Role of molecular and crystal structures on tensile deformation of impact resistance polypropylene copolymer: segmental copolymer and crystal orientation.

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Impact resistance polypropylene copolymer (IPC) is one of the commercial polypropylenes (PPs) for industrial uses due to high impact resistance with balancing its stiffness. Among those superior properties, the resistance of the uniaxially stretching has been extensively explored in a relation to its microstructure. Here, we raise two examples of the polymer structure-property relations for the tensile deformation of IPC. Firstly, at the molecular level, it has been widely accepted that it is not only the ethylene-propylene random copolymer (EPR) produced in the copolymerization reactor, but also ethylene-propylene segmental copolymer (EPS) with variety of segmental lengths made. The results showed that the EPS with long or high content of propylene (P) segment promotes higher elongations at yield and at break of the IPC. Various characterization techniques, such as chemical extraction, gel permeable chromatography (GPC), differential scanning calorimetry (DSC) and nuclear magnetic resonance (NMR), were used to analyst its microstructure in depth which the model explained the deformation behavior in the relation with its structure was proposed. Apart from the microstructure effect, the orientation of the lamellar crystal of the homo-PP (hPP) matrix was investigated. Small angle x-ray scattering (SAXS) and wide angle x-ray diffraction (WAXD) techniques with in-situ experiments via synchrotron source were used to trace the crystal evolution under the uniaxial tensile deformation. The results revealed that the IPC with the lamellar crystal oriented perpendicular to the stretching direction (SD) shows higher elongation and strength at break comparing with the IPC possessing the lamellar crystal oriented parallel to the SD. This work shows the example how the micro- and meso-structures affect the mechanical properties of the in-reactor polymer alloy system through the study case of IPC with applying various characterization techniques.

References:

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