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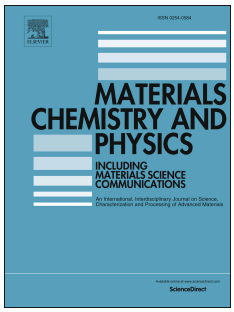

Effect of BaO addition on the structural and mechanical properties of soda lime phosphate glasses

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Effect of BaO addition on the structural and mechanical properties of soda lime phosphate glasses

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Abstract

The phosphate glasses of composition (26-x)Na_2O-xBaO-29CaO-45P_2O_5 (x = 0,5,10,15 mol%) are prepared by melt-quenching technique. The variations in structural and mechanical properties are studied on glasses prepared at 1000, 1100 and 1200°C. The density of glasses increases with barium content for glasses prepared at different temperatures. The molar volume is nearly constant with compositional parameter. The amorphous nature of samples is confirmed by XRD. The calculated values of mass percentage of elements in the batch composition and EDS data are in a reasonable agreement. The FTIR spectra show that the main structural units in these glasses are Q^1 and Q^2 phosphate units. The frequency of the P-O-P band remains constant with barium substitution. The microhardness is measured using Vickers indentation method by applying 0.98 N for 10 s. The hardness and fracture toughness are independent of composition. The nature of crack formations is examined by SEM. The brittleness and crack length are correlated with plastic flow in the material.

Keywords: Glasses, Energy dispersive analysis of X-rays (EDS), Fourier Transform Infrared Spectroscopy (FTIR), Hardness

1. Introduction

Phosphate glasses have wide range of applications in the field of lasers, optical fibers, high temperature seals, nuclear waste disposals and bio materials [1, 2, 3, 4, 5, 6]. The properties of these glasses can be tuned by changing its compositions. The low glass transition and melting temperatures make them widely attractive for various researchers [7]. But the poor chemical durability of these glasses due to the presence of hygroscopic P-O-P bonds is limiting its usage in many fields [8].

The glasses containing 45 mol% of P_2O_5 can be melt easily and also biocompatible in nature [9]. Na_2O, BaO and CaO act as network modifying oxides which can depolymerize the glass network by forming non-bridging oxygen (NBO). The addition of Na_2O, decreases the