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Long-term fuel retention and release in JET ITER-Like Wall at ITER-relevant baking temperatures

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JET with its ITER-Like Wall (ILW) material configuration is presently the only machine in which ITER-relevant plasma-material interactions, such as material erosion and migration and in-vessel fuel retention and removal, can be studied on the tokamak-scale. Especially the in-vessel tritium (T) retention in ITER has high safety importance. The ITER baseline to recover the trapped T is to perform baking of the Plasma Facing Components (PFC), at 240℃ for the Be first wall and at 350℃ for the W divertor.

To study the fuel retention and release at ITER-relevant baking temperatures, a representative set of samples were cut from different ILW regions of selected divertor and main chamber PFCs for deuterium (D) outgassing studies using Thermal Desorption Spectrometry (TDS). The prepared samples represent PFC locations with varying co-deposit thicknesses (up to 15 μm). The TDS experiments were performed with different annealing rates (1 and 10 K/min) and dwell times (5 and 15 hrs) at the ITER-relevant bake temperatures. Finally, the sample temperature was raised up to 1000℃ to empty the samples of any remaining D.

Results for the thickest ILW deposition indicate that more than 55% of the D is still retained after 15 h of baking at 350℃. A thinner deposited layer (5 μm) was found to have 40% retention after 5 h of annealing. A general feature to all of the ILW divertor samples was, that annealing up to 1000℃ showed the D2 release maxima to take place at high temperatures above 330℃ over a broad temperature range. For the Be main chamber samples, a relatively higher retention is observed after the ITER-relevant baking temperature at 240℃. The preliminary TDS result for a clean, deposit-free bulk Be sample shows over 60% retention after a 5 h baking at 240℃. Previous ILW post-mortem results showed an order of magnitude less global retention in the main chamber as compared to the divertor. However, in ITER the much larger main chamber surface area compared to divertor and its low baking temperature 240℃ may play an important role in assessing the accumulated T.

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