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Network glasses, dangling ends and intermediate phases

P. Boolchand

Department of Electrical and Computer Engineering, University of Cincinnati, Cincinnati, OH 45221-0030

Bulk glass formation occurs over a very small part of phase space, and 'good' glasses (formed by cooling even at a slow rate ~1°C/min) select an even smaller part of that phase space. Theory and experiment suggest [1] that these sweet spots of glass formation represent Intermediate Phases consisting of rigid but stress-free networks. Calorimetric and Raman scattering experiments show that Intermediate Phases occur over a finite range of chemical compositions with sharply defined phase boundaries. Experiments also reveal that widths of Intermediate Phases collapse sharply in the presence of dangling ends [2] like one-fold coordinated halogen atoms or hydrogen or OH. We describe experiments where the near collapse of Intermediate Phases has been observed in ternary Ge-S(or Se)-I glasses. Experiments also reveal [3] that the manner in which network structure self-organizes in the narrow Intermediate Phase of these two systems are quite different, and that relative atom sizes play a role.

1. P. Boolchand, G. Lucovsky, J.C. Phillips, M.F. Thorpe, "*Self-Organization and the Physics of Glassy Networks*", Phil. Mag. 85, 3823 (2005) (article in pdf format)

2. Y. Wang , J.Wells, D.G.Georgiev, P. Boolchand, Koblar Jackson, M. Micoulaut. *Sharp Rigid to Floppy Phase Transition Induced by Dangling Ends in a Network Glass.* Phys.Rev.Lett. 87, 18, 5503 (2001) (article in pdf format).

3. F.Wang, P. Boolchand, K.A. Jackson, M. Micoulaut, "*Chemical Alloying and light-induced collapse of the intermediate phase in chalcohalide glasses*", J. Phys.: Condens. Matter 19 (2007) 226201 (article in pdf format).