P 16: Complex Plasmas and Dusty Plasmas II

Time: Wednesday 16:15–17:30 Location: ZHG006

P 16.1 Wed 16:15 ZHG006

Plasma surface interaction at objects at floating potential — •Dietmar Block and Sören Wohlfahrt — IEAP der CAU Kiel, Leibnizstr. 15, 24118 Kiel

A plasma as an ionized gas has markedly different properties than a normal gas. Especially the free electrons and ions can be used to trigger and enhance chemical reactions. Therefore, low-temperature plasmas are a working horse of material processing. From etching via deposition to catalytic reactions a huge variety of processes are subject of research or already used in applications. For most of them the plasma surface interaction is strongly influenced by the plasma sheath region, which has significantly different properties than the plasma bulk region. To study the chemical processes in such plasmas is not trivial. The standard approach uses ex-situ diagnostics, i.e. the treated surface is extracted from the plasma device and transferred to a diagnostic device. This approach has some limitations: the surface might change during this process and to resolve the chemical processes temporally is difficult. However, for spherical dust grains it is possible to realize an in-situ Mie-scattering diagnostic which is powerful enough to give detailed information on chemical reaction at the surface and surface modifications. Starting with a brief introduction of the diagnostic itself, this contribution will discuss the surface modification observed in-situ.

P 16.2 Wed 16:30 ZHG006

Dust acoustic wave properties in varying discharge volumes — •Christina A. Knapek[1,2], Mierk Schwabe[2,3], Victoriya Yaroshenko[2,4], Peter Huber[2], Daniel P. Mohr[1,2,3], and Uwe Konopka[5] — [1]Institute of Physics, University of Greifswald, 17489 Greifswald, Germany — [2]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, 51147 Köln, Germany — [3]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, 82234 Oberpfaffenhofen, Germany — [4]Institut für Solar-Terrestrische Physik, Deutsches Zentrum für Luft- und Raumfahrt, 17235 Neustrelitz, Germany — [5]Physics Department, Auburn University, Auburn, Alabama 36849, USA

Properties of self-excited dust acoustic waves under the influence of active compression of the dust particle system were experimentally studied in the laboratory and under microgravity conditions (parabolic flight). Ground based laboratory experiments clearly show that wave properties can be manipulated by changing the discharge volume, its aspect ratio, and thus the dust particle density. Complementary experiments under microgravity conditions, performed to exclude the effects of gravity inflicted sedimentation and anisotropic behavior, were less conclusive due to residual fluctuations in the planes acceleration indicating the need for a better microgravity environment. A theoretical model, using plasma parameters obtained from particle-in-cell simulations as input, supports the experimental findings. It shows that the waves can be described as a new observation of the dust acoustic mode, which demonstrates their generic character.

P 16.3 Wed 16:45 ZHG006

Electron sticking coefficients of dusty plasma relevant materials — •Franko Greiner, Isabel König, and Armin Mengel — Institute of Experimental and Applied Physics, Kiel University, 24118 Kiel, Germany

A relative measurement approach [1] was employed to determine the low-energy sticking coefficient $\tilde{s}$ of dielectric materials frequently utilized in "dust in plasma" research, including silica, melamine formaldehyde (MF), and polymethyl methacrylate (PMMA). The new $\tilde{s}$ values offer valuable insights for analyzing experiments involving different materials or their mixtures, facilitating more accurate comparisons and improved experimental design. Additionally, more precise values of $\tilde{s}$ are necessary to enhance the simulation of discharge systems with dielectric electrodes.

[1] A. Mengel et al. PRL 2024,
https://doi.org/10.1103/PhysRevLett.133.185301

P 16.4 Wed 17:00 ZHG006

Three-dimensional FTLE analysis of fluid dusty plasmas under weightlessness — •Andre Melzer, Christina Knapek, Daniel Maier, Daniel Mohr, and Stefan Schütt — Institute of Physics, University of Greifswald

We have performed experiments on dusty plasmas under the weightlessness conditions of parabolic flights where the dust particles form an extended homogeneous dust cloud. The particle trajectories have been recorded using a four-camera stereoscopic camera system. From that, the three-dimensional particle trajectories have been determined using both a machine-learning particle reconstruction technique and the deterministic shake-the-box algorithm. From the trajectories, fluid parameters, flow fields and finite-time Lyapunov exponent (FTLE)-based fluid structures have been calculated and analyzed. The FTLE analysis indicates that the fluid behavior changes during the course of the parabola. Furthermore, it is demonstrated that the machine-learning based approach allows to reliably characterize the dynamic states by comparison with the shake-the-box algorithm.

P 16.5 Wed 17:15 ZHG006

Modern imaging polarimetry as diagnostics for plasma-grown nanoparticles: Challenges and first results — •Alexander Schmitz, Andreas Petersen, and Franko Greiner — IEAP, Kiel University, Kiel, Germany

Full-Stokes Mie polarimetry is an established diagnostic technique for plasma-grown nanoparticles. It enables the in situ measurement and monitoring of the particle size and complex refractive index. Both parameters are also essential for other diagnostics, such as dust density measurements via extinction. Expanding prior 1D measuring techniques to an imaging polarimeter system presents a number of challenges, such as precise alignment and impurities and aberrations in commercially available polarization optics.

To solve this, a calibration method based on the null-space method for the device's transfer matrix has been applied to a new high-resolution, imaging polarimeter. First 2D polarisation measurements on a dust cloud have been conducted and the spatial and temporal evolution of the particle size evaluated.