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Polymer Spheulites

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The growth and/or structural features that determine lamellar shape in polymer spherulites and therefore their structure and properties have been debated for many years. The spectacular twisting of lamellae in optically banded spherulites has been explained by the existence of unbalanced stresses in opposite fold surfaces of the lamellae. This mechanical origin implying the folds explains also the demonstrated absence of correlation between lamellar twist sense and molecular chirality of chiral polymers. Unbalanced surface stresses may also generate spherulites made of scrolled lamellae, with the scroll axis radial. This original morphology was first observed in spherulites of poly(vinylidene fluoride) in its γ phase. It arises from a chemical disparity of folds formed on opposite fold surfaces, the volumes of which differ by 10Å*3. Similar chemical disparities have been suggested to explain the formation of highly unusual scrolled single crystals of polyamide 66 obtained from solution under specific annealing and crystallization conditions. Related thermal histories lead to the formation, in the bulk, of unusual optically negative spherulites of polyamide 66 that were first observed in the 1940s. These still poorly understood negative spherulites may well display a similar scrolled lamellar morphology. The analysis of unbalanced surface stresses requires to evaluate the interplay and mutual impact of crystal and fold structures. The stresses associated with different fold structures are locally small perturbations but are cumulative and are exerted on thin, flexible lamellae. The latter non-planar morphologies reveal these stresses and help reach sub-moleculr insights on the fold structures.