Scalable production of nanowire arrays and powders using plasmas

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ABSTRACT

This presentation will highlight our group's efforts with various scalable methods for continuous manufacturing of nanowires powders and arrays with help of plasmas. These scalable methods can be categorized in to the following: (a) scalable production of nanowires of low-melting metal oxide nanowire powders; (b) scalable production of nanowire arrays and powders for titania and related oxides; and (c) low-temperature growth of nanowires of silicon and related materials.

Scalable production method for nanowires of low-melting metal oxides: A novel atmospheric microwave plasma reactor is designed to process about a kilogram of nanowires per day and has already been demonstrated for the synthesis of tin oxide, zinc oxide and aluminum oxide nanowires.[1] The resulting nanowires are 50-100 nm in diameter and several microns long. We will discuss our ongoing work on the optimization of reactor in terms of powder feeder and collection and quality of resulting nanowire powders. In this presentation, we will highlight progress with our recent results with another scalable technique for production of titanium dioxide nanowire powders and arrays.

Scalable production of titania and related metal oxide nanowires: We report a new ultrafast (reaction time on the scale of a minute) gas-phase method for synthesizing highly crystalline TiO_2 nanowires (NWs) using direct oxidation of either Ti metal (foils or powders) or spherical TiO_2 powders using an atmospheric pressure microwave plasma reactor.[2] The current state of the art methods involve long reaction time scales (~1 day) for synthesis of TiO_2 NWs.

Low-temperature synthesis of nanowire arrays of silicon and related materials: This presentation will also highlight our recent experiments on the synthesis of silicon nanowire arrays at temperatures lower than 300 C.

References:

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2. V. Kumar, J-H. Kim, J.B. Jasinski, E.L. Clark, and M.K. Sunkara, "Alkali assisted, atmospheric plasma production titania nanowire powders and arrays", *Crystal Growth and Design*, 11 (7), 2913 (2011).