Modelling of Beryllium migration in JET-ILW with ERO2.0

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The JET ITER-like wall (ILW) can be used as a test bed for ITER [1] for studying erosion of main chamber beryllium (Be) and its migration into the tungsten (W) divertor [2]. While Be erosion affects the lifetime of main chamber wall components, its migration into the divertor can lead to W erosion there and also to tritium retention by co-deposition.

The newly developed Monte-Carlo code ERO2.0 code has been recently applied for modelling of the Be erosion and migration in JET limiter discharges [3]. It has been demonstrated that due to massive parallelization and other technical improvements, ERO2.0 is capable of simulating the entire 3D-shaped ILW (with high level of detail) and the edge plasma volume of JET. This provides several advantages in comparison to local modelling with the previous code version ERO1.0 [4]. Most notably, the increased volume allows the validation with a larger number of experimental diagnostics situated at different locations. These include 2D camera images (infra-red for heat flux and filtered Be I, Be II line and BeD band emission for particle fluxes) as well as multiple line-of-sight (LOS) integrated spectroscopy chords.

In the present contribution, we demonstrate that including the long-range migration of Be in the modelling of limiter discharges allows a self-consistent treatment of self-sputtering. This eliminates the need for Be plasma concentration assumptions which were unavoidable in the earlier simulations considering just the local volume. Furthermore, we present first ERO2.0 modelling of Be erosion and migration in JET diverted discharges, using plasma backgrounds simulated with SOLPS-ITER [5]. We study the influence of various main chamber erosion mechanisms, such as physical sputtering by ions, chemically assisted physical sputtering (CAPS) leading to release of BeD molecules, and physical sputtering by charge-exchange (CX) neutrals, which is dominant for the main chamber in discharges with divertor configuration. The simulation results are compared to LOS integrated spectroscopy [2] characterizing the Be effective sputtering yields to demonstrate improved understanding over ERO1.0 modelling. ERO2.0 validation is broadened by the simulation of 2D IR and spectroscopy measurements. We compare the erosion and subsequent migration and deposition of Be in diverted discharges to those in limiter configuration. This allows to provide a first preliminary estimate for the maximum possible tritium retention due to co-deposition with Be (re-erosion of Be deposits and outgassing are neglected).

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