

## Electrical Interactions and Patterning of Bio-Polymers and Nanoparticles in Water Suspensions

**Authors :** N. V. Klassen, A. A. Vasin, A. M. Likhter, K. A. Voronin, A. V. Mariasevskaya, I. M. Shmit'ko

**Abstract :** Regular patterning in mixtures of bio-polymers (chitosan and collagen) and nanoparticles in water suspensions has been found by means of optical microscopy. The patterning was created either by external electrical field of moderate amplitude (200–1000 v/cm) or spontaneously. Simultaneously with the patterning pushing out of water drops mixed with nanoparticles to the external regions was observed. These phenomena are explained by interactions of charged bio-polymers and nanoparticles with external and internal electrical fields as well as with the regions of decreased dielectrical permittivity surrounding nano-objects in water which possesses anomalously high dielectrical permittivity. Electrical charges of opposite signs of the nano-objects induce their mutual attraction whereas dipole moments created around these nano-objects by the electrical fields are pushing these particles to the regions with lower fields. Due to this reason, non-homogeneities of dielectrical permittivity around nano-objects immersed into water suspension induces mutual repulsion of the objects. This spatial decrease of this repulsion with the inter-particle distances is more sharp than that of the Coulomb attraction. So, at longer distances, the attractions are stronger whereas at shorter distances the repulsion prevails. At a certain distance these two forces compensate each other creating the equilibrium state of the mixture of nano-objects with opposite charges. When the groups of positive and negative nano-objects consist from identical particles, quasi-periodical pattern of the suspension is observed like mesoscopic two-dimensional super-crystal. These results can clarify the mechanisms of healing of internal organs with direct or alternative electrical fields.

**Keywords :** bio-polymers, chitosan, collagen, nanoparticles, Coulomb attraction, polarization repulsion, periodical patterning, electrical low frequency resonances

**Conference Title :** ICBBE 2014 : International Conference on Biophysical and Biomedical Engineering

**Conference Location :** Paris, France

**Conference Dates :** June 26-27, 2014