Abstract

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Fabrication, linear/nonlinear optical properties, Judd-Ofelt parameters and gamma-ray attenuation capacity of Er2O3 doped P2O5-ZnO-CdO glasses

Multicomponent glasses doped with erbium oxide 70P2O5–14ZnO-(15-x)CdO-xEr2O3 (where x = 1, 2, 3, 4, 5 and 6 mol%) named as [Er1 ?Er6] have been prepared using the melt quenching method. The density was increased with increasing Er2O3 content and the molar volume increased linearly showing exactly like the behavior of the density. The optical absorption spectra indicate that erbium ions lived as an Er3+ environment. The measurement of the optical mobility difference and the breadth of the UV–VIS absorption energy tail of glass revealed a small decrease accompanied by a rise in their values. The optical energy band gap (Eg) varied from 2.9929 to 2.088 eV. The linear (no) and nonlinear refractive indices (n2) changed from 2.3989 to 2.451 and from 5.494 x 10?11 to 6.603 x 10?11 esu, respectively. It was found that the optical dielectric constant (?o) changed from 5.755 to 6.005, while the nonlinear susceptibility (?3) varied from 3.494 x 10?12 to 4.289 x 10?12 esu. From the calculated oscillator intensity of the specific absorption bands, the parameters of the Judd – Offet intensity were tested to test the bonding condition around the Er3+ ions in the prepared glasses. The spectroscopic efficiency element has been determined. Branching ratio (?r) and lifespan (?) is determined using J-O parameters. Absorption and emission cross-sections were determined to measure the probability of an absorption emission process. Additionally, the capacity of the Er1–Er6 glasses for gamma-ray shielding was evaluated via calculating some significant parameters such as mass attenuation coefficient (MAC), linear attenuation coefficient (LAC), effective atomic number (Zeff), effective electron density (Neff), half value layer (HVL), and mean free path (MFP). Results revealed that the MAC and LAC follow the trend: (MAC,LAC)Er1< (MAC,LAC)Er2 < (MAC,LAC)Er3 < (MAC,LAC)Er4 < (MAC,LAC)Er5 < (MAC,LAC)Er6, while both HVL and MFP were follow the trend (HVL,MFP)Er1 > (HVL,MFP)Er2 > (HVL,MFP)Er3 > (HVL,MFP)Er4 > (HVL,MFP)Er5 > (HVL,MFP)Er6. Generally, the studied Er1–Er6 glasses are attractive for various optical and radiation shielding applications.