Overview of material migration and its impact on diagnostic components in the JET tokamak with ITER-Like Wall

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The installation of the JET ITER like wall (JET-ILW) with beryllium limiter and inner wall surfaces and tungsten divertor surfaces has resulted in a significant decrease in erosion, material migration and deposition around the vessel when compared with the JET carbon wall configuration preceding it. With the JET-ILW erosion is dominated by sputtering due to particles (ions or neutrals depending on location) from the plasma. Eroded particles can be ionised and locally deposited back to the surface as seen in the divertor where 95% of eroded tungsten is promptly re-deposited, or can migrate over longer distances along the scrape off layer at the plasma boundary to surfaces further away as evidenced by the deposits forming at the high field side above the inner divertor where the majority of beryllium eroded from the main chamber is located. In either case a cycle of re-erosion and re-deposition of impurities continues until they reach a plasma inaccessible surface, where deposits build up.

Of concern is the effect of deposition on mirrors used in optical plasma diagnostics. Where deposition occurs on mirror surfaces, the reflectivity decreases having a detrimental effect on the calibration of optical data. Recessing mirrors is considered to be one method of reducing deposition. In the JET-ILW, mirrors recessed in channels and located at the outer wall show only minor surface modification due to low levels of impurities on the surface which result in a minimal change in reflectivity – an encouraging result. Whereas for mirrors mounted in channels in the remote corners of the JET divertor pump duct, deposits are formed, and reflectivity is reduced up to 80%. In addition to deposits, solidified splashes and droplets from melted regions of beryllium PFCs have been found on mirror surfaces, which also have a negative impact on the reflectivity of mirrors. Cleaning methods may be deployed and are under research and development for ITER, but non-uniform composition, thickness and presence of droplets pose significant challenges for the efficacy of cleaning techniques. Shaping of channels and use of baffles is also being considered to mitigate deposition.

In JET a series of near infra-red (NIR) cameras are used to protect plasma facing components from exceeding maximum operating temperature limits deemed detrimental to the longevity of the components. Such cameras feed data directly to a vessel thermal mapping system which terminates a JET pulse if limits are exceeded. Hence accurate temperature measurement is crucial for the effective operation of the system. However the temperature calibration from IR data depends on the emissivity of the surface of PFCs which is affected by changes in morphology, composition and thermal conductivity arising from erosion and deposition. Therefore knowledge of how surfaces are altered by these processes is needed.

**See the author list of “Overview of the JET preparation for Deuterium-Tritium Operation” by E. Joffrin et al. to be published in Nuclear Fusion Special issue: overview and summary reports from the 27th Fusion Energy Conference (Ahmedabad, India, 22-27 October 2018)*