P 4: Low Pressure Plasmas II / Laser Plasmas II

Time: Monday 16:00–17:00 Location: P-H11

P 4.1 Mon 16:00 P-H11

Secondary electron induced effects in the ion energy distribution of a symmetrical capacitively coupled plasma — •Christian Schulze[1], Zoltán Donkó[2], and Jan Benedikt[1] — [1]Institute of Experimental and Applied Physics, Kiel University, Germany — [2]Institute for Solid State Physics and Optics, Wigner Research Centre for Physics, Hungary

The Particle in Cell/Monte Carlo Collisions (PIC/MCC) approach is established as a widespread simulation tool in low pressure plasma science since it offers access to a variety of plasma parameters and - in conjunction with experiments - can provide information about surface properties that are not directly measurable in experiments. However, PIC/MCC simulations are based on simplifications. For example, secondary electron emission (SEE) is usually described by an effective yield for ion ($\gamma_{\rm eff}$) and electron ($r_{\rm eff}$) impact that include other effects leading to SEE like photoemission or kinetic SEE by fast atoms. In order to describe experimental conditions correctly experimental validations are necessary to estimate realistic input parameters. Here, ion flux-energy distributions are measured with an energy-selective mass spectrometer in a geometrically symmetric capacitively coupled plasma and compared with data obtained from 1d3v PIC/MCC simulations. Surface induced effects are studied with Al_2O_3 coated electrodes in comparison to uncoated stainless steel electrodes. The observed changes can be explained by altered plasma properties due to an increase in SEE in the case of an oxidized surface. With this comparative approach, the effective SEE coefficients $\gamma_{\rm eff}$ and $r_{\rm eff}$ are estimated.

P 4.2 Mon 16:15 P-H11

Toroidal electron beam source for electron-induced processes at atmospheric pressure — •Lars Dincklage[1], Burkhard Zimmermann[1], Gösta Mattausch[1], and Ronny Brandenburg[2,3] — [1]Fraunhofer Institute for Org. Electr., EB and Plasma Technol. FEP, Dresden, Germany — [2]Leibniz-Institute for Plasma Science and Technology, Greifswald, Germany — [3]University of Rostock, Germany

Accelerated electrons can be utilized to induce chemical reactions in gases. A toroidal electron beam (EB) source has been developed for optimum treatment of fluids in tubes as well as to generate EB-sustained atmospheric plasmas for plasma-chemical conversion processes. Electrons are created at a cooled metal cathode by the impact of ions from a low pressure wire anode (WA) plasma, accelerated in the electric field of the cathode and then emitted through an electron exit window (EEW) into the reaction space at the center of the torus. The energy of the electrons (typically 120 keV) and the EB current density at the EEW (about 100 μA/cm^2) are controlled by the cathode potential and the electric properties of the WA discharge. In order to identify stable operation parameter windows, the WA discharge characteristics as well as its effect on the EB properties were investigated for helium and hydrogen. In case of operation at low pressure and with insufficient plasma current, limiting factors such as the contraction of the plasma and a high ignition voltage were determined. Whereas the first issue was handled by pulsing the plasma, the second was met by applying an external magnetic field. Furthermore, the current efficiency of the source was determined for different states of the metal cathode.

P 4.3 Mon 16:30 P-H11

Start to End simulations with 20 J Laser in relativistically induced transparency regime — •Ilja Göthel[1,2], Tim Ziegler[1,2], Marco Garten[1,2], Constantin Bernert[1], Karl Zeil[1], Marvin E.P. Umlandt[1,2], Thomas Miethlinger[1,2], Sergei Bastrakov[1], Ulrich Schramm[1], and Thomas Kluge[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden — [2]Technische Universität Dresden, 01069 Dresden

TNSA has proven the experimentally most robust mechanism for accelerating ions with ultraintense laser pulses. In experiments at the Draco-PW laser we achieved the promising RIT regime, known for enhancing the performance beyond normal TNSA (several shots of 100MeV protons). Also, advanced pulse and beam characterization techniques enable us to deepen our understanding by simulations.

We present here a start-to-end simulation campaign with a hybrid code approach - hydrodynamic preexpansion in the time 100ps-1ps before the peak, and a 3d PIC mainpulse interaction with input from the hydro code. The scan reproduces the experimentally found behaviour of reflected and transmitted beam diagnostics with thickness.

The enhancement in the RIT regime is known from literature. For a predictive simulation, however, the hybrid code approach is necessary due to the decisive effect of preexpansion by the intrinsic contrast of the laser. Reaching these high energies reproducibly without pulse contrast cleaning devices opens the way to high repetition rate usage; deeper understanding the dynamics by predictive simulations may prove crucial for further progress.

P 4.4 Mon 16:45 P-H11

Characterization of fast electrons accelerated into matter by laser-solid interaction — •Nico Potzkai, Bastian Hagmeister, and Georg Pretzler — Institut für Laser- und Plasmaphysik, Heinrich-Heine-Universität Düsseldorf

Intense laser pulses create plasma on solid surfaces and accelerate electrons into the vacuum as well as into the target. We investigated the latter electrons concerning numbers and energy. Sub 10-fs-laser pulses on different bilayer targets did induce the plasma. The characteristic x-ray line emissions of the two materials were used to quantify the electron population traveling though the material. Our experimental results have been compared with PIC simulations and yield information of details of the laser-surface interaction.