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High resolution scanning electron microscope for sequential testing and analyses of full-size PFC components of AUG

Monday, 17 September 2018 11:00 (2 hours)

The complex power and particle wall loading conditions in fusion devices lead to various surface modifications of plasma-facing components (PFCs). To assess the consequences of these modifications on power handling capability and lifetime of PFCs, detailed microscopic studies of the surface and internal structure are required. Essential are analyses of the same area before and after plasma exposure. Non-destructive analyses are mandatory for such sequential testing, i.e., the complete tile as installed in the fusion device must fit into the microscope. Therefore, a scanning electron microscope (SEM) with focused ion beam (FIB) and analytics, energy and wavelength dispersive X-ray spectroscopy (EDS/WDS), was procured and commissioned at Max-Planck-Institut für Plasmaphysik.

This SEM is equipped with a newly developed heavy-duty stage, which allows to analyse samples up to a mass of 10kg, a length of 44cm, and a height of 10cm without and 6cm with additional rotation module. The accessible area on the sample is 23x10cm2. The achieved imaging resolution is better than 5nm. Cross-sections can be prepared by FIB. A multiple gas injection system enables, e.g., to coat markers for erosion measurements. Elemental mapping by X-ray spectroscopy is possible also on FIB cross-sections. Small features (tens of nanometers) can be investigated by using low electron beam energy (3-5keV).

In this contribution selected SEM analyses using FIB and EDX/WDX capabilities will be presented from material erosion and deposition experiments on divertor and first wall tiles exposed in ASDEX Upgrade (AUG). The examples include analyses of tiles with controlled pre-exposure damage structures and of W monoblock mock-ups pre-damaged by high heat flux testing after their exposure using the AUG divertor manipulator. Also data from heavy-alloy AUG divertor tiles installed for an entire campaign in AUG will be presented. The potential of the analyses capabilities of this SEM device will be elucidated.

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