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EX/P5-14: Development of Laser Based Techniques for In-situ Characterization of the First Wall in ITER and Future Fusion Devices

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In situ methods to measure the fuel retention and characterize the material deposition on the wall are highly important for ITER and future fusion devices. Laser-based methods are the most promising candidates (for non-invasive applications) and are being investigated in a cooperative undertaking in various European associations under EFDA coordination.
The work concentrates on laser techniques by which the laser light is guided from outside the biological shield by a mirror system through a window onto special wall areas and on three different laser methods i) laser induced desorption spectroscopy (LIDS) in which ms laser pulses thermally desorbs the retained fuel from a wall area of about 1cm2 and the desorbed fuel is spectroscopically detected in the edge of a running plasma, ii) laser induced ablation spectroscopy (LIAS) in which ns laser pulses ablates the a small wall spot and the ablated material together with the incorporated fuel is detected in a similar way as for LIDS and iii) laser induced breakdown spectroscopy (LIBS) in which ns (or even ps) laser pulses pulse produces a plasma plume which (in proper conditions) emits line radiation being a fingerprint of the chemical composition of the ablated materials in front of the irradiated wall spot. The aims are to compare the pros and cons of the methods and fix an optimized solution for ITER.
LIDS and LIAS have been developed to a prototype-like status for ITER application in the TEXTOR tokamak. LIBS has been investigated in several EU associations in dedicated lab experiments with a focus on the particular conditions in ITER, including pilot experiments in the TEXTOR tokamak. To enable a clear and fair quantification of the methods, standard deposits of diamond like carbon (DLC) and mixed W/Al/C (Al mimic Be here) with thicknesses of 2-3 μm deposited on rough and polished W substrates with a known D inventory have been prepared by magnetron sputtering and vacuum arc deposition and used as standard samples in these observations.

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Collaboration (if applicable, e.g., International Tokamak Physics Activities)

EFDA

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