Phase Separated SiO2-B2O3-Na2O Glasses: Part II - Fracture

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Abstract

Phase separated glasses are well known in industry and have multiple industrial uses: references electrode junctions, desiccants, coatings, medical devices, chromatography, synthesis substrates, catalyst support, filtering impurities from polluted water or air, etc. Patents show that they have an increase in their resistance to crushing, yet their resistance to stress corrosion cracking (SCC) is less well-known in literature. A typical SCC curve reveals the velocity of a crack front in a material verses the stress intensity factor, and the SCC behavior of homogeneous glasses systematically evidences three regions between two thresholds. The lower and upper thresholds correspond to the environmental limit (below which the crack front does not interact with the environment) and the fracture toughness (after which the velocity of the crack is unstable). Between the two limits, one finds the three regions. In the first region, Region , the crack front velocity increases nearly linearly with the stress intensity factor. The crack front interacts with environmental water, and the limit in this zone is the time for the reaction to occur. In the second region, Region , the crack front velocity is nearly constant with the stress intensity factor. The limit in this zone is the time for the water to reach the crack front. In the last region, Region , the crack front velocity increases nearly linearly with the stress intensity factor. It is commonly recognized that the crack front dynamics does not depend on the amount of water in the environment. However, it does depend on other environmental factors. This presentation will look at how phase separation influences the environmental limit and the Region of the SCC curves. (SBN) glasses are well known to have a large phase separation zone. Selecting one glass from this zone, the works presented herein alters the mesoscale of SBN glasses by invoking phase separation and then studies how these alterations affect the stress corrosion cracking (SCC) behaviour. To do this, the chemical composition of the glasses was selected to be in the theoretical three-phase section of the SBN ternary glass system. After fabrication, annealing samples provoked the formation of amorphous phases separated glass systems. Another presentation (see Laure Chomat's presentation) presents how the structure of the glasses are altered due to phase separation. This presentation focuses on stress corrosion cracking and how it varies with the amorphous phase separation in SBN glasses. Specifically, depending on the time of annealing

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the mesoscale structure of the glass changes. This causes shifts in the environmental limit and changes in slope in region . Hence, there is a clear evolution of the SCC behaviour with the annealing time, which is linked to the growth of the different phases.

Keywords: SBN glasses, fracture, stress corrosion cracking (SCC), phase separation