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Nonthermal Plasmas: Silicon Nanocrystals made easy[1]

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In this presentation, low pressure plasmas are discussed as a superior source for the controlled synthesis of semiconductor nanocrystals. Among the prime advantages of low pressure plasmas are their ability form highly monodisperse, single-crystal nanoparticles which are prevented from agglomeration due to the electrical charge that particles acquire in the plasma. Two examples of this approach are presented: In the first example, a constricted mode capacitive discharge is used to produce single-crystal, virtually defect-free, cube shaped silicon nanoparticles. Particles are between 20-50 nm in diameter with a highly monodisperse particle size distribution. These particles have enabled our recent success in manufacturing single-nanoparticle-based Schottky barrier vertical transistors. Electrical characterization of these devices provides insight into the electronic properties of the silicon nanoparticles. In the second example, a high-yield plasma process is used to form luminescent semiconductor quantum dots in a flow-through reactor. Our work has focused on several Group IV elements due to their compatibility with silicon technology and their low toxicity. Results of the synthesis and application of various materials systems will be presented.

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