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Electron paramagnetic resonance linewidth narrowing of Gd3+ ions in Y-doped ceria nanocrystals with decreasing crystallite size

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Abstract

Electron paramagnetic resonance (EPR) spectra of Gd3+ ions in crystalline Ce1-x-y Gdx Yy O2-[0.5* (x+y)] (x=0.0025, y=0.10, and 0.25) with crystallite sizes ranging from 600 nm down to 5 nm have been measured at X -band and at Q -band near liquid He and room temperatures. The EPR line shape is controlled by the low-symmetry surrounding of Gd3+ ions in a coordination environment with one oxygen-vacancy and seven oxygen nearest-neighbors forming GdO7 polyhedra. These coordination polyhedra are characterized by a wide distribution of crystal field parameters that primarily controls the EPR linewidth. The EPR linewidth of the central (- 1 2 + 1 2) transition is observed to decrease systematically with decreasing crystallite size. This observation implies that the size of the crystallites in the nanoregime may have important influence on the energetics of vacancy distribution in crystalline materials. © 2009 American Institute of Physics.

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