Nanocomposites and nanomaterials

Optically transparent ceramics based on rare-earth oxides

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Systems with yttria, lanthana and rare-earth oxides are perspective for the development of transparent ceramics and laser matrices [1]. Alternatively to isotropic garnets, the transparent ceramic matrices based on anisotropic rare earth oxides and their compounds are considered perspective for advanced laser systems. The anisotropic crystals enable to harvest excitation energy randomly from all surrounding, but emit monochromatically in one selected direction. Fabrication of transparent polycrystalline ceramics from non-cubic materials requires precise crystal orientation control so that optical scattering losses to be prevented [2].

This work is focused on manufacturing of textured transparent ceramics through the colloidal deposition of Nd(Yb):$LaYO_3$ nanoparticles oriented under strong magnetic field (higher than 10 T) followed by drying and sintering. Synthesis of Nd(Yb):$LaYO_3$ nanopowders has been carried out by the hydroxide co-precipitation method mixing nitrate solutions of rare earths with complex ammonia-based solution. The specific surface area was about 80÷110 ±5 m^2/g independently on concentration of dopant for all dopants used. The particle size distribution measured for 1.0-10 at. % doped perovskites has shown mean particle size of 10-20 nm and agglomerate sizes increasing from 45 to 170 nm. The slip casting of Nd:$LaYO_3$ nanopowders under strong magnetic field conditions of 12 T has been carried out to allow nanoparticles to be oriented in textured non-isotropic green ceramic pieces of 0.55-0.60 theoretical density.

The semitransparent samples (relative density higher than 99%, transparency of 50%) were obtained after slip casting in strong magnetic field.

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2. *Akiyama J., Sato Y., Taira T.* Laser ceramics with rare-earth-doped anisotropic materials // Optics Letters. – 2010. - **35**, N 21, November 1. – P. 3598-3600.