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Homogeneous crystal nucleation in polymers

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Abstract

© 2017 IOP Publishing Ltd. The pathway of crystal nucleation significantly influences the structure and properties of semi-crystalline polymers. Crystal nucleation is normally heterogeneous at low supercooling, and homogeneous at high supercooling, of the polymer melt. Homogeneous nucleation in bulk polymers has been, so far, hardly accessible experimentally, and was even doubted to occur at all. This topical review summarizes experimental findings on homogeneous crystal nucleation in polymers. Recently developed fast scanning calorimetry, with cooling and heating rates up to 10 6 K s -1 , allows for detailed investigations of nucleation near and even below the glass transition temperature, including analysis of nuclei stability. As for other materials, the maximum homogeneous nucleation rate for polymers is located close to the glass transition temperature. In the experiments discussed here, it is shown that polymer nucleation is homogeneous at such temperatures. Homogeneous nucleation in polymers is discussed in the framework of the classical nucleation theory. The majority of our observations are consistent with the theory. The discrepancies may guide further research, particularly experiments to progress theoretical development. Progress in the understanding of homogeneous nucleation is much needed, since most of the modelling approaches dealing with polymer crystallization exclusively consider homogeneous nucleation. This is also the basis for advancing theoretical approaches to the much more complex phenomena governing heterogeneous nucleation.

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Keywords

classical nucleation theory (CNT), crystallization, fast scanning calorimetry (FSC), growth, nucleation, polymers

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