Damian Mickiewicz
Centre of Molecular and Macromolecular Studies, Polish Academy of Sciences

Title: *Spheroidal microparticles with polystyrene core and polyglycidol enriched shell: preparation, functionalization, properties and self-assembly*

Abstract

Particles with colloidal sizes are the object of much research. In the last several years, the interest of researchers is directed to particles with non-spherical shapes. Their ability to form ordered structures, the properties of the resulting systems are being studied, the theoretical basis for the interactions of particles and particles with the environment is being established.

Such particles find various applications in science and technology (electronics, optics, catalyst carriers and also drugs). Particles with colloidal sizes can be polymeric. For the moment, a large number of works are devoted to particles and systems of polymer spherical particles (isotropic with respect to shape), which is due to the ease of obtaining them and are well described in the literature.

In contrast, polymer microparticles with shape anisotropy, as well as systems formed from them, are currently still little understood. In addition, anisotropic shape represents new degrees of freedom that provide opportunities for different ways of ordering particles in systems that are unavailable in spherical particle systems.

Particles with shape anisotropy include spheroidal particles with a core-shell structure, with a hydrophobic polystyrene core and a shell enriched in hydrophilic polyglycidol (PS/PGl). Polystyrene microspheres with a polyglycidol-enriched coating of uniform size can be obtained by emulsion copolymerization, and their size can be controlled.

I obtained spheroidal particles by deforming spherical particles. The ability to deform microspheres under the right conditions allowed me to obtain a series of spheroidal particles, homogeneous in shape and with different but controlled degrees of deformation.

The microspheroids were characterized and subjected to ordering processes into two- and three-dimensional systems (mono- and multi-layers). It turned out that in monolayers the microspheroids exhibit the ordering typical of liquid crystals (named quasicrystalline systems). I confirmed the ordering of microspheroids in multilayers by microscopic and optical techniques.

In addition, for the first time (to the best of my knowledge) I determined the mechanical properties (elastic modulus and hardness) of the obtained multilayers. The study was performed by nanoindentation technique. In the next stage of the work, I subjected the particles to surface functionalization, giving them a permanent positive or negative charge on the surface. I used chemical and physical methods to impart the charge. Positively charged microspheroids were used to study the adsorption processes of particles on solid substrates under hydrodynamic conditions.