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Nature of electrical conductivity threshold in bulk $(Ag_2Se)_x(GeSe_4)_{1-x}$ 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. Ag_2Se as an additive to $GeSe_4$ base glass leads to macroscopic phase separation as revealed by bimodal T_gs (base glass-T_g =168 $^\circ$ C, additive glass T_g = 230 $^\circ$ C at low x < 15% . In addition, at higher x (> 16%), a third T_g near 211 $^\circ$ 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 $GeSe_4$units (200 cm^{-1}) steadily decreases with increasing x, suggesting that the third phase (T_g=211 C) most likely is a conducting $GeSe_4$-Ag_2Se phase. These data are consistent with a volume percolation[2] of solid electrolyte phases near x$\sim$ 16% 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

Chad Holbrook
Univ. Cincinnati

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