
Viscosity and glass transition of lithium aluminosilicate glasses containing ZrO₂ nanocrystals

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Abstract

The effects of nanoparticle-containing natural and synthetic silicate glasses on viscosity at the glass transition are not fully understood. In case of glass-ceramic manufacturing, nanoparticle suspensions are already present after the precipitation of the nucleation agent. It was found that the viscosity increases much more even for small precipitated volume fractions of ZrO₂ than for suspensions whose crystals have a size in the μm range. Typical models such as Roscoe and Krieger & Dougherty therefore do not describe the viscosity of nanodisperse systems. In calorimetry, the rapid precipitation of ZrO₂ nanocrystals prevents the determination of the glass transition temperature of the homogeneous glass. However, the glass transition temperature of the residual glass was in turn used to determine the relative viscosity of the suspension. Using these data, specific models for nanocrystalline suspensions were tested that incorporate effective radii of ZrO₂ nanocrystals.

Keywords: Viscosity, nanoparticle, containing glass, calorimetry, nucleation

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