66c Synthesis of Tellurium Dioxide Nanoparticles by Spray Pyrolysis

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Tellurite glasses (amorphous TeO_2 based materials) have two useful optical properties, high refractive index and high optical nonlinearity, that make them attractive for a range of applications. Unlike other metal oxide nanoparticles, which can be synthesized in large quantities by vapor phase processes, TeO_2 nanoparticles have not been prepared by such methods. Here, we describe the vapor-phase synthesis of telluria-based nanoparticles by spray pyrolysis, in which the precursor, telluric acid, $Te(OH)_6$, is dispersed into fine droplets by an atomizer. These droplets are carried by nitrogen through a high temperature furnace, in which they evaporate and the telluric acid is converted to TeO_2 nanoparticles. The resulting nanoparticles, with typical primary particle diameters from 10 to 30 nm, have been characterized by TEM, XPS, FTIR and XRD. The effects of operating parameters on nanoparticle composition, production rate and size were also studied. The interaction of telluria nanoparticles with various solvents was studied and the mechanism of crystallization of telluria nanoparticles in water was identified. The effects of rare-earth doping on telluria nanoparticle properties were also investigated, and the best conditions for producing nanoparticles that exhibit IR to visible upconversion were found. Efforts are underway to incorporate the TeO_2 nanoparticles into polymeric matrices to produce transparent composites with tunable refractive index and nonlinear optical properties.