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SYNTHESIS AND DIELECTRIC MEASUREMENTS OF LEAD AND LEAD CHLORIDE PHOSPHATE GLASSES

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ABSTRACT

A series of binary lead phosphate glasses $(PbO)_x(P_2O_5)1\text{-}x$ and lead chloride phosphate glasses, $(PbCl_2)_x(P_2O_5)_{1-x}$ have been successfully synthesized with x ranging from 0.1 to 0.5. The objective of the research is to determine the effect of mole fraction and temperature on dielectric properties of phosphate glasses. Frequency ranging from 10^{-2} to 10^6 Hz was chosen. The results obtained for the binary lead phosphate glasses showed that the addition of PbO or $PbCl_2$ into the system will decrease the number of cross-links, hence increases the number of the non-bridging oxygen that will eventually weaken the structure bonds of the glasses. We can also say that the stiffness of the lead phosphate glass was decreasing as the mole fraction of PbO or $PbCl_2$ increases. At room temperature, the value of the imaginary component of complex dielectric, ε'' was seen to decrease with a slope of –1 as the frequency was increase whilst the real part, ε' also decreased in parallel with ε'' as the frequency was decreased but later flatten out towards high frequency. The trend was present in both the lead and lead chloride phosphate glasses. This low frequency dispersion could be due to the hopping of electrons or an ion in a potential double well arising at some localized defect. However as the temperature was increased, we found that the behavior of ε'' was inversely proportional to frequency while ε' remained relatively constant at all frequency measured. This response is usually associated with direct current conduction in the material in the relevant frequency range.

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REFERENCES

[1] Jonscher, A.K. 1983. Dielectric Relaxation in Solids. Chelsea Dielectric Press: London.
[2] Kawamura, J. and Shimoji, M. 1986 The AC conductivity of superionic glasses, J.of Non-Crystalline Solid 79, pp 367-381.
[3] Rothenbery, G.B. 1976. Glass Technology. London: NOYES Data Corporation.
[4] Sahar, M.R. 1992. Preparation and Properties of Chloride Phosphate Glass. 21 Century Vision 2020, Department of Physics, Universiti Putra Malaysia.