Spring 10

Colloquium Cukrovarnická

v pondělí dne 19. července 2010 v 10:00 hod.
ve Fyzikálním ústavu Cukrovarnická
v seminární místnosti (budova A, 1. patro)

New polymer crystallization mechanism and realization of the ultra high performances

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Materials can be divided into hard and soft materials. Typical examples are inorganic metals and polymers, respectively. The polymers show significant ability of "self-organization" that results in high performances and functions and finally produced lives on this planet. Therefore it is interesting to solve the self-organization (such as crystallization) mechanism of polymers, but it has been not solved for long years.

We have solved the unsolved problem by proposing a so called "chain sliding diffusion theory" and explained polymer crystallization mechanism.[1,2] It has been confirmed that the "chain sliding diffusion" and "entanglement" of polymer chains take the most essential role in the self-organization mechanism of polymers, due to the "topological nature" of long chain molecules.

We will talk on a recent topic that we succeeded for the first time in controlling the entanglement and chain sliding diffusion in polymer crystallization and in producing a novel morphology of nano-oriented crystals (NOCs).[3] As the NOCs showed ultra high performances in physical properties, comparable to metals, NOCs will be able to widely replace inorganic metals or ceramics in both industrial and daily purposes, which will contribute to construct a sustainable society.

Materials used in this study are popular and cheap commodity polymers, such as polypropylene (PP). When we added significantly strong elongational field to the supercooled melt, all polymer chain molecules are oriented in parallel, the nucleation and growth rates are accelerated by a factor of 10^9 and NOCs are formed. The NOCs showed ultra high performances, such as high tensile strength (s_B=230MPa), high thermal resistance and high transparency.

References

1. M.Hikosaka, Polymer (1987) 28 1257-1264
2. M. Hikosaka, K. Okada et.al. Advances in Polymer Science, (2005), 191, 137-186
3. K.N.Okada, M.Hikosaka et.al., Polymer Journal (2010) 42, 464–473

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