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Dynamics of nano and micro objects in complex liquids

The main purpose of the Ph. D. thesis is to analyze dynamics of nano and micro objects in complex liquids. The experimental results are described in three main Chapters: **3.1** *Diffusion of nano-particles in polymer solutions*, **3.2** *Diffusion of plasmid DNA in polymer solutions*, **3.3** *Ions motion in liquid crystal/polymer mixtures.*

The Chapter **3.1** is devoted to the issue of translational diffusion of nanoparticles in nanostructured media represented by solutions of water soluble polymers. The problem is addressed experimentally by determining diffusion coefficients of nanoparticles in aqueous polyethylene glycol solutions using the Dynamic Light Scattering technique. The observations are explained on the basis of the concept of scale-dependent diffusion coefficient and strong spatial variations of the viscosity as a function of a distance from the nanoparticle. Such variations of viscosity are due to the presence of the depletion layer around the particles.

The main goal of the researches contained in the Chapter **3.2**, is a qualitative study of diffusion of biomolecules in polymer and in low molecular mass agent solutions. It is known, that biochemical reactions in living systems take place in an environment crowded by various macromolecules and ligands. Such environment strongly affects the dynamics of biomolecules in living cells, but not in an evident way. Hence, careful analysis of influence of complex liquids (glycerol, PEG 6000 and PEG 8 M solutions) on the dynamics of biomolecules (DNA and restriction enzyme HindIII) is a very important topic. It is shown that PEG 6000 solution decreases the diffusion coefficient of DNA and HindIII more efficiently than glycerol solution of the same concentration or PEG 8 M solution of the same macro-viscosity. The DNA cleavage in PEG and glycerol solution is explained by the concept of size dependent nano-viscosity. Moreover, the size of DNA obtained by Dynamic Light Scattering measurement is compared with that obtained by theoretical analysis to demonstrate formation of aggregates of plasmid DNA in PEG 6000 solution due to depletion interactions.

The main purpose of the Chapter **3.3** is to demonstrate the industrial applications of the study of motion of nano and micro objects in complex liquids. Free ions (ionic impurities) inevitably contaminate liquid crystal and polymer systems. All experiments, which are presented in this section, prove that such ions are responsible for the acceleration of the phase separation process in the liquid crystal/polymer mixtures. In this part, it is experimentally demonstrated, that alternating current electric field can be used to accelerate the rate of phase separation in the liquid crystal/polymer mixtures by orders of magnitude.