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Copolymers with long-range domain order: structure and dynamics

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Block copolymers (BCPs) due to their unique self-assembling properties represent important group among synthetic materials and they are believed to play a significant role in modern nanoelectronics. It is well known that below certain critical temperature TODT (order-disorder transition temperature) two dissimilar polymer subchains (blocks) become immiscible and tend to separate one from another gathering with similar chemical species accordingly forming domain-like structures.

Periodic nature and nanoscopic dimensions of observed domain structures can easily give access to sub-10-nanometric sizes. However, although the microphase separation leads to nicely defined ordered structural motifs on the local scale, the maintaining of the long-range order in the bulk still poses a considerable challenge. Therefore, in order to fully deploy BCPs as nanostructures with long-range order, we are using the directed self-assembly (DSA) technique employing surface interactions, to impose the desired spatial organization of BCP domains.

The potential application of the specific type of BCPs requires a thorough understanding of their polymer dynamics versus domain architecture, confined crystallization processes, reorientations present within rigid amorphous phase fraction and domain interface thickness. In this talk I will present the experimental results of these research topics, using various techniques (as discussed in refs.: 1-5), including atomic force microscopy, scanning electron microscopy, NMR spin diffusion and dielectric experiments.

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