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In addition to these variables, at large strains, defect distribution and presence of morphological imperfections controls the onset of plastic deformation (yielding, crazeing) and fracture. Unlike in glassy thermoplastics, morphology is the single most important structural variable controlling mechanical response of semicrystalline polymers. Temperature, strain rate, loading geometry, state of stress within the solid, environment, annealing and physical ageing are the external variables affecting mechanical response of thermoplastics.

Deformation Response of Semicrystalline Thermoplastics

The importance of spherulitic and spherulitic morphology for the mechanical response of semicrystalline thermoplastics rests on experimental evidences that spherulite sizes fix the scale for coordinated local mobility of an assembly of segments, or, in other words, for the extent of plastic deformation. The deformation response of semicrystalline polymers depends also on the morphology of the crystalline phase, especially on the size and shape of spherulites.

Polymers with small, uniform spherulites, prepared by quenching polymer melts, exhibit ductile behavior with lower elastic moduli, while morphologies with coarse spherulites resulting from slow crystallization fail in rather brittle manner exhibiting slightly greater rigidity. In the latter case, cracks propagate generally along the boundaries of large spherulites due to low density of tie molecules. When cracks meet spherulites head-on at boundary intersections, they tend to propagate through these spherulites along surfaces of locally radial lamellae. This behavior is, however, dependent on the ease of interlamellar cleavage. Polymers with fine spherulitic morphology exhibit generally plastic yielding,