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Friday, October 15
11:10AM-12:00PM
Bourns Hall A265

Plasma Synthesis of Silicon Quantum Dots

Abstract: This talk will highlight the advantages of a gas-phase, non-thermal plasma approach for the synthesis of silicon nanocrystals. For the case of silicon, standard wet-chemistry techniques fail to produce small, crystalline silicon nanoparticles. On the other hand, we will show that a gas-phase discharge can produce crystalline silicon nanoparticles with sizes below 5 nm. For that size range, quantum confinement effects lead to an opening of the optical band gap and to the appearance of efficient fluorescence in the visible range. For the plasma produced silicon quantum dots, we report that not only fluorescence in the visible is observed, but that world record fluorescence efficiencies are measured after appropriate surface passivation. Moreover, we will show that multiple plasmas can be used in series to nucleate, grow and functionalize the surface of the nanoparticles, with the final goal of realizing a semiconductor 'ink', which is of great interest for many applications, such as printable electronics.

Data from extensive material and process characterization will be presented, with the intent of showing that a good understanding of the properties of silicon nanostructures is far from being reached, leaving many opportunities to perform scientifically relevant work in this area. In particular, the potential applications of silicon nanostructures for photovoltaic applications will be discussed.

Bio: Lorenzo Mangolini received his Ph.D. and M.S. in Mechanical Engineering from the University of Minnesota, Minneapolis, and received his B.S. from the Polytechnic University of Milan, Italy. His Ph.D. work focused on the synthesis and characterization of silicon quantum dots. Upon completion of his Ph.D., Lorenzo joined the Chemical Engineering Department at the University of Minnesota as a Post -Doc, working on the fabrication of titania and zinc-oxide based photovoltaic devices. He later joined Cima Nanotech, Inc. as a Senior Researcher, working on the development and large-area fabrication of transparent conductive coatings for applications in the electronics industry. Lorenzo is currently an Assistant Professor in Mechanical Engineering in the Bourns College of Engineering at the University of California in Riverside.