Temperature-Modulated Differential Scanning Calorimetry Analysis of High-Temperature Silicate Glasses

Norbert J. Kreidl Award Lecture

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(GOMD-AW-005-2018) Temperature-Modulated Differential Scanning Calorimetry Analysis of High-Temperature Silicate Glasses

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Temperature modulated differential scanning calorimetry (TM-DSC) has not been widely applied in the silicate glass community, since commercial instruments have typically been restricted to ~700°C. In this talk, we discuss how to obtain high quality data on silicate samples with high glass transition temperatures (T_g) by adjusting the experimental parameters considering T_g and liquid fragility (m) of the probed glass. Furthermore, we show how to determine m in tectosilicate CaO-Al_2O_3-SiO_2 glasses using the thermal relaxation caused by the temperature modulation to estimate the structural relaxation time. Fragility decreases with increasing silica content, consistent with trends observed from direct viscosity measurements and standard DSC using the activation energy for structural relaxation. TM-DSC thus succeeds in reproducing the trend in m, whereas the absolute values of m are systematically lower for high-m compositions and vice versa for low-m compositions. Finally, we discuss the use of TM-DSC to probe the so-called intermediate phase in silicate glasses, featuring isostatic topology with minimal structural relaxation upon heating. Our data suggests that within the tectosilicate system, the relaxation behavior can be tuned by changing the network topology. We thus infer that TM-DSC could be used to search for silicate glasses with minimal volume relaxation during heating.