Microscopically nonuniform deposition and deuterium retention in the divertor in JET with ITER-like wall

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The divertor surfaces in JET with ITER-like wall (ILW) have been studied post mortem, using micro ion beam analysis (µ-IBA) methods, optical microscopy and scanning electron microscopy (SEM). Divertor tiles 1, 3, 4, 6 and 8 have been studied. The surfaces were originally W coated carbon fibre composite (CFC). The metal coating was 20 µm thick, partly also with a Mo marker layer, with about 5 µm surface roughness carried over from the CFC substrate. Deposited layers with beryllium as main constituent had been formed during plasma operations through 2011-2012. The distributions of Be, D, W, C and Inconel components were measured, both at the surface and in layer cross sections. The deuterium trapping was found to be non-uniform along the surface, frequently enhanced within regions reaching in size from 20 µm to 200 µm. The distribution of metal impurities and carbon at the divertor surfaces was likewise found to be non-uniform on a microscopic scale. Qualitatively the non-uniform fuel trapping is similar to the situation at the vertical surfaces in the inner divertor following operations with carbon wall, although the layers are thinner and the overall amount of trapped fuel is smaller with ILW. As in the carbon wall case, the microscopic variations in composition could largely be related to the surface topography. In particular, locally enhanced amounts of D, Be and C were found at pits and cracks in the tungsten coating. The impurity deposition and fuel retention were also found to be correlated with the surface roughness. The microscopically non-uniform deuterium trapping with ILW accounts for a relatively larger fraction of the total fuel trapping at divertor surfaces than in the carbon wall case, where most of the deuterium was trapped in thick layers with more uniform fuel content. The influence of surface structure on fuel trapping is of consequence for understanding the trapping mechanisms and for the interpretation of other surface analysis data. It is also relevant for the extrapolation of fuel retention data from JET ILW to ITER, since the fuel trapping associated with coating damage and large scale surface roughness is not expected in ITER.