Homogeneous crystal nucleation in polymers – Nucleation kinetics and thermal stability of nuclei

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Crystal nucleation in polymer melts at common laboratory cooling rates (<10 K/s) is typically heterogeneous. In order to study homogeneous crystal nucleation, two ways have been suggested. (i) Modifying the condition of crystal nucleation such that homogenous nucleation is distinctly more efficient than heterogeneous nucleation by bringing the system to the nucleation temperature without prior formation of nuclei, which requires cooling at high rate. (ii) Dividing the sample into tiny, non-communicating parts, ensuring homogeneous nucleation as the initial step of crystallization in most of the droplets. Regarding the droplet-approach, review of the literature [1] revealed that the droplet size must be extremely small (nm size) which only has been achieved in few cases. The first approach, introduced in the first part of the presentation, became possible with the availability of fast scanning chip calorimetry [2]. We discuss the temperature dependency of the rate of homogeneous nucleation and its relation to the glass transition and to cross link density [3].

In a second part we describe a method allowing to investigate the ability of nuclei to stabilize/grow on heating to the crystallization temperature [4] and, finally, to determine the thermal stability of homogeneous nuclei in polymers.

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