Polymer Crystals: Structure and Morphology

Under the title that heads this report, the 14th Europhysics Conference on Macromolecular Physics was held in Vilafranca del Penedés (Spain) from 21-24 September 1982. About 100 participants from (10) western and (4) eastern European countries, the USA (8) and Japan (1) came together in the Auditorium of the Museum of Vilafranca an ancient residence of the kings of Catalonia, strategically located in the core of a XIII-XIV century square. The organizing committee composed of members of the Institute for Structure of Matter, Higher Research Council for Scientific Research (CSIC), Madrid, set up a four day programme which ought to be commended for its balance between invited lectures (10), contributed papers (24), posters (26), general discussion sessions (3) excursions (to the beautiful monasteries of Poblet and Santa Creus and Montserrat) and time for discussions and social get-togethers (10 min. after each paper, 15 to 30 min. at the end of each session).

The conference preprints (*Europhysics Conference Abstracts*, vol. 6G) are particularly valuable and make an important addition to the literature. Some, as well as providing an extended abstract, contain an excellent bibliography.

At the conference, exhaustive conclusions about the morphology and structure and thermodynamic properties of polymer crystals were drawn and compared in some cases with the theories of crystallization. A great amount of relevant data on a) thickness and morphology of the lamellae, b) crystallinity and equilibrium melting point, c) molecular trajectory in the crystalline state, d) rate of linear growth, were given. In many of the presentations, the detailed structure of the disordered material between adjacent lamellae and the nature of chain re-entry at the fold surface were the focal points of discussion. But even when this was done, there seemed to be a certain lack of cross-information. This underlines the necessity for conferences of this type and the desirability of using different physical methods to look at the same material.

Two different views concerning the nature of the fold surface are still current. Whereas from the study of various levels of morphological structures in melt crystallized polymers and their properties a model of irregular fold surface is inferred (Mandelkern, Strasbourg), the microscopical investigation of isolated lamellae of melt crystallized PE (Martinez-Salazar, Bristol) and PEO fractions (Kovacs) favour the view of a regular fold surface. The effect of reptation introduced by J.D. Hoffman (Washington) in kinetic theories requires similarly a substantial degree of adjacent re-entry or regular folding. Experiments using neutron scattering also lead to different views concerning this problem. Thus, according to Fischer (Mainz) there is no indication of privileged adjacent re-entry for melt crystallized polymers. However, other results (Sadler, Bristol) and (Guenet, Strasbourg) emphasize the alternation of molecules in a folded strip in PE and adjacent folding in isotactic PS respectively.

Other groups were focussing attention on the role of chain defects in determining the final morphology of lamellar crystals (Martuscelli, Naples; Ania, Balta Calleja, Martinez Salazar, Lopez Cabarcos, Rueda, Madrid). These investigations suggest that many defects expanding the lattice of drawn PE are non-equilibrium defects. In the case of oriented systems, in the course of the general discussion, the several models suggested supplied a more complete picture of the drawn polymer.

In these systems, the need to consider the arrangement of the molecular chains as distinct from the morphology and crystallization was emphasized (Ward, Leeds; Peterlin, Washington and Lemstra, Geleen). In this case, the concept of a molecular network plays a fundamental role and provides a connection between the drawing behaviour and the properties of the drawn materials. Finally, the importance of residual trapped entanglements which are essential to understanding the long-term mechanical properties of ultra-drawn PE was also pointed out (Lemstra, Geleen).

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