Plenary Talk PV IV Tue 9:45 e415

From Plasma Electrons to Electrons in Quantum Dots: Nanocrystal Growth in Plasmas — •Uwe Kortshagen — University of Minnesota, Mechanical Engineering, 111 Church Street SE, Minneapolis, MN 55455, USA

Chemically reactive nonthermal plasmas are an interesting environment for the growth of nanocrystals. Molecular precursors are dissociated by electron impact reactions and the resulting molecular fragments and radicals, many of them charged, nucleate to form clusters and nanocrystals. Energetic surface reactions can heat these initial clusters to temperatures that exceed the gas temperature by hundreds of Kelvin. This enables plasmas to form crystalline nanoparticles of strongly covalently bonded or ionically bonded materials, many of which require high temperatures for crystallization. This presentation briefly discusses the physics of the plasma nanocrystal growth mechanisms.

Plasmas can be used to produce high quality silicon nanocrystals, also called silicon quantum dots. With the proper surface functionalization such silicon quantum dots exhibit strong photoluminescence, different from bulk silicon material. Solar luminescent concentration is a potential application for these highly luminescent nanocrystals. We recently demonstrated that the indirect bandgap nature of the silicon nanocrystals virtually eliminates reabsorption losses in luminescent solar concentrators, making them a promising materials system for this application.

The ability of plasmas to produce doped nanocrystals has recently enabled new insights into the electronic transport in nanocrystal films, leading to the development of a new theory for the insulator-to-metal transition (IMT) in directly connected nanocrystal networks. This talk will discuss recent progress in achieving the IMT in plasma-produced nanogranular media.

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