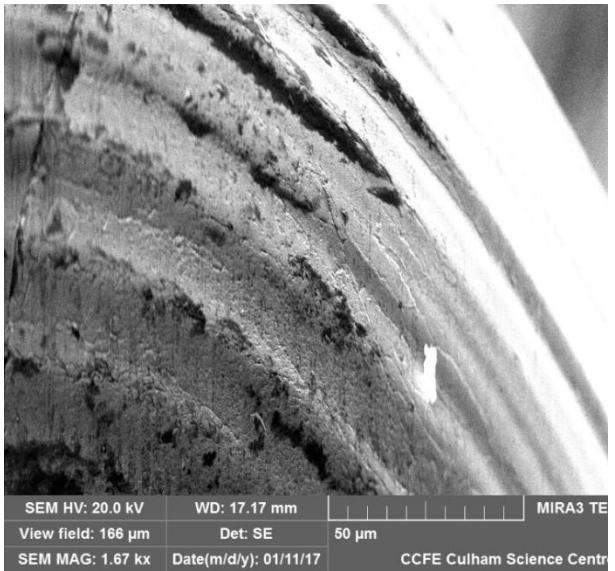




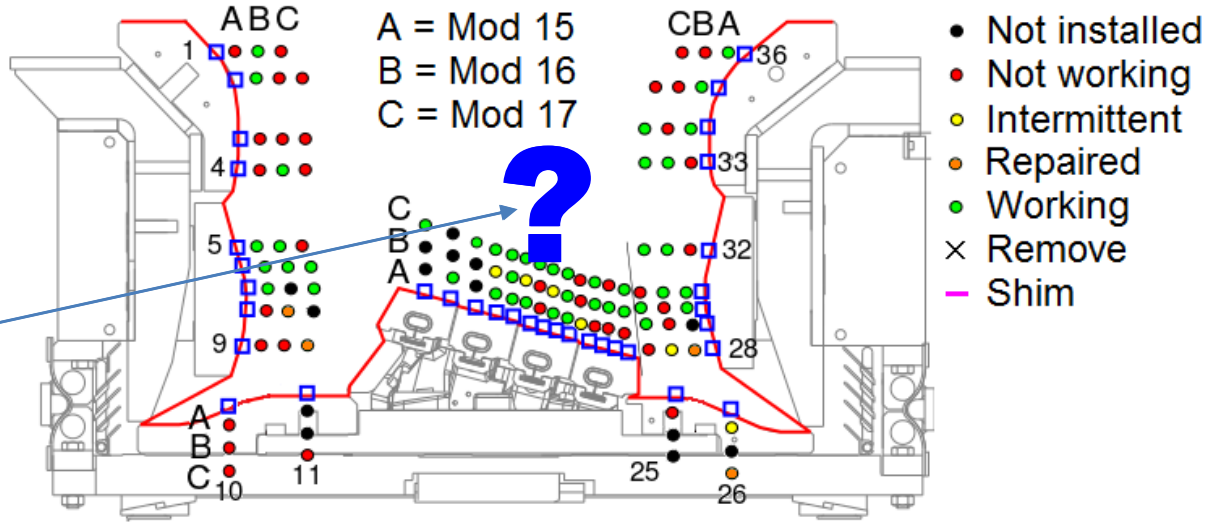








Langmuir Probes and damaged W



something from that region ?

Caveats/Remarks

- *In mechanical studies a comparison must be done to samples of molten/recrystallized W in order to address a crucial point. Is the change of hardness characteristic for the damage in fusion environment or is it typical for molten/recrystallized material??*
- *Comparison can be done to tungsten limiters and probes damaged in TEXTOR.*