Abstract

This paper reports the fabrication and characterization of Eu3+/Nd3+ co-doped phosphate (PNE) glasses and glass–ceramics as a function of Eu3+ concentration. The precursor glasses were prepared by the conventional melt quenching technique and the opaque glass–ceramics were obtained by heating the precursor glasses at 450 °C for 30 h. The structural and optical properties of the glass and glass–ceramics were analyzed by means of X-ray diffraction, Raman spectroscopy, UV–VIS–IR absorption spectroscopy, photoluminescence spectra and lifetimes. The amorphous and crystalline structures of the precursor glass and opaque glass–ceramic were confirmed by X-ray diffraction respectively. The Raman spectra showed that the maximum phonon energy decreased from 1317 cm\(^{-1}\) to 1277 cm\(^{-1}\) with the thermal treatment. The luminescence spectra of the glass and glass–ceramic samples were studied under 396 nm and 806 nm excitation. The emission intensity of the bands observed in opaque glass–ceramic is stronger than that of the precursor glass. The luminescence spectra show strong dependence on the Eu3+ ion concentration in the Nd3+ ion photoluminescence (PL) intensity, which suggest the presence of energy transfer (ET) and cross-relaxation (CR) processes. The lifetimes of the 4F3/2 state of Nd3+ ion in Eu3+/Nd3+ co-doped phosphate glasses and glass–ceramics under 806 nm excitation were measured. It was observed that the lifetimes of the 4F3/2 level of Nd3+ of both glasses and glass–ceramics decrease with the increasing Eu3+ concentration. However in the case of opaque glass–ceramics the lifetimes decrease only 16%.