

EPR, optical, and dielectric spectroscopy of Er-doped cerium dioxide nanoparticles

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Abstract

Abstract authors Abstract authors The cerium dioxide nanoparticles doped at low level with Er ions and with grain sizes of about 22 and 300 nm were comprehensively studied using EPR, optical and microwave dielectric spectroscopy. The EPR observation of mainly cubic sites of Er³⁺ dopant in CeO₂ reveals that vacancies are located more distant than the nearest neighbor position. This finding does not agree with recently published results based on density functional theory calculations. Time and spectral dependences of the permittivity of Er:CeO₂ nanoparticles under UV laser excitation were studied by a Q-band microwave resonance technique at the room temperature. The photoconductivity threshold for cerium dioxide nanoparticles has been estimated. The luminescence spectra for the nanocrystals in wide spectral range ($\lambda=240-1000$ nm) were investigated. The anti-Stokes emission of Er³⁺ ions under irradiation in 545-562 nm spectral range, stipulated by the thermally coupled 2H_{11/2} and 4S_{3/2} levels of Er³⁺ ions, has been observed. The UV irradiation (240-370 nm), which is not resonant with the 4f-4f transitions of Er³⁺ ions, excites emission of Er³⁺ ions due to the charge transfer from O²⁻ to Ce⁴⁺ host ions and the subsequent energy transfer to Er³⁺ dopant ions. © 2014 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

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Keywords

Ceria nanoparticles, Electron paramagnetic resonance, Erbium, Luminescence, Photoconductivity