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Kinetic Modeling of Nanoparticle Growth in Low Pressure Dusty Plasmas[1] STEVEN LANHAM, JORDYN POLITO, U. Michigan, HIMASHI ANDARAARACHCHI, ZHAOHAN LI, ZICHANG XIONG, UWE KORTSHAGEN, U. Minnesota, MARK J. KUSHNER, U. Michigan — Low pressure "dusty" plasmas can be used to synthesize high quality nanoparticles (NPs) from feedstock gases with controllable properties based on operating conditions. Negatively charged NPs can be trapped by the positive plasma potential, enabling growth by collisions with precursors. Understanding the coupled effects between the plasma and particles is fundamental to improving production of nanoparticles. In this paper, we discuss results from a computational investigation of the effects of operating conditions on the growth rate of Si NPs in low pressure plasmas. The Hybrid Plasma Equipment Model (HPEM), a multi-fluid model, was used in the study. Kinetics algorithms which allow for particle growth and subsequent size-dependent forces were incorporated into the Dust Transport Simulator (DTS) to track three-dimensional trajectories and growth of NPs. The demonstration system examines Si NP growth in an argon inductively-coupled-plasma sustained in a flow tube in which SiH_4 is injected [1]. Scaling of NP growth rates, agglomeration, particle trapping, and formation of Coulomb solids will be discussed as a function of operating conditions such as pressures, flow rates, and power. [1] U. Kortshagen et al. Chem. Rev. 116, 11061 (2016).

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