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SrO-reinforced potassium sodium borophosphate bioactive glasses: Compositional, physical, spectral, structural properties and photon attenuation competence

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ABSTRACT

The melt quenching process is assumed in making the glass system $45P_2O_5$-$15B_2O_3$-$22Na_2O$-(18-x) K_2O: xSrO where x = 0-12 mol%, namely as S1-S5. Compositional, physical, spectral, structural properties and radiations attenuation competences of S1-S5 bioglasses have been investigated compared to ordinary concrete (OC) cortical bone (CB) and soft tissue (ST). The density of the prepared bioactive glasses has been found to increase with an increase in the SrO content, whereas an opposite trend has been observed in the molar volume. FTIR study shows the existence of different structural groups such as BO_3, BO_4 and BPO_4 units in the network. Optical absorption spectra of the glasses revealed that the cutoff wavelength decreases with increased in SrO content. The maximum (minimum) MAC values were 7.986 (0.021), 7.925 (0.0214), 7.863 (0.0217), 7.865 (0.0217) and 8.837 (0.022) cm^2/g for S1, S2, S3, S4, and S5, respectively. The maximum value of LAC was also obtained at 15 keV with values equal to: 18.528, 18.942, 19.343, 19.898, and 20.144 cm^{-1} respectively for S1-S5. At 0.1, 1.0, and 10 MeV, values of HVT of the glasses were 1.72, 1.54, 1.38, 1.34, and 1.14 cm for S1-S5, respectively, however, the HVT of S1–S5 were less than that of ordinary concrete (OC). The MFP was reduced as SrO content of the S1-S5 glasses increased. Results of the calculated radiation interaction parameters showed that S5 is a better photon, proton and electron absorber compared to the other four bioactive glasses in this study. Improving in photon absorption of the glasses was recorded for higher SrO content. The effect of SrO addition on photon (energy) absorption is more significant for photon energies less than 0.2 MeV. The studied bioactive glasses can function better than ordinary concrete for photon shielding applications.

1. Introduction

strong bonding to bone and soft tissues hence, making them useful as