Oriented crystallization and melting of polypropylene. Structure formation and its mechanisms.

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Uniaxially oriented polypropylene (iPP) is molten in the synchrotron beam and crystallized from the quiescent melt keeping its orientation in order to study the mechanisms of crystallization. We document microstructure evolution as a function of melt-annealing temperature, undercooling and time [1].
Isothermal crystallization at 155°C results in slow formation of (primary) lamellae placed at random. As the crystallization temperature is decreased (150, 145, and 140°C), more and more secondary crystallites are observed which develop from a block mesostructure according to Strobl's mechanism. During the isothermal phase the blocks are fusing more or less to form imperfect lamellae.
The structure evolution observed in the time-resolved small-angle X-ray scattering (SAXS) data during crystallization and re-melting facilitates discrimination between the block structure and another frequently discussed morphology, Keller's cross-hatched structure. Data analysis is carried out both via the original scattering pattern and the CDF (a function in real space which describes domain sizes and distances) [2]. Additional WAXS studies of the initial and recrystallized structures confirm this observation.

References

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[2] Stribeck N 2007 X-Ray Scattering of Soft Matter. Springer, Heidelberg, New York