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O2.107 Modelling of tungsten erosion transport and deposition in fusion devices

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Tungsten (W) is a candidate for plasma-facing components in future fusion reactors like DEMO and already used in fusion experiments like JET-ILW and ITER, which is currently under construction. It is foreseen for wall areas of highest particle and power loads as it has high melting point and low physical sputter yield. However, already small amounts of W in the core plasma can lead to plasma cooling and radiation collapse. Thus, W erosion has to be minimised and for this understanding of the erosion and deposition mechanisms is needed. In [1] a dedicated pulse of JET-ILW has been successfully benchmarked with ERO modelling by comparing measured and modelled W emission in the outer divertor for inter- and intraELM phases. The focus of the present contribution is on ERO modelling studies of W erosion, transport and deposition under typical conditions present in the inner and outer divertor of JET-ILW. For this, the strike point plasma temperature and density for the interELM phases are assumed to be 7eV, 2.5E20m^-3 for the inner and 35eV, 6E19m^-3 for the outer divertor. For the ELM-phases the densities are increased and the background ions (deuterium and beryllium) are assumed to have impact energies in the keV range following the "FreeStreaming-Model". Under all conditions the deposition of eroded W is very high with surface-integrated values up to nearly 100%. The gross W erosion is largest during ELMs, whereas in particular the erosion in-between ELMs in the inner divertor is negligibly small. The W erosion in-between ELMs is dominated or exclusively due to the beryllium (Be) background ions, whereas during ELMs deuterium ions contribute significantly. The role of W self-sputtering and various Be plasma concentrations will be discussed. The deposition of Be from the background leads to W-Be surface mixing and thus a decrease of the W erosion with exposure time. However, the individual inter- and intra-ELM phases are too short to reach steady state surface concentrations within these phases. The results of a dynamic simulation with consecutive ELM- and inter-ELM phases will be presented.

[1] A. Kirschner et al., Nuclear Materials and Energy 18 (2019) 239

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