Structure Formation on Cooling During Controlled Ultra-fast Temperature Treatments

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For a thorough understanding of the fast kinetics of all kinds of temperature- and time-dependent processes during polymer processing, there is an urgent need for new techniques [1]. One can imagine how fast a polymer melt cools down during solidification in a cold mold. Investigation of thermodynamic properties of polymeric materials during such treatments is of high interest. A new calorimetric device was developed that performs simultaneous heat flow measurements during complex temperature profiles, mimicking manufacturing processes. Using low addenda heat capacity thin film chip sensors [2] in a differential scheme allows scanning rates from 10 to 10^5 K/s with equilibration time of 3 ms. The device was used to study crystallization kinetics of isotactic polypropylene and polyethylene in a wide temperature range. Heterogeneous and homogeneous nucleation was observed. The smallest crystallization half time of nucleated iPP was 10 ms at 65 °C– that is 10 times faster than pure iPP at the same temperature.

[1] Brucato V, Piccarolo S, La Carrubba V., Chem Eng Sci 2002:57(19):4129-4143.
[2] Minakov AA, Schick C., Rev Sci Instr 2007:78(7):073902-073910.