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Plasma-particle interactions and their role in nanocyrstal formation in plasmas[1]

UWE KORTSHAGEN, University of Minnesota

Nonthermal plasmas have recently been demonstrated to be capable sources of nanocrystals with some unique properties. The negative charge of particles acquired in a plasma strongly reduces particle agglomeration. Moreover, particles in plasmas are selectively heated by electron-ion and hydrogen recombination at the particle surface, heating the particles to temperatures that exceed the gas temperature by several hundreds of Kelvin. This property makes nonthermal plasmas uniquely suited for the synthesis of nanocrystals of covalently bonded materials, such as silicon, which require high temperatures for crystallization. Several plasma processes for the synthesis of silicon and germanium nanocrystals of different sizes and morphologies are discussed. The plasma properties are assessed with capacitive probes and emission spectroscopy. The particle density and size evolution in the plasma is studied via polarization-sensitive laser light scattering. Based on the experimentally determined plasma properties, the plasma-particle interactions are analyzed and their influence on the particle formation is discussed. Finally, several examples for the applications of plasma-synthesized nanocrystals are presented.

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