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EX/4-1: Fuel Retention Studies with the ITER-like Wall in JET

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JET underwent a transformation from a full carbon-dominated device with all Plasma-Facing Components (PFCs) made of Carbon-Fibre Composites (CFC) to a full metallic device with Be PFCs in the main chamber, bulk W at the outer target plate, and W-coated CFC elsewhere in the divertor. The ITER-Like Wall (ILW) experiment at JET provides an ideal test bed for the ITER material choice in the DT phase and shall demonstrate as primary goals the plasma compatibility with the new metallic wall and the expected reduction in fuel retention. We report on a set of experiments (Ip=2.0MA, Bt=2.4T) in different plasma conditions (ohmic, L- and H-mode) with global gas balance demonstrating a strong reduction of the long term fuel retention with the ILW by a factor ten with respect to previously performed CFC references. All experiments have been executed in series of identical plasma discharges in order to achieve a maximum of plasma duration until the analysis limit for the Active Gas Handling System has been reached. The composition analysis shows high purity of the recovered gas, typically 99% D, with a reduction of residual hydrocarbons with operational time. For typical L-mode discharges (0.5MW RF heating) and type III ELMy H-mode plasmas (5.0MW NBI heating) in high triangularity a drop of the retention rate from 1.27x1021D/s and 1.37x1021D/s to values down to 4.8x1019D/s and 7.2x1019D/s, respectively, has been measured. The retention rate is normalised to the integral divertor time which amounts 440s for the L-mode and 317s for the H-mode plasmas. The dynamic retention increases in the limiter phase with the Be first wall in comparison with CFC, but also the outgassing after the discharge has risen in the same manner and compensates this transient retention.

The main retention mechanism for the long term retention is the co-deposition of fuel with Be eroded from the main chamber, whereas the fuel content in the Be layers is potentially reduced by one order in comparison with carbon layers as laboratory experiments suggested. The lower retention is also in line with the reduction of the C flux in the same order in the plasma edge layer measured by optical spectroscopy. The reduction is fully supportive in the ITER material choice

and widens the operational space without active cleaning an is in line with retention predictions by J. Roth (J. Nucl. Mater. 390, 2009).

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