Local structure and glass formation in Al20Te80 glass

Karuppannan Ramesh*[1], Wilson P.t.[2,3], Ramanna Rangappa , and Madesh Kumar[3]

[1]Department of Physics, Indian Institute of Science (IISc) – C V Raman Avenue, Bengaluru, Karnataka 560012., India

[2]NMR Research Centre, Indian Institute of Science (IISc) – C V Raman Avenue, Bengaluru, Karnataka 560012., India

[3]Reva University – Department of Physics, Reva University, Bangalore-560064., India

Abstract

Chalcogenide glasses are known for their wide range of application in many areas. Properties of chalcogenide glasses can be altered to a larger extent by the addition of metal atoms. In these glasses metal atoms are normally found to be in higher coordination state. For example, Al atoms are reported to be in 4- and 6- fold coordination in Al-Te and Al doped As-Te glasses. But recent reports on Al-Te glasses show 5- fold coordination for Al along with 4- and 6- fold coordination states. Correspondingly the electrical properties particularly, the electrical switching is found to be completely different. We believe that there should be a favouarble preparation condition at which the 5- fold coordinated Al may form. In this study 27Al Magic Angle Spinning (MAS) NMR measurements have been carried out to understand the origin of 5- fold coordinated Al in Al20Te80 glass.
Two series of glasses have been prepared by melt quenching method: (i) quenching of the melt from different temperatures (700 oC, 800 oC and 900 oC) (ii) quenching of the melt from different pressures (atmospheric pressure, 10-2 Torr, 10-4 Torr, 10-5 Torr and 10-6 Torr). The glasses quenched from different temperatures do not show any variation in 5-fold coordinated Al whereas the glasses prepared from different pressures show systematic changes in 5- fold coordinated Al. This study indicates that to form Al-Te glass a minimum pressure of 10-4 Torr is needed. The samples prepared from pressures $>$ 10-4 Torr show only 4 and 6 coordinated Al while the glasses formed from pressures $\leq$ 10-5 showed the appearance of 5- fold coordinated Al.

Keywords: Chalcogenide glasses, MAS, NMR, Melt quenching, Glass formation, Network connectivity

*Speaker