INVESTIGATION OF POLYMER CRYSTALLIZATION PROCESS

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It is well known that crystallization is a phase transition that plays an important role in determining the morphology of a polymer for a wide range of technological processes, in which commodities are formed from synthetic plastics. Therefore, studies of the isothermal crystallization of polymers commonly have been used to investigate the specific mechanisms of the crystallization process and from a technical standpoint are relevant to optimizing process conditions. In fact, the morphological structure (size, shape, perfection, orientation of crystallites), which is formed by crystallization from the molten state, influences strongly most of the physical and mechanical properties of polymeric products. Moreover, because the crystal structure and morphology (the crystal habit and organization of crystals into aggregates of a higher order) are responsible for many properties of the final products, knowledge of the crystallization mechanism is crucial for designing materials with the required properties. The crystallization kinetics are investigated by DSC and hot-stage optical microscopy (MO), both available at the laboratories of the Department. MO technique, beside measuring spherulitic growth rate, allows to obtain information on crystal phase morphology, which changes with undercooling degree and therefore with Tc. Both melt isothermal and non-isothermal crystallization kinetics studies are carried out. Melt isothermal crystallization kinetics is investigated by DSC technique and the data analyzed according to the Avrami's treatment, which allows the calculation of kinetic constant of crystallization process. On the contrary, the data obtained from measurements carried out under non-isothermal conditions are analyzed according Tobin and Ozawa equations. The crystallization process is also investigated employing equipments located at other research laboratories, such as: XRD, AFM and DETA. Lastly, crystallization rate is correlated with polymer chemical structure, to establish structure-property relationship, which are fundamental to design a new material with "ad hoc" properties. For copolymers, crystallization parameters are correlated with copolymer composition (random copolymers) and with molecular architecture, i.e. crystallisable block length (block copolymers).

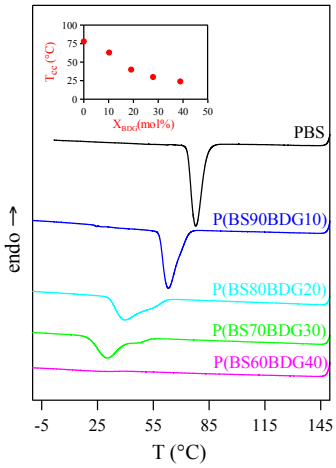

Fig. 1. Non-isothermal crystallization studies for PBS and random PBSPBDG copolymers (image by N. Lotti).

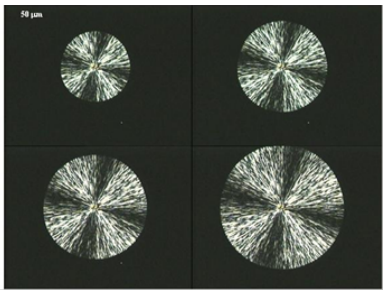

Fig. 2. Optical micrographs of PGA copolymer, isothermally crystallized at 145°C (image by N. Lotti).

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