Hybrid Glasses and Melts

Neville Greaves*[1]

[1]Department of Materials Science and Metallurgy [Cambridge University] (DMSM) – 27 Charles Babbage Rd, Cambridge CB3 0FS, U.K., United Kingdom

Abstract

Hybrid Glasses have recently been discovered, derived from the newly emerging and versatile Metal Organic Framework Materials or MOFs. Several ways of producing Hybrid Glasses have been developed, so far, starting with low density Zeolitic Imidazolate Frameworks or ZIFs: melt-quenching, amorphization, ball-milling, and low temperature solution chemistry. These diverse methods raise issues currently fundamental to glass science: conventional melting, low temperature or decelerated melting, pressure-induced amorphization, polyamorphism and liquid-liquid phase transitions, perfect glasses, rheometry at supercooled temperatures, and glass forming ability (GFA) etc. There is also the question of porosity, as glasses incorporating a solvent moderator by can exhibit accessible internal areas comparable to crystalline ZIFs, whereas, for melt-quenched glasses, internal voids occupy far less capacity and are unconnected, and are similar to the distribution of Free Volume in oxide glasses. Structurally Hybrid Glasses, and the melts they can be derived from, align with the familiar Continuous Random Network, but with tetrahedral metals, like zinc and cobalt, replacing silicon or germanium for example, and organic linkers such as imidazolate groups, substituting for bridging oxygens. In contrast to conventional CRN glasses, though, metal nodes in Hybrid Glasses are floppy while linkers are stiff. Moreover, different combinations of linker strongly affect the viscosity at the melting point Tm, so that by increasing the linker rigidity the viscosity at Tm can be substantially increased, significantly reducing the supercooled range. As a result, GFA can be raised, and for selected Hybrid Glasses is currently superior to that for any other melt-quenched glass. Throughout this presentation the physical, structural and dynamic properties of Hybrid Glasses, and the liquids they are condensed from, will be emphasised, and future developments will be considered in this exciting new branch of glass science.

Keywords: hybrid glasses, glass forming ability, polyamorphism, porosity

*Speaker