Short introduction to polymer structure, crystallization and melt memory

Alejandro J. Müller[1,2]

[1] POLYMAT and Department of Polymers and Advanced Materials: Physics, Chemistry and Technology, Faculty of Chemistry, University of the Basque Country UPV/EHU, Paseo Manuel de Lardizabal 3, 20018 Donostia-San Sebastián, Spain.
[2] IKERBASQUE, Basque Foundation for Science, Plaza Euskadi 5, Bilbao 48009, Spain.
email: alejandrojesus.muller@ehu.es

When polymer chains crystallize, they experience a dramatic change in their segmental conformation, transitioning from isotropic random chains to well-ordered extended chain segments in fixed and symmetric conformations determined by the resulting crystal structure (e.g., chains closely packed in, for example, orthorhombic or monoclinic unit cells). In this lecture, a short introduction to why polymers crystallize and how they do it will be presented. Crystallization directly influences mechanical and optical properties, permeation, and biodegradation, among other important properties.

If polymer crystals are heated above their melting point, they require a specific temperature and duration to revert their ordered conformation into an isotropic random coiled melt. When the temperature is slightly above the melting point, the chains retain a memory of the conformation they had in the crystals. The exact nature of these memory regions in the melt is unknown, but their presence can induce significantly higher crystallization temperatures when cooling from the melt compared to an isotropic melt. Such accelerated crystallization and thus solidification can have practical consequences for material properties and even applications.