Prediction of Crystallization Rate Function from Isothermal Crystallization Experiments. 1
- Crystallization Half Times as Overall Rates of Crystallization -

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In polymer processing, especially in fiber spinning, crystallization is the most important phase transition. Crystallization in the melt spinning occurs under nonisothermal conditions and frequently in the presence of molecular orientation. The mathematical modeling of crystallization for such processes requires a nonisothermal description of crystallization and knowledge of crystallization rate as a function of temperature. But crystallization rates are usually measured under quiescent, isothermal conditions, and, in many cases, they are experimentally accessible only over a narrow temperature range at low undercoolings, a temperature range that is often well above that where crystallization occurs in spinning processing. Although many workers have studed the nonisothermal crystallization kinetics, the results are unsatisfactory for estimation of the crystallization rate.

In this study we have attempted to predict the crystallization rate equation as a function of temperature by using isothermal experimental data. The growth rate equation with WLF relation as a transport term is used to evaluate and extrapolate the isothermal crystallization data of nylon 6, nylon 66, poly(ethylene terephthalate), and poly(butylene terephthalate). A half-time analysis is used to represent the isothermal crystallization rate. The results show that the crystallization function extrapolated from isothermal data using WLF relation as a transport term shows satisfactory agreement with the experimental data reported by others. The relative rates of crystallization among these polymers can be evaluated by comparing the maximum values of the crystallization functions.