Nature of electrical conductivity threshold in bulk \((\text{Ag}_2\text{Se})_x(\text{GeSe}_4)_{1-x}\) glasses

C. HOLBROOK, P. BOOLCHAND, P. CHEN, Univ. Cincinnati, A. PRADEL, A. PIARRISTEGUY, Univ. of Montpellier — Bulk glasses were synthesized over the 0 < \(x\) < 25% range, and examined in FT-Raman, m-DSC, Electric Force Microscopy (EFM) and complex impedance experiments. \(\text{Ag}_2\text{Se}\) as an additive to \(\text{GeSe}_4\) base glass leads to macroscopic phase separation as revealed by bimodal \(T_g\)s (base glass- \(T_g=168\) °C, additive glass \(T_g=230\) °C at low \(x\) < 15%). In addition, at higher \(x\) (> 16%), a third \(T_g\) near 211 °C is observed, and its strength increases with increasing \(x\). EFM confirms the heterogeneous character of the glasses displaying a conducting phase that is segregated at low \(x\) (<12%), and which percolates at higher \(x\) (>16%). Electrical conductivity results show a step-like jump of nearly 2 orders of magnitude in the 16% < \(x\) < 20% range. Frequency of the Raman active corner-sharing mode of \(\text{GeSe}_4\) units (200 cm\(^{-1}\)) steadily decreases with increasing \(x\), suggesting that the third phase \((T_g=211\) °C) most likely is a conducting \(\text{GeSe}_4\)-\(\text{Ag}_2\text{Se}\) phase. These data are consistent with a volume percolation\(^2\) of solid electrolyte phases near \(x\sim16\%\) contributing to the step-like jump in conductivity of glasses. \(^1\) V.Balan et al. J.Optoelectronics Adv. Mater. 8, 2112(2006). \(^2\) H. Scher and R.Zallen, J. Chem. Phys. 53, 3759(1970). * Supported by NSF grant DMR 04-56472

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