# Rheology and crystal growth in supercooled $Al_2O_3$

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Angell introduced the terminology of fragility to classify glass forming systems. Fragility is given by the steepness of the viscosity curve at the glass transition temperature. Strong systems show smaller values of fragility with their viscosity typically following an Arrhenius law or showing some temperature dependence close to Arrhenian. Fragile systems on the other hand are characterised by a much steeper slope with the temperature dependence of viscosity often described by the Vogel-Fulcher-Tammann equation. In the so called Angell plot the viscosity of different glass forming systems is shown as a function of temperature rescaled with the glass transition temperature. The viscosity temperature behaviour of some systems, however, can not be reconciled in the standard Angell classification. These systems show for example Arrhenius behaviour around $T_g$ and a viscosity curve characteristic for a fragile system at high temperatures. These so called fragile to strong transitions received increased interest in recent years. Here we report evidence for a possible fragile to strong transition in $Al_2O_3$. Viscosities are contactlessly measured by using a novel aerodynamic levitation furnace at several hundred degree above and below the melting point. Viscosities in the range inaccessible by steady state measurement techniques due to crystallisation of the sample are estimated from crystallisation speeds in free-cooling runs using the Maxwell relation. High-speed video imaging of the crystallisation front indicates that $Al_2O_3$ undergoes planar growth. Further, it is interesting to note that $Al_2O_3$ shows a dramatic 25% volume change between solid and liquid. This volume change leads to negative pressure on recrystallisation evidenced by micrograph images and now in-situ by imaging the remelting of previously crystallised spheres. Hereby, a largely closed network of voids is clearly visible in the semi-liquid sample.