

Transient nucleation theory as a tool to determine interfacial energies

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Abstract

The interfacial energy, σ , is one of the most important parameters in Classical Nucleation Theory. The determination of σ will enable the testing of theoretical models and thus lead to a refinement in the description of transformation kinetics of glass melts.

Our method is based on experimental data and theoretical results for the transient kinetics of crystal nucleation. In particular, we use Shneidman's theory to provide explicit expressions for the induction time in a continuous nucleation model. These expressions are employed in conjunction with free energy values to determine interfacial energies from experimental nucleation data. Expressions were derived to utilize transient data from experiments with single and two stage heat treatments. We determine crystal-liquid surface energies directly, if data from single stage nucleation experiments were employed. For double stage transient data, prior determination of the critical size of the nucleus at the development temperature is necessary to obtain σ .

A description of the method is presented. Current limitations of the method due to the lack of experimental data in $\text{Na}_2\text{O} \text{ 2CaO } 3\text{SiO}_2$ glasses are discussed.