

X-RAY SCATTERING STUDIES OF THE EARLY STAGES OF CRYSTALLIZATION IN POLYMER FIBERS

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The early stages of structure development during melt-spinning have been studied for a number of polymer fibers and are reviewed here. Among the polymers reported are HDPE, nylon 6, poly(oxymethylene), poly(vinylidene fluoride), and poly(trimethylene terephthalate). The results of selected ancillary experiments on structure development during heat-setting of PET are also shown. In the aggregate, the spinning results show that, during melt-spinning, crystallinity develops from metastable phases of intermediate or low chain packing. Further, shish-kebab morphologies are the favored morphological type, with SAXS signals from the shish or a fibrillar precursor preceding a recognizable WAXD crystal signal. A critical strain criterion for the onset of crystallization is found. Comparison to more detailed heat-setting studies of PET fibers is useful. In those studies, very narrow fibrillar precursors are revealed using radial distribution function analysis and transmission electron microscopy. These fibrillar precursors act to develop the thermal stability of the fiber.