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EX/P5-05: Characterization of Tungsten Sputtering in the JET Divertor

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The current design of ITER projects tungsten (W) as plasma-facing components (PFCs) in the divertor for its active phase. The physical sputtering of W by impurities is an important issue, in particular when extrinsic impurities are seeded. It may compromise the life time of the PFCs as well as cause deterioration of the fusion performance by radiation due to unduly high W concentrations in the centre. In this contribution, we utilize the present ITER-like Wall (ILW) at JET to gain insight into ITER-relevant aspects of divertor W erosion such as impurity flux density, charge state and impact energy. A systematic spectroscopic study of L-mode and H-mode discharges with auxiliary heating by RF or NBI was performed using various W and W+ spectral lines to quantify the W source strength at the solid tungsten outer divertor target subject to the local plasma conditions. The results demonstrate that Be is the main sputtering species for unseeded discharges and causes in L-mode at divertor temperatures between 20 and 40 eV a total W sputtering flux in the range of 1-5E18 /s in the outer divertor. The inter ELM sputtering in H-mode was in the same range but (based on an example with 13 MW NBI heating, 7.5E19 /m^3 line averaged density, 10 Hz ELMs) typically more than a factor of 5 lower than the sputtering due to ELMs. Sawteeth were observed to increase the divertor Be content and therewith the W sputtering by up to an order of magnitude. The W sputtering decreased to below the detection limit (~1E17 /s) at semi-detached conditions.

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