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LUMINESCENCE OF MALTODEXTRIN-COATED CERIUM OXIDE NANOPARTICLES DOPED WITH RARE EARTH ELEMENTS

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Nanocrystalline cerium oxide CeO_2 is a promising object for various applications, including biomedical issues [1-3]. Physicochemical properties of cerium oxide change during the transition to the nanoscale state. This is assumed to be related to changes in material electronic structure, oxygen vacancies formation due to increasing the proportion of atoms located on the particle surface and, consequently, change in the oxygen nonstoichiometry. The appearance of oxygen vacancies leads to the reduction of Ce^{4+} ions on the nanoparticle surface to the Ce^{3+} state. Such oxygen nonstoichiometry correlates with the catalytic activity of cerium oxide nanoparticles and is responsible for their unique biological activity [2]. Modifying the degree of CeO2 surface oxidation and increasing the number of oxygen vacancies can be carried out by doping with trivalent rare earth (RE) metals [3]. We assume that this modification will lead to a change in the optical properties of the material. The purpose of this work is to study the luminescent properties of RE-doped cerium oxide nanocrystals.

CeO_2 nanoparticles with maltodextrin coating and doped with Er^{3+} and Sm3+ ions were produced by the deposition method according to the procedure presented in [4]. The photoluminescence (PL) emission and PL excitation spectra were recorded with a 400 W deuterium discharge lamp (DDS-400), two the double-prism DMR-4 type monochromators and a R6358-10 (Hamamatsu) type photomultiplier tube (PMT). The optical absorption spectra were recorded with a Helios Alpha spectrophotometer (λ = 190–1000 nm) equipped with the Vision 32 software.

Figure 1 shows the PL emission and PL excitation spectra of undoped maltodextrin-coated CeO_2 nanoparticles. The PL spectrum is presented by a wide intensive band with a maximum of 3.1 eV and a weak band at 2.5 eV. The band at 3.1 eV is probably due to radiative transitions in the Ce^{3+} ion from the relaxed lower 5d-excited state to the ground 4f state. The weak band at 2.5 eV nm could be associated with the emission of defects related to the oxygen vacancies [3]. The PL spectra of RE-doped CeO2 nanoparticles consist of characteristic emission bands related to radiative transitions in Er^{3+} и Sm^{3+} ions

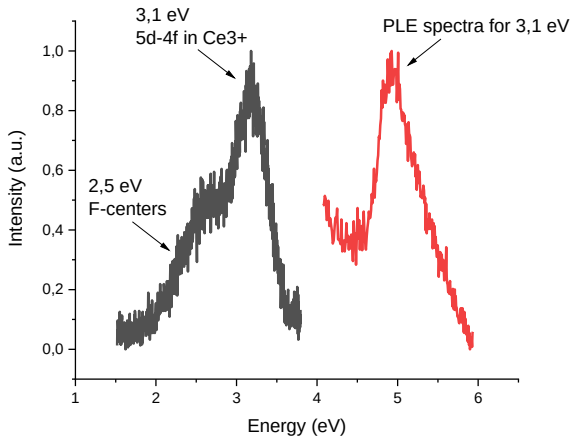

Fig.1. PL emission and PL excitation spectra of pure maltodextrin-coated CeO2 nanoparticles.

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