Creation of Nano-Track Electronic Devices

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The tracks are formed as a result of the bombardment of thin dielectric films by fast heavy ions. The diameter of tracks is of nanosize. Such structures formed the basis of new electronics, so called "track electronics" (TE). To create novel track devices it's important to study physical mechanisms of tracks formation, the properties of the internal surfaces of tracks, the processes of penetration of electrolytes through the tracks of different size and shape, peculiarities of ion currents in tracks and so on.

In our theoretical work a model of the track system isworked out. The proposed model is designed on the base of classical moleculardynamics (MD). We developed an appropriate computer program and improved the standard MD approach. In our model quantum effects are accounted.

The model is applied to describe the ion current pulsations in track-containing foils. Typically pulsations ofthe ion current are observed in experiments in which the track-containing polymer foils are embedded in electrolytes, and AC voltage is applied. The interacting currents in tracks are simulated by two-dimensional system of oscillatingmodel particles located in the nodes of a plane lattice. In the model external discontinuous forces areintroduced to simulate an application of AC voltage. Interaction between model particles is varied toclarify its influence on pulsation effect. It is assumed that the average amplitude of oscillations of modelparticles is proportional to the average amplitude of current oscillations in real track structure. Themodel describes adequately the main features of the pulsation effect that were found experimentally.The obtained results are useful for creation and improvement of sensors and other devices of trackelectronics.

Now we continue this work to clarify the influence of geometry parameters and other features of tracks on the characteristics of ion currents through the tracks. We show how to use the results of nanotracks study to create new biosensors.

The work is closely coordinated with investigations of experimental groups in European universities.