

Editorial

Designed chemical structures for supramolecular assembly in polymers

One of the goals of synthetic polymer chemistry, and maybe the most important one, is the synthesis of macromolecules having tailored macroscopic properties. The synthetic strategies involved in the preparation of new polymeric materials usually utilize the formation of covalent bonds. In recent years the ability of molecules to self-organize has gained increased attention for the development of new materials. Self-assembly can be defined as a spontaneous intermolecular process involving noncovalent bonds (*e.g.* electrostatic or solvophobic interactions, hydrogen bonds) that results in the formation of, usually, thermodynamically stable supramolecular structures with well-defined order in the nm to μm scale. A plethora of self-organizing systems can be found in nature *e.g.* double-helical structures of DNA and bilayers of lipids in cell membranes. In natural systems their organization is closely linked to their biological function. These systems continue to provide inspiration to synthetic chemists. Control over the self-assembling process of synthetic macromolecules opens new fascinating opportunities for fabrication of functional materials for technological applications where manipulation of macroscopic properties is essential *e.g.* electronic devices, microsensors, separation membranes, catalysts and biomaterials. However, the information needed for self-assembly in a macromolecular system is always stored, in various ways, in its detailed primary chemical structure. It is this structure that defines the nature and strength of the interactions that are more probable to be developed in the system.

This special issue contains papers concerned with the evolution of self assembly processes and structures of macromolecules, both in solution and in bulk state, through the control of the macromolecular architecture, the selective and functionalization of polymers with functional groups, the introduction of amphiphilicity and of conformational asymmetry in the different parts of block copolymers, by using specific interactions between polymers and low molecular weight compounds or by changes occurring in the physicochemical properties of the environment around polymer chains. By use of well-developed polymerization routes, especially anionic and controlled free radical polymerization techniques, new synthetic macromolecules can be produced and used successfully in the formation of complex, self assembled nanostructures (*i.e.* block copolymer mesophases, micelles and vesicles from block copolymers, nanoobjects, etc.), in many cases responsive to their environment and having an internal structural hierarchy. These features allow for their use in emerging technologies and applications.

Obviously a wide field like that of self-assembly in polymer containing systems cannot be fully covered in the limited space of a single special issue. However we hope that by the works presented here we have given a flavor of some of the issues that attract current scientific interest in this field. We also hope that we have shown the degree of concerted effort and collaboration that is often required, between scientists of different disciplines, theoreticians and experimentalists, in order to design, synthesize, study and understand self-organizing polymeric systems. It is our goal to initiate discussion in this, to our opinion, interesting and important field.

The *European Physical Journal E-Soft Matter* aims in becoming a place where more related studies will be published, and especially on the synthesis of designed polymeric chemical structures, in the framework of multidisciplinary that characterizes this Journal and the field of Soft Matter in general.

Martin Möller (Editor)
Stergios Pispas (Guest Editor)