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Using dust grains to investigate plasma conditions in the sheath¹

K. S. ASHRAFI, D. SANFORD, M. CHEN, L. MATTHEWS, T. HYDE, CASPER, Baylor University — Plasma conditions within a plasma sheath or a narrow trench on the powered electrode are difficult to measure, since traditional probes can alter the plasma on small spatial scales. Micron-sized dust grains have been found to be both non-perturbative and very sensitive to changing plasma conditions allowing them to be used to investigate dust dynamics and equilibrium dust structures. Unfortunately, the charge on the grain and the electric field(s) in the plasma are difficult to measure independently. For example, the streaming ions accelerated by the electric field inside a glass box placed on the lower powered electrode of a GEC rf reference cell can affect the overall charge on the surface of the grains within the box. In addition, the positive ion wake field formed downstream of the grains changes the interaction between the grains. In this study, a molecular dynamics simulation is used to consistently model the interaction between the ions and dust grains, while determining the dust charge for grains within the glass box. Comparison to experimental observations of dust structures formed inside the glass box allows plasma characteristics such as the wake potential, the electric field, and variations in the electron and ion density within the sheath to be identified.

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