Session «Optical & electromagnetic properties of nanostructures II»

Photo- and Electroluminescence CdS/CNT Hybrids

A. Okotrub[1], L. Bulusheva[1], S. Larionov[1], I. Asanov[1], P. Gevko[1], A. Zarubanov[2], K. Zguravlev[2], T. Duda[2]

[1]Nikolaev Institute of Inorganic Chemistry SB RAS, Russia
[2]Rzhanov Institute of Semiconductor Physics SB RAS, Russia

Simple and effective methods for synthesis of the hybrid material from the CdS nanoparticles (NP) on carbon nanotubes (CNTs) are proposed. CNT arrays were grown on silicon substrates using aerosol assistant chemical vapor deposition (CVD) method. The size and the shape of the CdS NP formed on CNT were found to depend on the temperature of water or other organic solutions. Method for deposition of CdS nanoparticles based on Langmuir–Blodgett technology was developed. Electron microscopy study revealed a direct contact between CdS nanoparticles and CNT surface. X-ray photoelectron spectroscopy examination of the CdS/CNT hybrid material detected surface oxidation of the grown nanoparticles. The synthesis methods allow preserving alignment of CNTs in the array and uniform decorating the CNTs with CdS nanoparticles or deposition only on nanotubes tips. Formation of the continuous CdS/CNT interface indicates that nucleation and growth of the NP take place directly on the nanotube surface. Electroluminescent properties of synthesized materials were studied on a set-up elaborated for measurement of field electron emission characteristics. To observe electroluminescence from CdS NP deposited on the CNT cathode, surface the phosphor screen was replaced by transparent glass coated with ITO. Image luminance of individual radiation centers is more homogenous than that observed on the phosphor screen. Furthermore, the radiation centers can have different spectrum, which is independent on the applied voltage. Photo luminescent bands were measured for samples with nanoparticles deposited on Si substrate and on CNT. Decrease of luminescence □ ~ 470 nm for CdS/CNT hybrids was detected and associated with Forster resonance energy transfer.

NOTES

Forming electronic waveguides from graphene grain boundaries

G. Márk[1, 4*], P. Vancsó[1, 4], Ph. Lambin[2], Chanyong Hwang[3, 4], L. Biró[1, 4]

[1] Institute for Technical Physics and Materials Science, Research Centre for Natural Sciences, Hungary
[2] Research Center in Physics of Matter and Radiation, Facultés Universitaires Notre Dame de la Paix, Belgium
[3] Division of Industrial Metrology, Korea Research Institute of Standards and Science, Republic of Korea
[4] Korean-Hungarian Joint Laboratory for Nanosciences, Hungary

Using wave packed dynamics based simulation [1,2] we investigated in atomic resolution the spreading of electronic wave packets on the graphene surface containing various configurations of grain boundaries (GBs). Our recent experiments [3] and simulations [4] show that in the regions in which an accumulation of graphene structural defects is found—like in GBs in CVD graphene—the charge-spreading phenomena are dramatically altered. Hence it is potentially possible to build all-carbon nanoelectronic circuits based on GB networks, or purposefully damagedregions on a graphene surface. In this paper we simulate the behavior of a few such nanoelectronic "building blocks", namely a waveguide (made of two parallel GB-s) and a beam splitter (formed as Y junction of GBs). We study the "robustness" of the phenomena, e.g. the dependence on the structure and symmetry of the GB and on the electron energy.

[1] Márk, G. I.; Biró, L. P.; Gyulai, J. Simulation of STM images of three-dimensional surfaces and comparison with experimental data: Carbon nanotubes. Phys. Rev. B 1998, 58, 12645-12648.
[2] Márk, G. I.; Biró, L. P.; Lambin, Ph. Calculation of axial charge spreading in carbon nanotubes and nanotube Y junctions during STM measurement. Phys. Rev. B 2004, 70, 115423.
[3] Tapasztó, L.; Nemes-Incze, P.; Dobrik, G.; Yoo, K. Y.; Hwang, C.; Biró, L.P. Mapping the electronic properties of individual graphene grain boundaries, Appl. Phys. Lett. 2012, 100, 053114 .
[4] Márk, G. I.; Vancsó, P.; Hwang, C.; Lambin, Ph.; Biró, L. P. Anisotropic dynamics of charge carriers in graphene, Phys. Rev. B 2012, 85, 125443.

NOTES