

Energy transfer between doubly doped Er³⁺, Tm³⁺ and Ho³⁺ rare earth ions in SiO₂ nanoparticles

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ABSTRACT

Preparation of Er³⁺, Ho³⁺ and Tm³⁺ ions co-doped SiO₂ nanoparticle phosphor powders by sol gel method is reported. The morphology and the particle size of the SiO₂ hostmatrix were confirmed by field emission scanning electron microscopy (FESEM). Ultraviolet, visible (UV/VIS) and cathodoluminescence measurements were carried out in order to investigate the optical properties of our powder phosphors. Green emissions at 520 nm from Er³⁺ and 544 nm from Ho³⁺, and red emissions at 665 nm from both Er³⁺ and Ho³⁺ ions are reported. Another emission peak in the near infra-red (NIR) region at 875 nm from Er³⁺ was also measured. Blue emission at 460 nm, red at 705 nm and a NIR peak in the region of 865 nm from Tm³⁺ were observed. Red, green and blue (RGB) colours were measured from both SiO₂:Er³⁺,Tm³⁺ and SiO₂:Ho³⁺,Tm³⁺ systems. The change in the intensities of the emission peaks in both the SiO₂:Ho³⁺,Tm³⁺ and SiO₂:Er³⁺,Tm³⁺ systems with the change in accelerating beam voltage is shown. Energy transfer from Tm³⁺ ions to Er³⁺ and Ho³⁺ ions was observed. A mechanism explaining the increase and decrease behaviour of the emission with accelerating beam voltage from both systems is reported.