O-13

ERO2.0 study of erosion and deposition on ITER diagnostic mirrors assuming different material mixes

Sebastian Rode[1], Sebastijan Brezinsek[1], Andreas Kirschner[1], Lucas Moser[2], Richard Pitts[2], Juri Romazanov[1], Alexis Terra[1], Tom Wauters[2], Sven Wiesen[3]

[1]Forschungszentrum Jülich GmbH, Germany
[2]ITER Organization, France
[3]DIFFER - Dutch Institute for Fundamental Energy Research, Netherlands

Optical diagnostics hold a critical role in the operation of experimental fusion devices. In ITER, diagnostic apertures are located in the Diagnostic First Wall (DFW) of the Equatorial and Upper Port Plugs (EPP, UPP). The apertures serve as entry points to mirror systems of optical diagnostics, such as the Visible and Infrared Wide Angle Viewing Systems. Impacting particle fluxes, e.g. energetic Charge-Exchange Neutral (CXN) hydrogen isotopes or sputtered wall material, can affect the quality of the mirror systems by deposition and erosion on the plasma-facing metallic mirrors, i.e. the First Mirrors (FMs).

In this study, the particle fluxes into the diagnostic ports and apertures of the UPP and EPP cut-outs in ITER were simulated with the Monte-Carlo transport code ERO2.0. A full 3D treatment of the particle transport in a validated multi-stage simulation workflow [1] was applied, evaluating the fluxes over the full expected ITER pre-fusion and fusion power operation times [2]. Changes in the elemental composition of the stainless steel (simplified to pure iron) port surfaces were described by a Homogeneous Mixing Model. This ERO2.0 study was presents predictive modelling as part of the recent ITER re-baselining activities [3] and assesses different material assumptions: full-tungsten (W) ITER, an infinitely boronized ITER representing the worst-case scenario fluxes into the ports from boron coatings put down on the First Wall by regular boronizations, and a comparison to the originally planned material mix with a beryllium (Be) First Wall and W divertor.

The key findings of this study are very favourable for the FM performance: the erosion and deposition on the FMs at the end of the envisaged ITER operational time are negligible in the centre of the FMs in both ports, featuring less than 5 nm deposition of impurities, and ˜10 nm erosion of the metallic mirror surface in all cases. Sputtering is caused nearly exclusively by the CXN, which means that the assumed DFW material does not significantly affect the FM erosion. Concerning additional deposition of material from outside the aperture on the mirrors, the boronized ITER performs slightly better than a clean Be/W ITER, while a pristine full-W ITER is expected to have the lowest additional deposition.