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Study of the rheological time series of evolving silicium oxyhydrate gels

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Abstract

Within the framework of the qualitative theory of dynamical oxyhydrate systems, formation of certain three-dimensional structures is accounted for the ratchet potential. Three-dimensional structures and ratchet objects are under the effect of noise and noise fluctuations, and geometry of the ratchet-forming space contributes to that as well. One has to take this impact into consideration to be able to induce the diffusive motion or secure its transition through the existent barriers.

In our research oxyhydrate gels are far from being in a state of equilibrium, and that stochastic ionic cluster flow motions occurred within a certain space in those systems. In other words, *implicitly fulfilled is the condition of an uncorrelated chain-shaped ratchet potential*. At that the absolute value flow increases significantly in contrast to the thermal Brownian motion. Ionic-cluster flows are constantly moving within the "hard walls". The oscillatory diffusion process and polymerization reactions in oxyhydrates enable the attractor formation mechanism and also provide it with the critical growth radius (peculiar quantum of the size). Clustered dipoles and their interaction secure the "hard walls" that prevent the pacemaker (cluster) from dilapidating under the dissolving or peptizating influence of the ambient medium.

The viscous friction in oxyhydrate systems of *d*- and *f*-elements appears in the moment of interaction between the double electric layers of macromolecules that change in time due to peptizing conformer transformations of the oxyhydrate macromolecules. It is also the action of the molecular cluster flows with the surface of the rotating recording cylinder that contributes to the phenomenon. The processes is repeated many times, and dynamic viscosity regularly and periodicly changes. Dynamics of oscillatory viscous motion is defined by the shapes and dimensions of macromolecular clusters of the oxyhydrate gel and may be described with the help of strange non-chaotic attractors.

In the maps of first-return SNAs there are two map types, namely, ball-shaped maps that look like densely coiled torus orbits caused by a change in an instantaneous dynamic viscosity, coming in a shape of limit cycles; and X-ray reflection maps of a colloid structure that are the most pronounced when pH 5.5, and the silicon's concentration in the colloid system is low, 0.2 moles/liter.

[1] K.I. Nosov also participated in the experiment.