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P2.071 Quantitative Deuterium detection by laser-induced-breakdown-spectroscopy in ITER relevant samples

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The detection of retained nuclear fuel in plasma facing components (PFCs) is currently one of the critical issues for ITER because of the impact tritium can have on the machine operation and safety. Laser Induced Breakdown Spectroscopy (LIBS) is a promising technique providing both qualitative and quantitative composition of the chemical elements retained in PFCs: it does not require sample treatment or manipulation, it can work in-situ between fusion discharges or during maintenance periods, it is suitable for measurements at different residual pressures.
In this work, carried under WPPFC, the results of LIBS measurements at 100 mbar nitrogen pressure on samples simulating ITER PFCs are presented.
The LIBS system is composed of a Nd:YAG laser (wavelength 1064 nm, pulse width 10 ns, repetition rate 10 Hz, spot diameter 1 cm) focused by a quartz lens of 500 mm nominal focal length into a vacuum chamber through a 1064-AR coated window. Pulse energy was 150 mJ, spot diameter at the sample surface was 2 mm. Light from the laser-induced plasma was focused into an optical fibers bundle (200 um core diameter) and sent to a 550 mm monochromator (resolution 0.1 Å at 500 nm) for the spectral analysis.
Small Mo tiles coated with 3 μm thick W-Al-D mixed layer (W 80% - Al 15% - D 5%) were used as samples, to simulate tungsten tiles contaminated with tritium (represented by deuterium) co-deposited with Be (represented by aluminium) eroded from the first wall.
LIBS spectra showed clear W, Al and D lines. Quantitative estimation was performed by applying the Calibration Free (CF) analysis. CF does not require reference samples so it's particularly suitable for this purpose. CF results have been compared with the nominal concentration values and found in good agreement. The aerial D density was found to be about 6·1017 D/m2.

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