ADVANCED MATERIALS

Polymer Crystals

Forty scientists from Europe, the United States and Japan were invited to Gargnano, Italy (Europhysics Conference on Advanced Topics in Polymer Science, June 19–24, 1988) to lecture on the progress achieved in topics concerning polymer morphology and kinetics in recent years. The opening session was overshadowed by the announcement of Dr. *David Sadler*'s death. Professor *Keller* (Bristol, UK) gave a memorial address, in which he paid tribute to Dr. *Sadler*'s work in many different fields of polymer science and biophysics.

Subsequently theoretical aspects of polymer crystallization were presented. These indicated the diversity of models still under discussion, ranging from tight folding (*J. D. Hoffman*, Midland, USA) via bundles (*G. Allegra*, Milan, Italy) to rough surface growth (*J. Point*, Mons, Belgium). The question of sharp folding and adjacent re-entry was also discussed, both theoretically (*E. Passaglia*, Gaithersburg, USA) and experimentally (*G. Wegner*, Mainz, FRG; *G. Ungar*, Zagreb, Yugoslavia) for *n*-alkanes. Although similar experimental techniques were used, the interpretations differed, suggesting regular fold surfaces and integer long spacings (*G. Ungar*) or, alternatively, a lack of sharp folds (*G. Wegner*).

Diversity was again demonstrated on the second day of the conference regarding the multitude of morphologies observed in polymers. A critical examination of the variety of growth habits exhibited by polymer crystals grown from dilute solution (*F. Khoury*, Gaithersburg, USA) and their crystal surface structure (*B. Lotz*, Strasbourg, France), as well as by those grown from the melt (*D. C. Bassett*, Reading, UK), provided a basis which should allow an evaluation of the different models proposed for crystal growth, as well as helping to correlate polymer morphology with mechanical properties. In this connection, two lectures presented evidence for the existence of a transition region between the crystalline and amorphous regions, both theoretically and on the basis of dielectric relaxation measurements (*D. Yoon*, San Jose, USA), as well as by thermal analysis (*B. Wunderlich*, Troy, USA).

In view of the complex morphologies observed in homopolymers, it was not surprising to find a large variety of differing observations for polymer blends in which at least one component is a crystallizable polymer. Depending on the compatibility of the components, the non-crystallizable component is generally rejected into the interlamellar regions, forming a homogeneous solution with that part of the crystallizable component which is not incorporated into the lamellae (*E. Martuscelli*, Naples, Italy), and thus strongly influencing the tensile and impact properties of the blend. Small angle X-ray and neutron scattering experiments indicated that there is a third phase near the crystal surface where crystalline order is dissipated (transition region), and from which the non-crystallizable component is excluded (*T. Russel*, San Jose, USA).

In the section on advances in experimental techniques, progress was reported particularly in vibrational spectroscopy, synchrotron radiation and high resolution electron microscopy. Synchrotron scattering was used as a technique for studying the early stages of crystallization (*A. Keller*) and crystallization kinetics (*H. Zachmann*, Hamburg, FRG). In contrast to the later stages in crystallization, where the crystal thickness is known to increase logarithmically with time, the initial process was shown to involve thickening in discrete steps (*A. Keller*). Direct imaging using high resolution electron microscopy was demonstrated to be a highly powerful technique for providing information at the molecular level in single crystals of poly(*p*-xylylene) (*E. Thomas*, Amherst, USA), in polymeric liquid crystals (*I. G. Voigt-Martin*, Mainz, FRG) and in polymeric whiskers (*H. Chanzy*, Saint Martin d'Heres, France). In all these cases a comparable stage of sophistication had been achieved with regard to information acquisition as well as image analysis. Various techniques were discussed for correctly taking account of the phases and amplitudes, thus avoiding misinterpretation of defect structures.

The final day of the conference was reserved for advances in processing and properties. This involved morphological engineering, particularly the creation of highly oriented, high modulus fibres (*A. Keller*), and processing techniques which have been developed to improve polymer properties (*J. M. Magill*, Pittsburg, USA).

From the lectures, as well as from the 42 posters that were also presented, it became clear that our understanding of polymer crystals has grown enormously in recent years.

I. G. Voigt-Martin
Universität Mainz (FRG)