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Free-Standing Silicon Nanocrystals using Plasma Enhanced Chemical Vapor Deposition B.N. JARIWALA, Colorado School of Mines, P. STRADINS, National Renewable Energy Lab, J.D. BEACH, R.T. COLLINS, J. FIELDS, S. RATHI, S. AGARWAL, Colorado School of Mines — Si nanocrystals (NCs) less than 5 nm in diameter exhibit a size-dependent tunable band gap, visible photoluminescence, and multiple exciton generation. These properties of Si NCs have led to an increased interest in their utilization in third-generation photovoltaic (PV) devices. In this presentation, we will discuss the synthesis of Si NCs from a SiH_4/Ar plasma. The particles are transported out of the plasma by gas flow, and are collected onto a grid. The structure and optical properties of the as-synthesized NCs have been characterized using transmission electron microscopy, infrared and Raman spectroscopy, and photoluminescence (PL) spectroscopy. The TEM measurements show that the NCs have a diameter over the range of 3 to 7 nm: the average size can be controlled by varying the residence time in the plasma volume. PL from $\sim$7 nm NCs has an emission peak centered at 850 nm, which blue shifts as the crystal size decreases due to oxidation. Our infrared measurements are consistent with the PL data and show that although the surface Si atoms of the as-synthesized NCs are H-terminated with mono-, di-, and tri-hydride species, these NCs oxidize over a few minutes. Support from NSF award number DMR-0820518 is gratefully acknowledged.

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