UNIVERSITI TEKNOLOGI MARA

EFFECT OF Nd_2O_3 / Y_2O_3 DOPING ON THE PHYSICAL, ELASTIC, STRUCTURAL AND OPTICAL PROPERTIES OF LEAD BOROTELLURITE GLASS SYSTEM

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ABSTRACT

Two series of lead borotellurite glasses doped with neodymium and yttrium oxide with the composition of (49-x)H_3BO_3-35TeO_2-15PbO-1.0Y_2O_3-xNd_2O_3 (Nd-series glass) and (49-x)H_3BO_3-35TeO_2-15PbO-1.0Nd_2O_3-xY_2O_3 (Y-series glass) where $0.0 \leq x \leq 2.5$ mol% were prepared using melt-quenched method. The physical properties of all glass such as density, molar volume, oxygen packing density as well as elastic properties were measured. The structural properties of the glasses were studied using X-ray diffraction (XRD) analysis, Fourier Transform Infrared Spectroscopy (FTIR), Raman spectroscopy and Energy Dispersive X-ray (EDX) spectroscopy analysis. The amorphous nature of the glass was investigated through XRD analysis, and all glass were confirmed.to be amorphous in nature. FTIR and Raman analysis revealed the presence of Te-O bond in TeO_4, TeO_3 and B-O bond in BO_4 and BO_3 in the prepared glasses. FTIR spectra analysis also indicated that the addition of Nd_2O_3 and Y_2O_3 content in the glass system tends to change the glass network due to the transformation of TeO_4 into TeO_3 and BO_4 into BO_3 and vice versa. Raman analysis showed there are some structural changes as dopant were added into the glass system where BOs and NBOs were created at the same time. The presence of all elements in the glass system were confirmed using EDX analysis. The optical properties of the glasses were tested using UV-Vis NIR and photoluminescence spectroscopy. The UV-Vis NIR results for both series glass shows eleven absorption peaks which are related to the main absorption spectra of Nd^{3+} ions. The absorption peaks that correspond to the transitions from the $^4I_{9/2}$ ground state to the ($^2P_{1/2}$ + $^2D_{5/2}$), $^2D_{3/2}$, ($^2G_{5/2}$, $^2K_{15/2}$), $^4G_{9/2}$, $^4G_{7/2}$, ($^4G_{5/2}$, $^2G_{7/2}$), $^2H_{11/2}$, $^4F_{9/2}$, ($^4S_{3/2}$, $4F_{7/2}$), ($^4F_{5/2}$, $^2H_{9/2}$) and $^4F_{3/2}$ excited state. The optical band gap, E_{opt} shows that the E_{opt} for Nd-series glass increases and for Y-series glass initially decreased before slightly increasing with respect to the composition changes. The increase of E_{opt} in both series glass suggests the formation of BOs with respect to composition while the initial decrease of E_{opt} in Y-series glass was caused by weaker bond strength of yttrium oxide compared to other chemical oxide in the glass matrix. As the bond strength of Y-O bonds replace the other chemical bonds with larger bond strength, the average bond strength of the glass system will be decreased. As a result, the conduction band edge energy and the E_{opt} will reduce as well. The photoluminescence data reveal that for Nd_2O_3 concentration higher than 1.0 mol% and for Y_2O_3 concentration higher than 1.5 mol%, the photoluminescence peaks decreased in intensity. These concentrations represent the quenching concentration.

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