Dissertation Title	Study on Physical, Structural, Optical and Luminescence Properties of Zinc Bismuth Borate Glasses Doped with Eu^{3+}
Dissertation Credits	48
Candidate	Ms. Patarawagee Yasaka
Dissertation Advisors	Dr.Nakarin Pattanaboonmee Asst. Prof. Dr.Jakrapong Kaewkhao
Program	Doctor of Philosophy
Field of Study	Physics
Department	Physics
Faculty	Science
Academic Year	2014

Abstract

Zinc bismuth borate (ZBB) glasses of the composition $10ZnO:xBi_2O_3:(90-x)B_2O_3$ (where x = 15, 20, 25 and 30 mol%) were prepared by the melt quenching technique. Their radiation shielding and optical properties were investigated and compared with theoretical calculations. The mass attenuation coefficients of ZBB glasses were measured at different energies which obtained by Compton scattering technique. The results showed the decrease of mass attenuation coefficient, effective atomic number and effective electron density values with increasing gamma ray energies. The experimental results are in good agreements with those of theoretical values. The glass samples with 25 and 30 mol% Bi_2O_3 concentration were observed with lower mean free path (MFP) values than the standard shielding concretes. These results indicated that the ZBB glasses could be developed as a lead-free radiation shielding material.

ZBB glasses doped with different Eu^{3+} concentrations of the composition $(60-x)B_2O_3 : 30Bi_2O_3 : 10ZnO : xEu_2O_3$ with $0.0 \leq x \leq 1.0$ (in mol%) were synthesized by melt quenching technique at 1,100 ^oC for 3 h. In order to understand the role of Eu_2O_3 in zinc bismuth borate glass systems, physical, structural, optical and luminescence properties were investigated. The results showed that the density of the glasses increased whereas the molar volume decreased with increasing Eu_2O_3 concentrations. The hardness of glasses were also measured and found to increase with increasing Eu_2O_3 concentrations. The FTIR studies indicated that these glasses are made up of $[BiO_3]$, $[BO_3]$, $[BO_4]$ and [BO] basic structural units. The optical absorption spectra of glasses were measured in the wavelength range of 1,800-2,400 nm. The intensity of all absorption bands increased with increasing Eu_2O_3 contents. In addition, the luminescence properties of Eu^{3+} doped $ZnO-Bi_2O_3-B_2O_3$ glass system were carried out using an excitation wavelength of 465 nm. Five luminescence bands were observed at 579 nm ($^5D_0 \rightarrow {}^7F_0$), 589 nm ($^5D_0 \rightarrow {}^7F_1$), 613 nm ($^5D_0 \rightarrow {}^7F_2$), 651 nm ($^5D_0 \rightarrow {}^7F_3$) and 696 nm ($^5D_0 \rightarrow {}^7F_4$). The intense peak (red orange emission) of the glasses was found at 613 nm. The measured lifetime of $^5D_0$ excited state increased with increasing Eu_2O_3 concentrations due to the increase of asymmetry around Eu_2O_3. In conclusion, all the glass samples obtained in this study have a potential for applications in laser and optical devices.

Keywords : Effective Atomic Number / Electron Density / Eu_2O_3 / Luminescence / Mass Attenuation Coefficient / Zinc Bismuth Borate Glass