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Beryllium Migration in JET ITER-like Wall Plasmas

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The understanding of material migration is a key issue for a successful and safe operation of ITER. JET is used as test bed to investigate the process cycle which is connected the lifetime of first wall components by erosion and the safety due to long-term retention.
Divertor configuration: The current understanding of Be migrationin the JET-ILW can be described as follows: neutral Be and BeD from physical and chemical assisted physical sputtering by CX neutrals and residual plasma flux at the recessed wall enters the plasma, is dissociated, ionised and transported by SOL-flows towards the inner divertor where significant deposition takes place. The amount of Be eroded at the first wall and the amount of Be deposited in the inner divertor are almost comparable (~12-15g). The primary impurity source in JET-ILW is by a factor 5.3 reduced in comparison with JET-C resulting in a lower divertor material deposition by more than an order of magnitude. Within the divertor, Be performs much less re-erosion and transport steps than C due to an energetic threshold for Be sputtering and inhibits by this the transport to the divertor floor and to remote areas at the pump-duct. The low migration is also consistent with low fuel inventory and dust production.
Limiter configuration: Be gross erosion yield was determined by spectroscopy between 0.03 (E=35eV) and above 1 caused by self-sputtering (E=200eV). Chemical assisted physical sputtering via BeD has been identified to contribute to the effective Be yield, i.e. at E=75eV about 1/3 enhanced erosion with respect to bare physical sputtering. An effective Be gross yield of 10% is representative for limiter plasmas in the initial campaign. This is equivalent to an average erosion rate of 4.1E18Be/s or 1.5g Be sputtered from one midplane tile. The corresponding net erosion rate amounts 2.3E18Be/s. This is equivalent to 0.8g Be revealing a factor two between net and gross erosion. The primary impurity source in limiter configuration in JET-ILW is only 25% above the JET-C case. The main fraction of eroded Be stays within the main chamber and only a small part of Be escapes geometrically from the main chamber into the divertor.

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