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PECVD Environmental Effects on Silicon Nanoparticle Size and Quality[1] GRANT KLAFEHN, CHITO KENDRICK, TIANYUAN GUAN, SAN THEINGI, KORY RISKEY, LAUREN VITTI, LUIGI BAGOLINI, MARK LUSK, BRIAN GORMAN, CRAIG TAYLOR, REUBEN COLLINS, Colorado School of Mines, JEREMY FIELDS, PAUL STRADINS, National Renewable Energy Laboratory — Silicon based nanoparticles (SiNPs) have recently been of great interest to the PV community because of their unique properties compared to their bulk constituents. By decreasing a nanoparticle's (NP) size below its exciton Bohr radius, its band gap can be increased relative to the bulk. This talk will discuss fundamental variables involved in defining and controlling plasma-grown SiNP size and quality. A quartz tube with a RF electrode ring is used to create a plasma in an argon-silane mixture to grow the SiNPs. Their quality and size can be changed by varying the reactor pressure, gas flow, and thus the resulting residence time. They are then characterized by Raman, PL, ESR, XRD, and TEM, and then mapped to a phase diagram with respect to pressure and flow. Higher residence times of 10 ms resulted in highly crystalline, 7 nm SiNPs. Residence times of 2 ms create 4 nm particles, while below 2 ms will result in highly defective material, even though the PL exhibits peaks at 1.6 eV. These parameters will be discussed, including how each variable affects the resultant SiNP size, quality. Also included will be a discussion about additive gasses and their additional effects on SiNP characteristics.

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