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Modeling of small dust Coulomb crystals in PECVD reactors[1]
MOHAMMAD DAVOUDABADI, BENIAMINO ROVAGNATI, FARZAD MASHAYEK, University of Illinois at Chicago — Modeling of dust crystal structures in the confining potential wells of laboratory non-equilibrium plasmas is of value from both aspects of theory and application. Motivated by simulation of process of nano-particle coating via Plasma Enhanced Chemical Vapor Deposition (PECVD) technique, whose underlying physics coincides with the dust contamination in PECVD reactors of microelectronics industry, we first simulate the plasma phase in a cylindrical PECVD reactor employing the local-field drift-diffusion model. Using a Lagrangian approach, we then three-dimensionally track a few number of interacting particles in a one-way coupling manner. After the particles reach their equilibrium state, their various multi-shell configurations are directly compared to the pertinent experiments. Meanwhile, a particle along with the ion focusing effect due to the ion flow in the sheath region is modeled as a superposition of the uncompensated residual plasma-shielded monopole, plus a plasma-shielded electric dipole. It is shown that the proposed model can successfully predict the vertically-aligned morphology of multi-layer arrangements of particles.

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