

Synthesis and Characterization of Stable and Crystalline $\text{Ce}_{1-x}\text{Zr}_x\text{O}_2$ Nanoparticle Sols

Atul S. Deshpande,[†] Nicola Pinna,[†] Pablo Beato,[‡] Markus Antonietti,[†] and Markus Niederberger*[†]

Colloid Chemistry, Max-Planck-Institute of Colloids and Interfaces, D-14424 Potsdam, Germany,

and Department of Inorganic Chemistry, Fritz-Haber-Institute of the Max-Planck-Society, Faradayweg 4-6, D-14195 Berlin, Germany

Abstract:

$\text{Ce}_{1-x}\text{Zr}_x\text{O}_2$ nanoparticle sols ($x = 0-1$) are synthesized by hydroxide coprecipitation of a mixed precursor solution of cerium ammonium nitrate and zirconyl chloride followed by redispersion in an aqueous medium by sonication using nitric acid as the peptizing agent. The obtained sols are highly concentrated and stable for weeks. Analytical ultracentrifugation measurements show a particularly narrow particle distribution with an average particle size of about 3.5 nm for pure CeO_2 and 2.5 nm for pure ZrO_2 nanoparticles. Wide-angle X-ray scattering (XRD) as well as high-resolution transmission electron microscopy give evidence that all of the as-synthesized nanoparticle sols with a ceria content larger than 20 mol % are well crystalline. The formation of a solid solution with an increasing amount of Zr was monitored by XRD and Raman spectroscopy.