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

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Abstract

Abstractauthoren Abstractauthoren The cerium dioxide nanoparticles doped at low level with Er ions and with grain sizes of about 22 and 300nm 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 (λ=240-1000nm) were investigated. The anti-Stokes emission of Er3+ ions under irradiation in 545-562nm spectral range, stipulated by the thermally coupled 2H11/2 and 4S3/2 levels of Er3+ ions, has been observed. The UV irradiation (240-370nm), 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