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Chemical analysis by Laser Induced Breakdown Spectroscopy of the poloidal cross-section of the JET divertor after its last D-T experimental campaign

Salvatore Almaviva[1], Jari Likonen[2], Antti Hakola[2], Juuso Karhunen[2], Sebastijan Brezinsek[3], Gennady Sergienko[3], Rahul Rayaprolu[3], Rongxing Yi[3], Timo Dittmar[3], Christoph Kawan[3], Marc Sackers[3], Erik Wüst[3], The UKAEA RACE Team[4], Anna Widdowson[4], Ionuț Jepu[4], Pavel Veis[5], Sahithya Atikukke[5], Shweta Soni[5], Paweł Gąsior[6], Wojciech Gromelski[6], Jelena Butikova[7], Indrek Jõgi[8], Peeter Paris[8], Jasper Ristkok[8]

[1]ENEA, Diagnostics and Metrology Laboratory, Italy
[2]VTT Technical Research Centre of Finland Ltd., Finland
[3]Forschungszentrum Jülich GmbH, Germany
[4]UKAEA, Culham Campus, Abingdon, United Kingdom
[5]Comenius University, Faculty of Math, Physics and Informatics, Slovakia
[6]Institute of Plasma Physics and Laser Microfusion, Poland
[7]Institute of Solid State Physics, University of Latvia, Latvia
[8]University of Tartu, Institute of Physics, Estonia

Following the last JET D-T experimental campaign, ended in late 2023, in the framework of a close collaboration between several EUROFUSION partners and UKAEA, it was possible to design and carry out a measurement campaign by using the Laser-Induced-Breakdown Spectroscopy (LIBS) technique [1]. For the first time, in-situ material characterization of the first wall (FW) part of the JET tokamak was conducted without requiring any manipulation or removal of plasma facing components. One particular attention was given to the divertor area, where the most evident phenomena of redeposition of the material eroded by the FW, implantation and co-deposition of the unburned D-T fuel are expected [2,3]. Several points of the divertor were sampled with a dedicated number of laser shots and the resulting LIBS spectra were recorded in the UV-VIS spectral range (250-750 nm) by using an Echelle spectrometer.
This contribution presents the main results of the data analysis, focusing the study on the poloidal cross-section of the JET divertor. The LIBS spectra have highlighted the redeposition on the divertor surface of Be, coming from the JET FW components, together with residual traces of Hydrogen isotopes and possibly, Oxygen. The structure of the divertor elements, consisting of both W bulk and W-coated Carbon fibre composites (CFC), with Mo interlayers has also been observed. Moreover, by performing a depth profile analysis on Be-coated elements of known thickness, the average ablation rate was estimated to be around 160 nm per laser pulse.
To estimate the residual content of Hydrogen isotopes, a calibration free [4] (CF) analysis will be applied to the spectral signal of the T-alpha/D-alpha/H-alpha lines (656-656.3 nm). CF technique is based on the knowledge of the plasma parameters, like electron temperature and density and can give quantitative results by looking at the intensities of the emission lines obtained by the experimental data. CF does not require calibration samples [4] and is more reliable when many emission lines of the detected elements are recorded in a broad spectral range, as in the case of the present data.

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