POLYPROPYLENE-DERIVED MATERIALS: THE INTERRELATIONS BETWEEN MECHANICAL BEHAVIOUR AND MOLECULAR MOBILITY

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Isotactic polypropylene has been enjoying the fastest growth in consumption since its discovery. The reason is not only its favourable price/performance ratio, but also the possibility of tailoring its end-use properties in very wide intervals. The modification of polypropylene includes:

- specific nucleation affecting crystalline morphology,
- incorporation of a discrete rubbery phase,
- loading by rigid particulate fillers and
- the combination of the above.

Even if filled polypropylene is widely used in various applications, there are still many unresolved questions and, at the same time, new possibilities for enhancing the mechanical performance. The unresolved questions mostly relate to interactions between individual phase components. Thus, the filler surface strongly affects not only molecular mobility of the matrix polymer at the interphase, but also the crystalline structure of the matrix in bulk.

The present lecture describes the relations between individual levels of structural hierarchy and resulting macroscopic short-term and long-term mechanical behaviour of selected materials derived from isotactic polypropylene. Particulate composites with different filler properties (type, shape and size, surface modification) and specifically β-nucleated materials are compared. Special attention is devoted to the molecular origin of toughness and to the effect of molecular mobility on the fracture toughness in particular. For this purpose, in addition to X-ray scattering and microscopical methods, a solid-state NMR was applied in order to get information about the dynamics of the polymer segments and its changes caused by the specific nucleation and/or presence of fillers. Based on the ss-NMR experiments the lecture emphasizes the role of amorphous phase on the mechanical behavior of polymeric materials derived from isotactic polypropylene.