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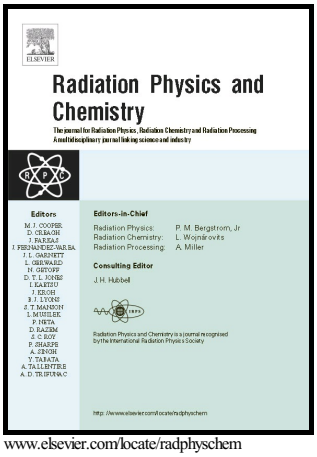

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Attenuation-density anomalous relationship of lead alkali borosilicate glasses

Y.B. Saddeek[1], KH. S. Shaaban[2], Reda Elsaman[1] , Atef El-Taher[1] , T. Z. Amer[3]

1Physics Department, Faculty of Science, Al-Azhar University, Assiut 71452, Egypt

[2]Chemistry Department, Faculty of Science, Al–Azhar University, Assiut, 71524, Egypt

[3]Physics Department, Faculty of Science, Al-Azhar University, Girls Branch, Cairo, Egypt

Abstract: The glass system 60 PbO – (40-x) SiO_2 – x (0.1 Li_2O – 0.86 B_2O_3 – 0.04 Dy_2O_3) with $0 \leq x \leq 30$ mol% was synthesized and explored. Based on the FTIR analysis, the content of [BO_4] structural units increased by a higher rate than that of [BO_3] structural units upon the variation of the concentrations of (0.1 Li_2O – 0.86 B_2O_3 – 0.04 Dy_2O_3). The increase of the density and the decrease of the molar volume indicated a more compactness of the lead alkali borosilicate network. On the other hand, the attenuation coefficients of lead alkali borosilicate glasses have been measured for different gamma- ray photon energies (356, 662, 1173 and 1332 keV) using narrow beam transmission geometry. These coefficients were used in the determination of the mass attenuation coefficients, effective atomic number and effective electron density. The obtained results indicated that the values of the mass attenuation coefficients, the effective atomic number and effective electron density of the glass samples decreased with the increase in the B_2O_3 concentration.

Keywords: Alkali-borate glasses – borosilicate glasses – elastic moduli – FTIR analysis

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Corresponding author: Tel: +01015687527 Fax: +2088325436

E-mail address: atef.eltaher@gmail.com

1. Introduction

The controversial PbO-SiO_2 glasses attracted attention as it can be used as raw materials instead of using metallic lead in the manufacturing of lead-containing glasses or in crystalline electronic ceramics [1-2]. The content of PbO in silicate network controlled its role either as a glass former (> 40 mol %) or as a glass modifying [3-6]. The electron cloud around Pb^{2+} that had a larger ionic radius compared with that of Si^{+4} is distorted when it is introduced into the silicate network [6-7]. At higher concentrations; PbO formed PbO_4 pyramids with Pb^{2+} at the apex of the pyramid and linked together the