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Solution – combustion synthesis and photoluminescence property of (Gd,Y)BO₃:Tb³⁺ phosphor powders

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Abstract content
   (Max 300 words)

Luminescent materials with quantum efficiency (QE) larger than unity might play an important role in the development of certain lighting and display systems [1]. Large band gap materials doped with rare earth ions are currently of great interest as new vacuum UV phosphors for lighting and displays. In this study, GdYBO3:Tb3+ nanocrystalline were successfully deposited by following a modified sol–combustion method, relative to those reported previously, using rare-earth nitrates, urea and boric acid as starting materials. The crystal structure, morphology, chemical composition, thermal and photoluminescence properties of the powders were investigated by Scanning electron microscope (SEM), X-ray diffraction (XRD) and Photoluminescence (PL). The TGA curves indicate weight loss attributed to removal of surface adsorbed water burning of organic compound ligands and the decomposition of metallic nitrates. The results of SEM revealed that the powders were composed of spherical GdYBO3:Tb3+ nanocrystals with average grain size of between 50 and 100 nm. EDS (electron diffraction spectroscopy) confirm (see Fig. 1b) the presence of the Gd, Y, B, O, and C. The crystalline nature of the annealed GdYBO3:Tb3+ nanocrystalline are clearly demonstrated by the X-ray diffraction results. The excitation spectra show two broad bands from 200 to 400 nm with peaks around 224, 340, 368 and 375 nm. The 340, 368 and 375 nm bands are associated with the crystal field splitting of the Tb d-orbital transitions from the ground level 7F6 to 5D1, 5D2 and 5D3 levels, respectively. The second broad band at higher energy is owing to host or the charge transfer state. The prepared phosphor compositions exhibit emission in the blue-green region. The GdYBO3:Tb3+ powders exhibited emissions at 490, 545 and 585 nm, which were assigned to the 5D4–7F6, 5D4–7F5 and 5D4–7F4 transitions of Tb3+, respectively. Among them, the green emission at 545 nm (5D4–7F5) was dominant and the emission intensities are greatly dependent on the excitation wavelength. The emission bands at 383, 419 and 438 nm that usually originate from the 5D3⟶7FJ transitions are not observed may be due to non radiative transitions through cross relaxation process.

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