Carbon low-dimensional systems in electromechanics

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Below presented a brief review of the works performed recently at Department of Semiconductors Physics and Nanoelectronics of Belarusian State University.

A motion of a conduction electron in a quasi-one-dimensional wire placed into a dielectric environment with distributed inductance was considered. A possibility of the existence in the wire of an inductive soliton (or *inducton*) was shown and its parameters was estimated. It was found that the waveform of inducton current is compressed with an increase of inductance 11[1].

Structural and energy characteristics of the endofullerene Fe@C_{20} using density functional theory approach were calculated. The ground state of Fe@C_{20} was found to be the septet state, and the magnetic moment of Fe@C_{20} was estimated to be $8\mu_B$. The characteristics of the (8, 8) nanotube with single Fe@C_{20} inside were studied in the framework of the semiempirical approach. The scheme of magnetic nanorelay based on cantilevered nanotubes filled with magnetic endofullerenes was elaborated. The proposed nanorelay is closed as a result of bending of the nanotubes by a magnetic force. The operational characteristics of the nanorelay based on the (8, 8) and (16, 16) nanotubes fully filled with Fe@C_{20} were calculated 22[2].

Quantum-chemical semi-empirical molecular-orbital calculations of *zigzag* graphene nanoribbons (*n*zGNRs) were performed for the number of *zigzag* carbon chains $n = 4$ and 10. The antiferromagnetic (AFM) nature of zGNRs' ground state was confirmed. The energy difference between AFM and ferromagnetic (FM) states was calculated and dimerization patterns of their chemical bond lengths were elucidated. The electron energy band structure calculations show that narrow nanoribbon (4zGNR) is semiconducting in both AFM and FM states. For wider nanoribbon (10zGNR), the AFM state is semiconducting ($\approx$0.1 eV band gap), whereas the FM state is half-metallic (electrical conduction with only one spin orientation) 33[3].

We considered a possibility to fabricate a generator of alternate current on the base of a graphene nanoribbon. Contrary to the works, where field emission occurs from the butt end of the nanowire (bunch of carbon nanotubes), we proposed a more simple and production-friendly construction in the form of a double-clamped graphene nanoribbon cathode placed above the flat anode surface 44[4].

References

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