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Controlled Fluxes of Silicon Nanoparticles By Extraction from a Pulsed RF Plasma[1] STEVEN GIRSHICK, CARLOS LARRIBA-ANDALUZ, Dept. of Mechanical Engineering, University of Minnesota, Minneapolis, MN — Deposition of silicon nanoparticles onto substrates may be a means of growing monocrystalline silicon films at low substrate temperature if the nanoparticles' impact energy and size can be controlled to provide melting or amorphization of the nanoparticle without damaging the underlying film. In order to explore conditions that could produce such controlled fluxes of nanoparticles we numerically model a pulsed RF argon-silane plasma, with a positive DC bias applied during the afterglow phase of each pulse so as to extract and accelerate negatively charged silicon particles. Operating parameters studied include pulse on time, pulse off time, DC bias voltage, RF voltage and pressure. This set of parameters is tested to find conditions under which one can achieve a periodic steady state with repeatable pulse-to-pulse conditions that maximize silicon film growth rates while maintaining nanoparticle impact energies in the range 0.5-2.0 eV/atom. We utilize a previously developed 1-D dusty plasma numerical model, modified to consider pulsing and applied substrate bias. This model self-consistently solves for the coupled behavior of plasma, chemistry, and aerosol. Results show that it is possible by this method to produce nanoparticle fluxes that are tailored with respect to their distribution of impact energies and mass deposition rates.

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