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Optical Properties of Nanocrystalline Europium-Yttrium Titanate EuYTi2O7

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Abstract : Lanthanide-doped yttrium titanium oxides, which crystallize in a pyrochlore structure with general formula (RExY1-x)2Ti2O7 (RE=rare earth element), have been extensively investigated in recent years for their interesting physical and chemical properties. Despite that the pure pyrochlore structure does not present luminescence ability, the presence of yttrium ions in the pyrochlore structure significantly improves the luminescence properties of the RE. Moreover, the luminescence properties of pyrochlores strongly depend on the size of formed nanocrystals. In this contribution, we present a versatile sol-gel synthesis of nanocrystalline EuYTi2O7pyrochlore. The nanocrystalline powders and thin films were prepared by the condensation of titanium(IV)butoxide with europium(III) chloride followed by the calcination. The introduced method leads to the formation of the highly-homogenous nanocrystalline EuYTi2O7 with tailored grain size ranging from 20 nm to 200 nm. The morphology and the structure of the formed nanocrystals are linked to the luminescence properties of Eu3+ ions incorporated into the pyrochlore lattice. The results of XRD and HRTEM analysis show that the Eu3+ and Y3+ ions are regularly distributed inside the lattice. The lifetime of Eu3+ ions in calcinated powders is regularly decreasing from 140 us to 68 us and the refractive index of prepared thin films regularly increases from 2.0 to 2.45 according to the calcination temperature. The shape of the luminescence spectra and the decrease of the lifetime correspond with the crystallinity of prepared powders. The results present fundamental information about the effect of the size of the nanocrystals to their luminescence properties. The promising application of prepared nanocrystals in the field of lasers and planar optical amplifiers is widely discussed in the contribution.

Keywords : europium, luminescence, nanocrystals, sol-gel
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