Book of Abstracts

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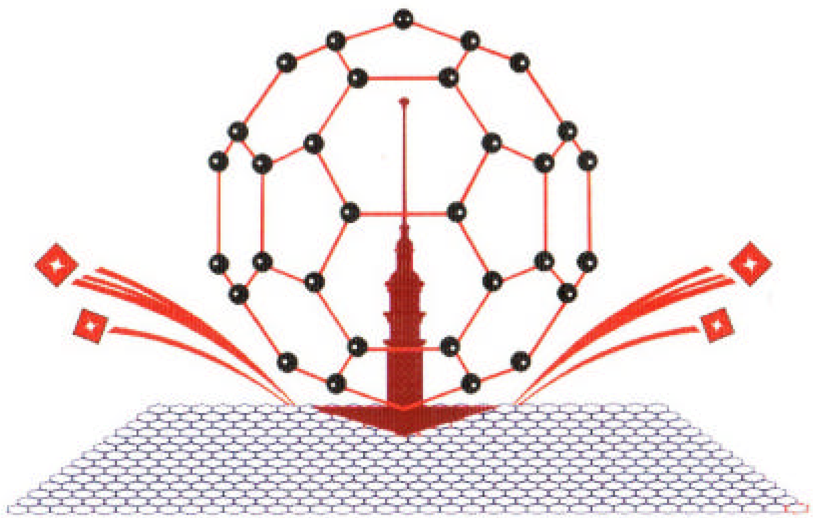

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Sensor activity of carbon nanotubes with modification of carboxyl group

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High sensitivity of electronic characteristics of carbon nanotubes to existence on their border of adsorbed molecules or radicals [1, 2] speaks about creation possibility on this basis of the high sensitivity super tiny sensor. With its help it will be possible to find availability of the slightest impurity in samples.

We studied the carbon nanotube which border was modified by carboxyl functional group -COOH (fig. 1). This system represents a test probe, capable to react to various chemical elements. For the proof of its sensor activity the theoretical researches of possible interaction of the modified single-walled carbon nanotube type (6,0) with atoms of alkaline metals K, Na, Li, Mg were executed. The quantum-chemical MNDO method within a molecular cluster was used. The process of accession of carboxyl group to the open border of nanotube was simulated and studied. Process of scanning by the test probe of any surface containing subject initialization atoms created thus is investigated, and activity of nanotube with the functional group to K, Na, Li, Mg atoms is defined. Process was modeled by step-by-step approach of metal atoms to hydrogen atom of functional group along the straight line parallel to modified border of the (6, 0) nanotube (fig. 1). Power curves of this process were constructed. The analysis of the constructed power curves found the fact of interaction between the modified nanotube and the chosen atoms (K, Na, Li, Mg). It is illustrated by characteristic minima on curves.

The received results proved possibility of use of the modified carbon nanotube as a sensor for certain elements and radicals.

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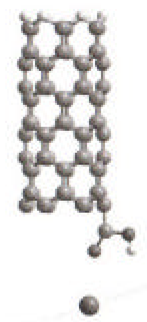

Fig. 1. The process of scanning of any surface containing metal atom; points showed a way of moving of atom about (6, 0) nanotube with the -COON functional group.

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Percolation Mechanism and Specific Features of Nanosecond Current–Voltage Characteristics of an Array of Carbon Nanotubes

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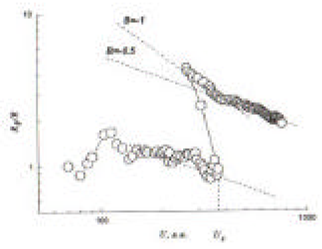
In recent years, we have studied for the first time nanosecond (ns) current–voltage characteristics in the regime of electric instability for arrays of multi-(MWCNTs) and single-walled carbon nanotubes (SWCNTs) [1-3]. It can be expected that the electric field can induce negative differential conductivity (NDC) in an inhomogeneous three-dimensional medium consisting of tangled nanotube bundles. It is also possible that electric fields close to the breakdown threshold can induce a process of current redistribution analogous to the mechanism of percolation or self-organized criticality. The present work was aimed at experimental verification of the percolation mechanism of conductivity in SWCNT and MWCNT arrays, which is responsible for the development of electric instability in the system. The performed investigations are based on the comparison of electrical conductivity dynamics in classical experiments, such as the "sand heap," the two-dimensional grid of resistances with a stochastic node blocking, and the ns percolation in a mode of NDC in nanotube tangles/granules. It was established that the dependence of the relative ns conductivity (R_0/R) on the electric field E during the formation of an electric instability in supercritical fields $E > E_c$ for MWCNT samples corresponds to the behavior of a two-dimensional graphite grid with randomly varied number of missing nodes [3]. A plot of R_0/R vs. U for MWCNT samples (Fig.) was measured at a voltage pulse duration of 20 ns.



The results of experiments showed that the critical electric conductivity index, on one hand, reflects certain changes in the state of conductivity with increasing number of randomly missing nodes in the base grid according to the classical experiment. On the other hand, this index may reflect an analogous variation of the conductivity of samples related to development of the percolation process as dependent on the increasing number of current channels. It seems likely that the situation associated with a new direction in studying the effects of electrical instability in macrosystems/tangles based on nanostructured objects is revealed in the course of performed investigations.

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