P 14: Plasma Wall Interaction

Zeit: Dienstag 16:30–18:30 Raum: HS Foyer

P 14.1 Di 16:30 HS Foyer

The effect of secondary electron emission on discharge properties in an rf-plasma — •Felix Georg, Thomas Trottenberg, and Holger Kersten — Institut für experimentelle und angewandte Physik, Kiel, Deutschland

A diagnostic combining a retarding field analyzer, a passive thermal probe and Langmuir probe techniques is presented. The setup is used to combine and compare measurements of these techniques to study the plasma-wall interaction for different materials.

In the plasma chamber two horizontal electrodes made of stainless steel are placed. The lower one is powered by an rf voltage with 13.56 MHz. The two electrodes are embedded into two MACOR contrivances which can be horizontally adjusted. Different materials (metal, metal oxide) can be placed onto the driven electrode. Thus, the interaction of the rf-plasma with the surface can be observed in special regard to varying secondary electron emission.

The electron density and energy distribution as well as the ion energy distribution have been independently measured. Additionally, the energy influx can be determined. By comparison of the three electric probe measurements the effect of the secondary electron emission of specific surfaces can be identified.

P 14.2 Di 16:30 HS Foyer

A molecular dynamics modeling of electron emission from metal surfaces induced by gas-surface interactions — •Alexey Filinov[1,2,3], Michael Bonitz[1], and Detlef Loffhagen[2] — [1]Institut für Theoretische Physik und Astrophysik, CAU Kiel, Leibnizstr. 15, D-24098 Kiel, Germany — [2]INP Greifswald e.V., Felix-Hausdorff-Straße 2, 17489 Greifswald, Germany — [3]Joint Institute for High Temperatures RAS, Izhorskaya Str. 13, 125412 Moscow, Russia

The interaction of a dilute monatomic gas with a solid surface is investigated by Molecular Dynamics (MD) simulations. The main goal is to provide a microscopic description of the electronic stopping-power effects and secondary electron emission. The gas-surface interaction (for Ar atoms and ions) is treated via the effective pair potential determined from the non-local van-der-Waals approach [1]. Different energy dissipation channels in the adsorption process are included. The electron-hole pair excitations are considered via the model of electronic friction [2]. The phonon excitations are treated via the Langevin MD simulations. We analyze how the electron emission current depends on the effective electron temperature (determined by the energy losses) and the work function of a metal modified by a surface electric field and positive ions slowly moving at atomic distances to the surface.

[1] R. Grenier et. al., J. Chem. Phys. A 119, 6897 (2015). [2] J.I. Juaristi et. al., Phys. Rev. Lett. 82, 1048 (1999).

P 14.3 Di 16:30 HS Foyer

Investigation of Plasma Detachment Characteristics and Dynamics at the ASDEX Upgrade Tokamak — •Amazigh Zerzour, Matthias Bernert, Daniel Carralero, Ulrich Stroth, and The ASDEX Upgrade Team — Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany

Future tokamaks like ITER and DEMO will experience heat fluxes of about 300 MWm^{-2} onto the divertor if not mitigated. This poses a major threat to the device as material heat load limits are expected to be in the range of 5 MWm^{-2}. An efficient solution to this is the detachment of the plasma from the divertor, a state in which the plasma temperature drops to values of several eV at the divertor, allowing for recombination and charge exchange processes in the divertor volume. However, future tokamaks are foreseen to operate in the High Confinement Mode (H-Mode) which features cyclic instabilities, so-called Edge Localized Modes (ELMs), periodically driving high heat fluxes onto the divertor. Heat loads during ELMs can last long enough to effectively reattach the plasma to the divertor. We therefore investigate H-mode plasmas at various densities and power fluxes to characterize the detachment cycles in between ELMs. Understanding the characteristics and dynamics of the detachment regimes, not only in between ELMs, and their influence on the bulk plasma is of crucial importance for the successful operation of future tokamaks.

P 14.4 Di 16:30 HS Foyer

A multipurpose room-temperature solid-state pellet launcher for ASDEX Upgrade — •Raphael Hoepfl[1,2], Martin Balden[1], Thomas Haertl[1], Otto J. W. F Kardaun[1], Peter T. Lang[1], Rudolf Neu[1,3], Bernhard Ploeckl[1], Volker Rohde[1], Datong Wu[2], and ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching — [2]Munich University of Applied Sciences, Lothstr. 34, 80335 München — [3]Technische Universität München, Boltzmannstr. 15, 85748 Garching

Recently, a system for the injection of lithium (Li) pellets into the Tokamak ASDEX Upgrade was developed. It is capable to launch mm-sized pellets at speeds up to 600 m/s with 2 Hz repetition rate. Now, the system was revised to act as a multipurpose unit for injecting different types of room-temperature solid-state pellets. As a first application, wall conditioning is envisaged. Encouraged by the favorable behavior observed during plasma start up gained by small amounts of Li, the idea is to inject solid-state boron (B) for wall conditioning. Usually the latter is performed burning a 4 hour long glow discharge in a He B_2H_6 mixture depositing about 10^{23} B atoms, conducted typically monthly after about 350 plasma discharges. Presently, boron nitride (BN) is selected as pellet material. The co-injection of nitrogen should be tolerable as it is introduced anyway regularly for radiative cooling and performance investigations. About 10^{20} B atoms per pellet and 10^{21} per discharge could be delivered, possibly sufficient for supplementary wall conditioning. Currently, BN raw material from different sources covering a variety of sizes, consistency and purity are investigated.

P 14.5 Di 16:30 HS Foyer

Untersuchung der Rückhaltemechanismen von Wasserstoff in Beryllium Wolfram Verbindungen — •Michael Eichler, Timo Dittmar und Christian Linsmeier — Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung - Plasmaphysik, 52425 Jülich, Germany

In den experimentellen Fusionsreaktoren JET und zukünftig auch ITER besteht die erste Wand im Hauptraum aus Beryllium (Be). In Bereichen der höchsten Wärmelasten (Divertor) wird zusätzlich Wolfram (W) verwendet. Als Brennstoff werden die Wasserstoffisotope Deuterium (D) und Tritium (T) eingesetzt. Durch den Kontakt der Reaktorwand mit den D- und T-Ionen wird unter anderem das Oberflächenmaterial erodiert und an anderen Stellen deponiert. Dadurch entstehen Be-W Verbindungen. Da das radioaktive T während des Reaktorbetriebs in der Wand eingelagert wird, ist die Untersuchung des Wasserstoffinventars, insbesondere der Rückhaltemechanismen in Be-W Legierungen von besonderem Interesse. Dazu wird das Ultra Hoch Vakuum Experiment namens ARTOSS vorgestellt, welches alle relevanten Oberflächenanalytiken vereint und somit die in situ Präparation und Analyse entsprechender Materialien unter wohldefinierten Bedingungen ermöglicht. Der Ionenbeschuss im Reaktor wird hier mit einer Ionenquelle simuliert. Mit Spannungen bis maximal 20 kV werden D- und Wasserstoffionen in Be-W Verbindungen implantiert. Ausserdem werden erste Untersuchungen mittels Röntgenphotoelektronenspektroskopie (XPS), thermischer Desorptionsspektroskopie (TDS) und nuklearer Resonanzanalyse (NRA) gezeigt.

P 14.6 Di 16:30 HS Foyer

Protection of the first wall of Wendelstein 7-X with neural nets. — •Daniel Böckenhoff and Marko Blatzheim — Max-Planck-Institut für Plasmaphysik, Greifswald, Deutschland

Wendelstein 7-X (W7-X) is the first fully optimized stellarator. One of its main objectives is to demonstrate steady state capability of the confinement concept. The plasma-wall contact is going to be realized with so called divertors that intersect the plasma. Various mechanisms, like the development of plasma currents, lead to a change in the magnetic topology as well as plasma parameters over time. Therefore the heat load pattern on the divertors is dynamic. To ensure the safety of the first wall and protect the plasma from impurities, heat load pattern control is essential for long term operation.

Since the physics of the underlying processes is highly complex, we seek plasma control based on artificial neural networks. Inputs are in particular infrared pictures of the heat load pattern. The first important step towards this goal is to train the neural net to reconstruct the magnetic edge topology from a series of given patterns and predict the further evolution. Moreover, a study of the optimal input quantities and their preprocessing is crucial and will be presented herein.