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First Results with Laser Induced Break-down Spectroscopy for Co-deposited Layer Studies at JET

Frederic Le Guern

JET-EFDA Culham Science Centre OX14 3DB Abingdon UK

In D-T fusion reactors, tritium is trapped in co-deposited layers that result from the sputtering of the surface of plasma facing components (C, Be, stainless steel) by the plasma during reactor operation. Re-deposition of the sputtered particles together with hydrogen, deuterium and tritium takes place on colder areas inside the vacuum vessel. The tritium trapped in this layer could impose limitations on ITER operation.

Diagnostics based on Optical Emission Spectroscopy (OES) have been implemented to analyse the plasma created during ablation of material by laser pulses. The results obtained in laboratory conditions on TORE-SUPRA and TEXTOR CFC tiles have shown that it is possible to discriminate the co-deposited layer from the substrate, to estimate its thickness and to study its composition. This faculty is due to the fact that the laser plasma optical emission spectrum is composed of lines specific of the layer composition (C, Fe, Cr and H).

In order to test this technique in relevant TOKAMAK conditions, the edge LIDAR laser (ruby laser: 3J, 300ps pulse duration, 1Hz repetition rate) of JET was used to create a plasma on the surface of an inner leg divertor tile. Part of the tile under observation was equipped with a Tungsten (W) stripe. This is itself covered with a co-deposited layer formed by the plasma interactions after the tile was installed. Preliminary results have shown that after a few laser shots the optical signal recorded when ablating the co-deposited layer almost disappeared, indicating that the laser reached the W stripe. Indeed, the laser energy density delivered to the surface is well below the W ablation threshold and therefore, no plasma is created when the laser interacts with the W surface. These preliminary indications, obtained from limited experiments at JET, constitute a proof of principle that this technique, when implemented in a TOKAMAK environment, should allow the evaluation of the thickness of a co-deposited layer formed on a tungsten surface.

Further experiments based on an optimised signal collection system are expected to provide a characterisation of the co-deposited layer composition.