# P 9: Plasma Wall Interaction

Time: Tuesday 16:15–17:15 Location: ZHG102

**Invited Talk** P 9.1 Tue 16:15 ZHG102

**In-vessel and depth-resolved hydrogen isotope composition analysis in JET by LIBS operated on a remote handling arm** — •Rongxing Yi[1], Rahul Rayaprolu[1], Gennady Sergienko[1], Erik Wuest[1], Marc Sackers[1], Timo Dittmar[1], and Sebastijan Brezinsek[1,2] — [1]Forschungszentrum Jülich GmbH, IFN-1 Plasmaphysics, Jülich, GERMANY — [2]HHU Düsseldorf, Faculty of Mathematics and Natural Sciences, Düsseldorf, GERMANY

As the world's most successful Tokamak, JET achieved a groundbreaking milestone in nuclear fusion during its final deuterium-tritium experimental campaign (DTE-3) last year by setting a new world energy record. However, one critical safety aspect, the fuel retention distribution within the vessel walls after DTE-3, remains an unresolved challenge. To resolve it, a laser-induced breakdown spectroscopy (LIBS) system has been deployed. Compactly integrated into a laptop-sized box, the setup is mounted on a remote handling arm inside the JET vessel. Spectral data collected through this system is transmitted via long optical fibers to multiple spectrometers for analysis. The laser achieves a surface and depth resolution of 130 $\mu$m and 180 nm on tungsten, respectively. Additionally, a high-flux Littrow spectrometer gives high sensitivity for detecting hydrogen isotopes. By utilizing the remote handling arm with the LIBS setup, over 800 positions were analyzed within the vessel, providing both global distribution and depth profiles of retained hydrogen isotopes.This approach represents a method in understanding fuel retention, crucial for improving the safety and wall material design of future fusion reactors.

P 9.2 Tue 16:45 ZHG102

**Experimental Investigations of the Hydrogen Isotopes Retention and Permeation in Boron Coatings** — •Eduard Warkentin[1,2], Anne Houben[1], Marcin Rasinski[1], Hans Rudolf Koslowski[1], Timo Dittmar[1], Bernhard Unterberg[1,2], and Christian Linsmeier[1,2] — [1]Forschungszentrum Jülich GmbH, Institut of Fusion Energy and Nuclear Waste Managment - Plasmaphysics (IFN-1), Jülich 52425, Germany — [2]Ruhr-Universität Bochum, Faculty of Physics and Astronomy, Bochum 44801, Germany

Fuel permeation and retention in fusion reactor wall materials are important issues for plasma operation and safety reasons in ITER. The loss of the hydrogen isotope tritium, which will be used as fuel, has to be estimated and prevented. Due to the change of the ITER first wall material from Be to W, oxygen and other impurities in the vessel are not sufficiently gettered by a W wall. A thin boron layer which is applied during the regular wall conditioning phase can solve the problem and a more efficient plasma operation can be obtained. In order to investigate hydrogen retention and permeation of boron coatings, pure boron layers were fabricated by magnetron sputter deposition on W and steel substrates. After characterization, the deuterium permeation flux was measured and the layer permeation was obtained. Boron coated samples were exposed to different deuterium plasma and ion loadings in order to investigate retention via nuclear reaction analyis (NRA) and thermal desorptions spectroscopy (TDS).

P 9.3 Tue 17:00 ZHG102

**Depth-resolved deuterium retention profiles in displacement-damaged tungsten with laser-induced ablation quadrupole mass spectrometry** — •Christoph Kawan[1,2], Sebastijan Brezinsek[1,2], Timo Dittmar[1], Erik Wüst[1,2], Thomas Schwarz-Selinger[3], Liang Gao[1], and Christian Linsmeier[1] — [1]Forschungszentrum Jülich GmbH, IFN-1 Plasmaphysics, 52425 Jülich, GER — [2]Mathematisch- Naturwissenschaftliche Fakultät, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany — [3]Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, 85748 Garching, Germany

Future fusion devices will operate with the hydrogen isotopes deuterium (D) and tritium (T) as fuel gases and tungsten (W) as wall material. The released high energetic neutrons from DT fusion reactions cause displacement damage in the W lattice and increase fuel retention by trapping and diffusion, leading to decreased reactor performance. Therefore, diagnostics are required to quantify the D and T content. Laser-induced ablation quadrupole mass spectrometry (LIA-QMS) is a promising method with good depth resolution and absolute quantification and can be combined with traditional diagnostics, such as laser-induced breakdown spectroscopy (LIBS). This study compares LIA-QMS D profiles with LIBS and nuclear reaction analysis (NRA) on self-damaged W samples. LIA-QMS shows a higher sensitivity ($<0.1$ at% D at 75 nm average ablation) than LIBS. Qualitatively, LIA-QMS can reproduce the NRA depth profiles, but quantitatively, LIA-QMS underestimates the total content by a factor of $\sim 3$.