The research in nanoscale science and technology contributes to the development of multifunctional materials composed of nanostructured polymers and nanocomposites. Polymer nanocomposites are systems containing three-dimensional heterogeneities of the size 1–100 nm (in one dimension). The unique behavior of the nanocomposites is mainly caused by a large interfacial area between the polymer and nanofiller. The interfacial interaction, resulting in immobilization of the polymer at the interface, plays a crucial role in the structure formation and behavior of the nanostructured polymers. In addition, the filler-filler interaction and a potential nanofiller percolation in the polymer matrix must be taken into account.

The nanostructured polymers exhibit the interfacial interaction on the nanoscale level. However, the supramolecular structuring including self-assembling and nanodomains ordering in the polymer matrix are also of high importance. Block copolymers, liquid crystalline and supramolecular polymers and gels are examples of organized polymer systems with a hierarchical structure.

Polymer nanocomposites often contain inorganic nanofillers, and hence the systems based on the organic-inorganic polymers are an important class of nanomaterials. Two main procedures of the formation of nanostructured polymer systems are used. The top-down approach consists in disintegration of large "filler" particles into nanoparticles within the polymer matrix, while the bottom-up procedure is based on formation of "filler" nanodomains in a polymer starting from molecular level of inorganic components or precursors. The former approach is typical of clay (layered silicates) nanocomposites where the dispersion of nanoparticles is a main problem and goal of the research. The controlled formation of nanostructures in the case of the bottom-up approach could be achieved by using in situ generation of nanodomains by the sol-gel process or by application of well defined nanobuilding blocks, such as polyhedral oligomeric silsesquioxanes (POSS) or other inorganic functional clusters. Moreover, the prospective class of nanocomposites is based on organic-organic nanostructured polymers containing carbon nanotubes, fullerenes and others.

The present Microsymposium contributed to the update of knowledge of nanostructured polymers and polymer nanocomposites and to the understanding of general relationships between synthesis, structure and properties of the nanomaterials. Approaches to characterization of hierarchical structure of nanostructured polymers by using novel experimental techniques are described including procedures for determination of dynamics of the nanostructured systems or interface interactions. An important part of the contributions is devoted to application of nanomaterials, such as optoelectronic and magnetic materials, coatings, membranes and many others.

Libor Matějka