Abstract

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Enhanced thermal stability and optical and structural properties of Tm+3 ions in doped tellurite glasses for photonic use

Tellurite glass (TLZNT) with compositions 75TeO2–5Li2O–10ZnO–(10–x) Nb2O5? x Tm2O3, (doped with x = 0, 0.5, 1.0, 1.5, 2, and 2.5 in mol%) were prepared through the melt quenching technique. In the present work, the glass transition value slightly decreased from 351 to 347 °C otherwise thermal stability ?Tchanges from 118 to 164°C of (TLZNT) glasses, investigated by using differential scanning calorimetry (DSC). The influence of Tm3+ ions (RE) on the structure of the TLZNT glasses was studied through different techniques such as X-ray pattern diffraction and Raman/Fourier transform infrared spectra. Moreover, the ratio of the relative bridging oxygen (BO) to non-bridging oxygen (NBO) in the prepared glass network was determined. Next, the packing density of oxygen, density, molar refraction, molar volumes, mettallization criterion, molar polarizability, and linear refractive index of the prepared glasses were computed. The optical energy gap, the Judd–Ofelt parameters (J–O), the radiative branching ratio (?R), and the radiative lifetime (?R) of Tm3+ in TLZNT glasses were determined. The absorption cross section (?ABS), emission cross section (?EMIS), and gain coefficient (?GA) were evaluated in the range wavelength of 1500–2000 nm. The high value of ?EMIS(1.50 × 10? 20 cm2) of the 3H6 ? 3F4 transition of TLZNT3 glass was reported. We produced TLZNT glasses in which the addition of Tm2O3 improved the ?T against nucleation and crystallization what is in good agreement with the decrease of the average force constant (F) from 225 to 221.7 N/m with increasing Tm2O3. For the 1870 nm emission band, the emission cross section was determined to be approximately 1.5 × 10? 20 cm2. Finally, the results herein will denote that the TLZNT glasses are a promising solid material for optical applications that could be excited by a commercial laser diode (LD).