

Seminar Series

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School of Materials Science and Engineering
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11:00 AM – Room 364 Serrine Hall

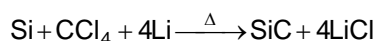
PRECIPITATION PROCESSES FOR THE SYNTHESIS OF NANOSTRUCTURED POWDERS

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This seminar will present an overview of leading precipitation processes for the synthesis of nanostructured ceramic and metallic powders, with special emphasis placed on reverse micelle synthesis for the preparation of oxides and solvothermal synthesis for the preparation of carbides. Specific examples will include the preparation of zirconium oxide doped with yttrium (Y-ZrO₂) and silicon carbide (SiC).

For the case of Y-ZrO₂, the thermal stability of the synthesized particles will be described. Transmission electron microscopy and Williamson-Hall analysis from x-ray diffraction have shown that the crystallite size ranges from 5-50 nm. A detailed study on the level of agglomeration and the particle size of the nanopowders will be described and corroborated using dynamic light scattering. The particle size was shown to be between 50 and 500 nm, depending on the heat treatment given to the powders. FTIR measurements for determination of impurities on the surfaces of the powders were also performed. The use of a novel wash medium allowed the synthesis of high purity powders with no measurable organic or inorganic impurities. Reaction parameters such as precursor concentration, aging time, and water-to-surfactant ratio were varied to optimize the synthesis process. Some of the powders were subsequently sintered using spark plasma sintering (SPS). Dense compacts of >98% density were obtained in 20 minutes.

For the case of SiC, initial efforts have involved the synthesis of pure silicon carbide nanopowders by using silicon powders and carbon tetrachloride (CCl₄) as silicon and carbon sources, respectively, and metallic lithium as the reducing agent. The reaction can be expressed as:



The reactants were placed in a stainless steel iron tube and sealed under argon atmosphere. The iron tube was heated to 600°C for 8 hours. After synthesis, the contents inside the tube were washed with reagent grade methanol, acetone, and distilled water to remove lithium chloride, carbon, and other impurities. After cleaning, the powders were characterized by x-ray diffraction and dynamic light scattering. The X-ray diffraction pattern of the product powders was indexed as cubic SiC with a crystallite size between 15-20 nm. The dynamic light scattering analysis of the powders showed that the particle size distribution consisted of powders between 1-4 μm.

A short description of the synthesis of metallic iron and lanthanum hexaboride nanopowders will also be presented.