The field emission peculiarities of nanodiode with nanotube cathode

P97

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It is known the current-voltage characteristic (I-V) of the field emission diode with 3D cathode is determined by the non-linear nature of the tunneling of electrons to vacuum through the potential barrier near the cathode surface which is well described by the Fowler-Nordgeim function. Replacing of 3D cathode onto the 1D nanotube cathode has the following consequences:

(i) the nonlinearity of the I-V characteristic of nanodiode already will be determined by the interaction of two nonlinear processes: the tunneling process of electrons in a vacuum and the quantum-dimensional process of nanotube cathode conductivity. As a result the resonance peaks near Van Hove singularity and the threshold voltage appear on the I-V characteristic of the nanodiode [1].

(ii) the electrical contact of 1D nanotube cathode with metallic 3D electrode of the electron source cannot be adiabatic and the conditions for quantization of electrons arise the along of the nanotube axis. When the voltage will be more than the threshold voltage, the components of DC and AC current can appear in the electric circuit of diode [2].

In detail the mechanism of field emission in diode with nanotube cathode and the experimental data of our study of the emission properties will be discussed.

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One-dimensional N_2 gas inside single-walled carbon nanotubes

P98

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Vertically aligned forests of sub-nm thin SWCNT can be filled with N_2 molecules if a mixed acetonitrile/ethanol feedstock is used during CVD synthesis. The interior space of these SWCNT is sufficiently narrow (d < 1 nm) that the contained molecules are kept in a strictly one-dimensional arrangement. The linear arrangement of co-axially oriented N_2 molecules inside aligned single-walled carbon nanotubes is revealed by high resolution near-edge x-ray absorption spectroscopy. [1] The encapsulated N_2 molecules exhibit free stretching vibrations with a long electronic lifetime of the x-ray-excited anti-bonding π^* states. Molecular dynamics simulations of N_2 inside (6,6) and (7,7) SWCNT confirm that narrow-diameter nanotubes (d < 1 nm) are crucial for stabilizing the linear arrangement of aligned N_2 molecules.

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