Effects of MgO on dielectric properties and electrical conductivity of ternary zinc magnesium phosphate glasses.

ABSTRACT

Glasses with composition (ZnO)30(MgO)x(P2O5)70-x(ZnO)30(MgO)x(P2O5)70-x (x = 5, 8, 13, 18 and 20 mol%) have been successfully prepared by the melt-quenching technique. The dielectric permittivity (ε′ε′) and loss factor (ε″ε″) were measured in the frequency range of 0.01 Hz to 1 MHz and in the temperature range of 303 to 573 K. From the results, there is evidence of dipolar relaxation occurring between View the MathML source103–106Hz, while at low frequencies, the spectrum is dominated by dc conduction which was manifested by the 1/ω1/ω slope of the loss factor plot. The value of the relaxing frequency (ωpωp) plotted against 1/T1/T shows a single relaxation mechanism with an activation energy of 0.45 eV. The average value of the activation energy for dc conduction was much higher (1.25 eV) suggesting its diffusion movement had encountered more difficult steps than the small displacement changing dipoles. With increasing MgO concentration, the dielectric permittivity (ε′ε′), dc conductivity (σdcσdc) and dielectric strength (ΔεΔε) decrease and these were attributed to some of the magnesium ions participated in the glass-forming positions as well as modifiers. At lower temperatures, the complex permittivity plots present a skewed arc with center point lying below the real axis which is a non-Debye characteristic. The empirical data were sufficiently fitted by using the Harviliak–Negami equation. The temperature dependent of the parameter αα is discussed.

Keyword: Dielectric properties; Relaxation, Electric modulus; Phosphates; Short-range order.