

Ferromagnetism in annealed Ce_{0.95}Co_{0.05}O₂ and Ce_{0.95}Ni_{0.05}O₂ nanoparticles

Misra S., Andronenko S., Harris J., Thurber A., Beausoleil G., Punnoose A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

This paper reports an investigation on the role of transition-metal ions in producing ferromagnetism in CeO₂ nanoparticles by electron paramagnetic resonance (EPR). Several samples of CeO₂ nanoparticles annealed at 200, 300, 400, and 500°C, doped with 5% Ni and 5% Co ions, characterized by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), thermogravimetry analysis (TGA) and mass spectroscopy (MS), were investigated by X-band EPR at 4, 10 and 300 K, and by magnetometry at 300 K. Magnetic properties and EPR/FMR (Ferromagnetic Resonance) spectra of these nanoparticle samples were found to depend strongly on the annealing temperature, oxygen stoichiometry, and dopant-ion species. Different behavior of saturation magnetization in the samples with the dopants, Co and Ni, is found to be due to different inward and outward-surface diffusion of these impurity ions, respectively, during annealing. A detailed simulation of EPR/FMR spectra of isolated Co and Ni ions carried out here provides in-depth details on the role of the doped ions and oxygen defects played in the observed magnetic properties. Copyright © 2013 American Scientific Publishers All rights reserved.

<http://dx.doi.org/10.1166/jnn.2013.7778>

Keywords

CeO₂ Nanoparticles, Ferromagnetism, Magnetic Properties., Spectroscopy