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# Modelling of Prompt Deposition of Tungsten under Fusion Relevant Conditions

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Tungsten is a promising first wall material in fusion devices. Though, due to its high atomic number, tungsten concentration levels in the plasma core have to be kept small. However, in addition to low sputtering yields the high atomic number has the beneficial effect of prompt deposition, i.e. depending on the plasma parameters large amounts of sputtered tungsten can be deposited during the first gyration.

The deposition of sputtered tungsten is simulated with the 3D Monte Carlo impurity transport and plasma-wall interaction code ERO. No specific device geometry is used but constant plasma parameters along the surface. Variations of plasma density, temperature, flow velocity and sheath potential along the magnetic field are considered according to the simple two point model and PIC-simulated sheath characteristics. Simulations have been done for a magnetic field of 3 T with an angle of 2 deg relative to the surface. With an electron temperature  $T_e = 20$  eV and density  $n_e = 6E19$  m<sup>^-3</sup> at the sheath entrance, the modelled amount of tungsten prompt deposition is 95%. Reducing T\_e at the sheath entrance to 5 eV lowers the modelled deposition fraction to 65%. In both cases tungsten ionisation occurs outside the sheath leading to mean deposition energies of about 3QT\_e (with Q the mean charge of depositing tungsten ions), which are in accordance with the sheath potential drop.

Further parameter studies with T\_e between 1 and 20 eV and n\_e between 1E18 and 1E21 m^-3 have been performed. At very high n\_e and T\_e, the tungsten ion trajectories do not describe clear gyration motions anymore as the movement is dominated by the large electric field near the surface. Therefore, the term "prompt deposition" is used for atoms, which after their ionisation return to the surface within t < t\_gyro. Whereas at the lowest T\_e, n\_e no prompt deposition occurs, all eroded tungsten is promptly deposited at the largest T\_e, n\_e. At high n\_e in combination with low T\_e deposited tungsten ions can reach energies much larger than expected from the sheath potential. The energy excess comes from very effective entrainment of the tungsten ions with the plasma via friction.

The possible runaway sputtering due to an avalanche effect of tungsten self-sputtering will be studied. Also, the influence of ELMs on the prompt and overall deposition and resulting sputtering will be addressed.

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