IAEA FEC 201

Contribution ID: **256** Type: **Poster**

ERO modelling of Be erosion in JET and extrapolation of the data for ITER

Thursday, 20 October 2016 14:00 (4h 45m)

Erosion will be one of the main factors determining the lifetime of the plasma-facing components (PFCs) in ITER, particularly the low Z beryllium (Be) first wall (FW). This paper presents the tests of Be erosion data during experiments with the ITER-Like Wall (ILW) in JET and the corresponding re-visiting of the predictive modelling for ITER. The key tool is the Monte-Carlo 3D impurity transport and plasma-surface interaction ERO code.
In this paper two fits for Be sputtering data are used, both based on simulated data including the molecular dynamic (MD) approach. The factor 3-4 lower one called 'ERO-min'implies large D content (50%) in a PFC surface. Chemically assisted sputtering (CAS) can contribute significantly (up to ~50%) to Be erosion. According to MD data used in ERO, CAS varies with energy of impinging ions and surface temperature T_s.
Benchmarking the ERO on results from the ILW is critical for gaining confidence in the modelling approach and the related data. Two Be erosion experiments have been performed in inner wall (IW) limited discharges. The T_s was found to have an influence on the molecular release fraction, which decreases to negligible values at 670K. The plasma temperature in SOL (ion impact energies) was scanned whilst simultaneously monitoring the spectroscopic emission of BeI, BeII and BeD in the vicinity of the solid Be limiter. 3D ERO modelling allows the surface erosion to be characterized by the line-of-sight integrated emission. The 'ERO-min'sputtering assumptions lead to the best match with experiments. ERO reproduces the BeD light emission trend and absolute value during the E_imp scan within 20%.
Earlier ERO erosion predictions for the ITER FW panels have been re-visited. The ILW benchmark shows that the previously calculated upper limit (based on the 'ERO-min'fit) of the FW panels lifetime estimation of ~4200 ITER discharges (steady state erosion) is the most appropriate. However, the improved (analytical) approach for calculating ion movement just before the surface impact leads to a decrease of the corresponding lifetime by 30% to ~3000 discharges. The CAS can lead to a further decrease, depending on T_s. However, these estimates are based on the most conservative assumptions regarding the background plasma and magnetic equilibrium expected for ITER. In reality, the Be FW panel lifetime is expected to be far greater.

Paper Number

EX/P6-3

Country or International Organization

Germany

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Session Classification: Poster 6

Track Classification: EXS - Magnetic Confinement Experiments: Stability