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Publication date:
2012

Document Version
Accepted author manuscript, peer reviewed version

Abstract, Glass Summit, Wuhan, China, 15-16 September 2012

T_g of Silica

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While most of glass systems exhibit normal glass transition and relaxation behaviors, vitreous silica shows many abnormal behaviors although it is chemically one of the simplest systems. Here we demonstrate and analyze some anomalous features of vitreous silica regarding the glass transition. First, the pattern of the heat capacity jump from glassy to liquid state becomes distorted after a certain number of the DSC scans (up to 1350 ºC). Second, the onset glass transition temperature (T_g) decreases with increasing number of DSC scans, and reaches a constant value after a certain number of DSC scans. Third, T_g of silica dramatically increases with decreasing the hydroxyl concentration (HOC), but will not reach the value of 1200 ºC at the zero OHC content as claimed in literature. Forth, there is a striking difference in the shape of the glass transition peak between bulk and fiber vitreous silica, even if they both undergo the same thermal history prior to calorimetric scans. All these features, along with high sensitivity of T_g to OHC, probably explains why there is still lack of a generally accepted T_g value for the vitreous silica in the glass community. Considering the above-mentioned anomalous features it is necessary to define and quantify the standard T_g of silica. The origin of those features of vitreous silica is discussed from the energetic and structural aspects.