Crystallinity in Polymers [pln54]

Macroscopic crystallinity in polymers is rare. Polymer crystallinity tends to stay incomplete.

The most common form of polymer crystallinity is a *semi-crystalline state*: small crystals are embedded in an amorphous (glassy or rubbery) i.e. less ordered state of the same material.

Reasons for partial crystallinity:

- slow kinetics caused by entanglement;
- ordering obstructed by
  - random sequencing in copolymers,
  - stereochemical randomness,
  - polymer branching.

Common hierarchical structures of semi-crystalline polymers:

- Chain-folded lamellae:
  - typical width: $\sim$ 10nm,
  - lamellae separated by amorphous regions,
  - individual polymer may be part of more than one lamella.
- Spherulites:
  - typical size: $\sim \mu$m
  - formed by sheaves of lamellae,
  - grow as fibrils from central nucleus.

Illustrations of lamellae and spherulites in [psl10].

The texture of the hierarchical structure depends on whether the nucleation is faster, comparable, or slower than the lateral growth from the nucleus.