TcSUH Bi-Weekly Seminar

Deployment of Nanowire-based Energy Conversion Devices: Opportunities and Barriers

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Room 102, Houston Science Center
11:00 a.m. – 12:00 p.m.
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ABSTRACT: The idea that materials with dimensions much smaller than 100 nm (i.e., nanomaterials) may exhibit properties that are not observed in their bulk counterparts and thereby lead to efficient renewable energy generation led researchers to document the properties of a wide variety of nanomaterials over the last three decades. For instance, nanowires have been demonstrated to function not only as efficient solar cells and thermoelectrics, but also as photocatalysts for either producing hydrogen fuel from water or disinfecting water. These demonstrations have primarily been made using individual nanowires and/or small-scale nanowire arrays and mats. Translating these demonstrations into industrial-scale production and deployment of nanowire-based devices requires extending enhanced energy conversion performances demonstrated in single nanowires and/or small-scale nanowire arrays and mats to devices composed of large-scale nanowire assemblies. This in turn requires the confluence of many desired nanowire properties ranging from thermal, electrical, and electronic properties to mechanical properties. For example, packing nanowires into highly-dense nanowire assemblies, without the loss of the nanowire morphology, requires that the nanowire be mechanically flexible. Contextually, this talk addresses many aspects involved in accomplishing such a task. It begins with a discussion of techniques specifically developed for the mass production and interface-engineered assembly of Zn_3P_2, ZnO, Si and Mg_2Si nanowires. Vapor phase methods useful for the production of Zn_3P_2 and ZnO nanowires and nanowire-containing inorganic-organic hybrids will be discussed. Solution-phase synthesis of Si nanowires, along with strategies useful for the interface-engineered assembly of Si nanowires into either randomly-oriented or aligned Si/Mg_2Si bulk nanowire assemblies, will also be discussed. Next, the impact of these strategies on the heat-to-electricity conversion efficiencies of nanowire-based bulk thermoelectrics will be presented in detail. Impact of these strategies on the functioning of nanowires as photocatalysts for rapidly disinfecting water will also be discussed. Finally, opportunities and barriers associated with the deployment of nanowire-based energy conversion devices will be explained.

BIO: Dr. Sreeram Vaddiraju is currently an Associate Professor in the Department of Chemical Engineering at Texas A&M University. He started working at the university in the fall of 2009. Apriori, he received his academic training at various academic institutions and national labs, including the University of Louisville, NASA Ames Research Center and Massachusetts Institute of Technology. Currently, a bulk of his research is focused on development of inexpensive and efficient nanowire-based renewable energy devices and systems (e.g., thermoelectrics, photovoltaics, photocatalysts for solar hydrogen production and water disinfection). This overall vision of his research effort is to streamline the production of nanowire-based energy conversion devices in a manner similar to that achieved with drug production by the pharmaceutical industry and integrated chip (IC) production by the electronics industry. His research work has been/is currently being supported by the Department of Defense (DOD, Army), NSF/DOE thermoelectrics partnership, Defense Advanced Research Projects Agency (DARPA), the Department of Energy (DOE), the Centers for Disease Control (CDC), National Institutes of Health (NIH), and the US department of Agriculture (USDA). Texas A&M University has recognized his efforts at excelling in teaching through a few awards, including the Fluor Distinguished Teaching Award in 2014 and a Phillips 66 First Year Faculty Fellowship in 2016.

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