P 2: Magnetic Confinement, Plasma-Wall Interaction & Helmholtz Graduate School I

Time: Monday 11:00–12:25 Location: H6

Invited Talk P 2.1 Mon 11:00 H6

Predictive modelling of beryllium erosion, transport and deposition during H, He and DT plasmas in ITER — •Juri Romazanov[1], Sebastijan Brezinsek[1], Andreas Kirschner[1], Richard A. Pitts[2], Vladislav S. Neverov[3], and Christian Linsmeier[1] — [1]Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung * Plasmaphysik, Partner of the Trilateral Euregio Cluster (TEC), 52425 Jülich, Germany — [2]ITER Organization, Route de Vinon-sur-Verdon, CS 90 046, 13067 St.-Paul-lez-Durance Cedex, France — [3]National Research Centre Kurchatov Institute, Moscow, Russia

Beryllium (Be) will be the main chamber armor material for the international thermonuclear fusion reactor ITER, which is currently under construction in France. We present a comparison of the Be erosion for different plasma conditions, including the baseline DT burning plasma scenario with power gain Q=10, as well as the low-power hydrogen (H) and helium (He) plasmas foreseen in the ITER pre-fusion power operation (PFPO) phase. It is shown that in the latter ones, the gross erosion is two orders of magnitude smaller. Another important finding is the difference in Be migration: in the DT baseline scenario 90% of the eroded Be is redeposited in the main chamber, while in the H and He cases the redeposition is reduced to 44 and 56%, respectively. The remaining Be is deposited in the divertor. Finally, it is shown that in DT the erosion is dominated by Be self-impact, while in H and He the sputtering by energetic charge-exchange neutrals (CXN) dominates.

P 2.2 Mon 11:30 H6

In situ mechanical characterization of ion-irradiated tungsten — •Bailey Curzadd[1,2], Max Boleininger[3], Maximilian Fuhr[1,2], Till Höschen[1], Robert Lürbke[1,4], Johann Riesch[1], and Rudolf Neu[1,2] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]Technical University Munich, Garching, Germany — [3]CCFE, UKAEA, Abingdon, UK — [4]RWTH Aachen, Aachen, Germany

Although its low erosion and low retention of tritium make tungsten (W) the preferred plasma-facing material for future fusion reactors, its low-temperature brittleness is a critical vulnerability that could lead to the premature failure of plasma-facing components. Additionally, the degradation of essential material properties in the reactor environment – especially by neutron radiation and H/He trapped in the microstructure – greatly increases the likelihood of component failure, yet the degradation of W in a fusion environment is poorly characterized. For this reason, a novel in situ accelerator experiment was developed to characterize the mechanisms by which the mechanical properties of W are altered by radiation damage and trapped impurities, with a principle focus on the investigation of synergistic interactions between the factors that lead to material deterioration. This experiment uses thin drawn W wires prepared to a diameter of 5 *m to enable complete irradiation of the sample cross-section and allows simultaneous damaging and implantation of impurity atoms. The capabilities of the system and the results of the first experimental campaign examining radiation-induced relaxation of tensile stress in W will be presented.

P 2.3 Mon 11:55 H6

Conventional and non-conventional diagnostics on an atmospheric pressure DC glow microplasma discharge for in situ TEM studies — •Luka Hansen[1], Niklas Kohlmann[2], Ulrich Schürmann[2], Lorenz Kienle[2], and Holger Kersten[1] — [1]Institute of Experimental and Applied Physics, Kiel University, 24098 Kiel, Germany — [2]Institute of Materials Science, Kiel University, 24143 Kiel, Germany

Plasma surface interaction is one of the most discussed topics in plasma technology due to its relevance for the production or modification of micro- or even nano-structured surfaces. Still, state of the art analysis is mostly limited to the separation of plasma processing and surface analysis, since observing plasma induced surface changes in real time and nanoscale resolution is challenging. Based on the proof of principle experiments by Tai *et al.* [1] a DC microplasma discharge cell for in situ TEM integration is developed to overcome this limitation. Prior to introducing the cell close to the sensitive TEM optics extensive testing and diagnostics of the plasma discharge have to be done to ensure stability and reproducibility. Results of the conventional (electrical measurements, optical imaging, and emission spectroscopy) as well as non-conventional (calorimetry) diagnostics will be presented and a report on the current progress of the in situ measurements will be given.

[1] K Tai *et al* 2013 *Scientific Reports* **3** 1325

P 2.4 Mon 12:10 H6

Ion-induced secondary electron emission of metal surfaces analysed in an ion beam experiment — •Rahel Buschhaus, Marina Prenzel, and Achim von Keudell — Experimentalphysik II, Ruhr-Universität Bochum

Electron emission from surfaces during ion impact is one of the most fundamental plasma-surface-interaction. The surface conditions in plasmas strongly affect this electron emission and thus have an impact on the discharge itself. However, data of oxidized targets for instance, as they would appear in any reactive plasma discharge, are very spare and may even contain significant systematic errors, because they were often measured by modeling the complex behavior of plasma discharges. Many experimental and theoretical approaches address secondary electron emission coefficient determination (SEEC; amount of released electrons per incident ion) in literature [1,2]. However, this determination may remain rather indirect, because the process of ion-induced electron emission overlaps with other plasma-surface-interactions. Using beam experiments avoids this complication and allows a precise electron yield determination. SEECs of clean, untreated (air-exposed) and intentionally oxidized Cu and Ni foils are investigated in a beam experiment. Here, metal foils and oxidized foils are exposed to beams of Ar^+ with E_{ion}=200 eV - 10 keV and electron yields are determined precisely. A model for the electron emission is presented to explain the data. Surface conditions were analyzed by ex-situ XPS measurements. [1] D. Depla et al. J.Phys.D:Appl.Phys.,2008 [2] M. Daksha et al. J.Phys.D:Appl.Phys., 2016