the CNT sensor (maximum of the resistance vs. temperature). Instrumentally, the icing condition could be easily detected as a result of the observation of the first derivative of the resistance vs. temperature passing zero value ($dR/dT = 0$) at the specific value of humidity.

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SPATIO-TEMPORAL LOW DIMENSIONAL SYSTEMS AND NANOSTRUCTURES

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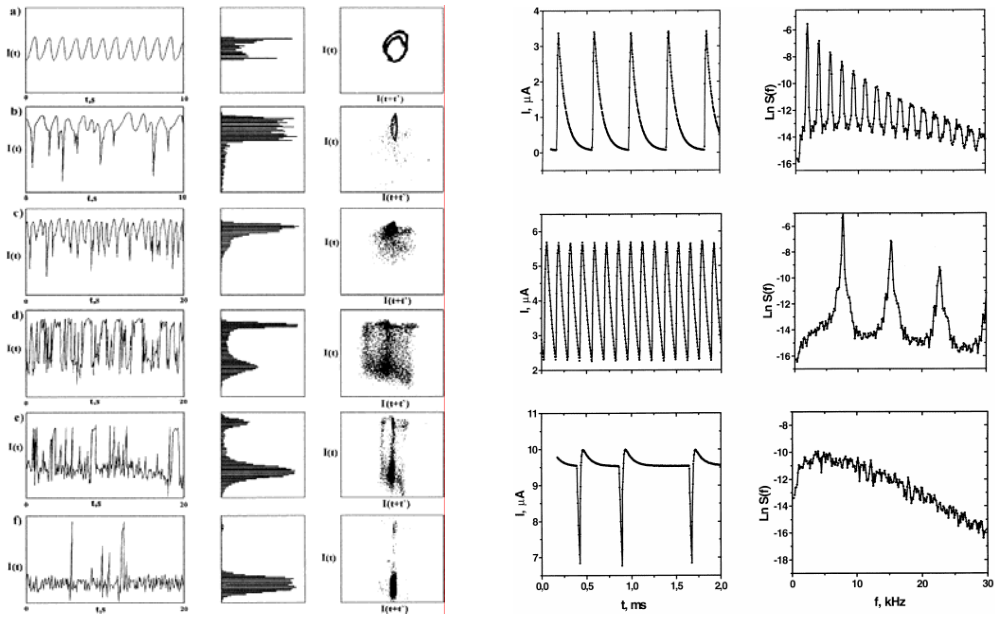
Since the Conference is devoted to "the Materials and Structures in Modern Electronics" we would like to present a brief review of some of our results on low dimensional and spatio-temporal structures.

CURRENT OSCILLATIONS IN SEMICONDUCTORS

We observed spontaneous low frequency current oscillations in polycrystalline Si [1, 2], amorphous Si [3–8], semi-insulating semiconductors [9–11] and *n*-type [12–13] GaAs. We did confirm a method of obtaining information on deep levels in semi-insulating GaAs and in Fe-compensated InP by analyzing the temperature dependence of low frequency current oscillations (Fig. 1, 2). From the power density spectra peaks the extraction of the Arrhenius plots of $\log(T^2/2f)$ versus $1/T$ gave us an activation energy of 0.47 eV for the main peak in InP and 0.75 eV in GaAs (Fig. 3). The method is complementary to the other deep level spectroscopy techniques and the information is obtained more easily on levels which exhibit field-enhanced trapping. In the meantime, the current oscillations in *n*-type GaAs (Fig. 4) [12–13] show an activation energy of hopping conductivity in this material.



a) b)

Fig. 1. – a) The waveforms of the current oscillations in semi-insulating GaAs, amplitude probability distributions and phase portraits for different values of the control parameter *U*, as indicated by the arrows at Fig. 2. Two interacting chaotic subattractors were observed; b) the wave-forms of the signals (left), and power spectra (right) of current oscillations in *n*-GaAs at $T = 4.2$ K, $B = 0$ at voltage 2, 5 and 8 V

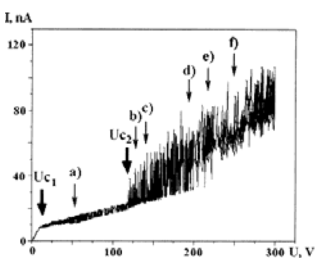


Fig 2. – *I-U* characteristic in dynamic regime. The thick arrows denote the critical voltages U_{c1} and U_{c2}

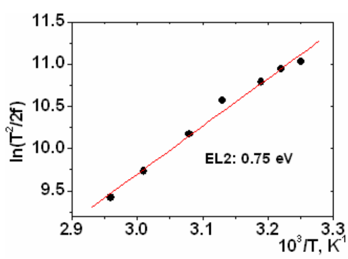


Fig 3. – The Arrhenius plot of $\log(T^2/2f)$ versus $1/T$ in semi-insulating GaAs shows the activation energy of 0.75 eV

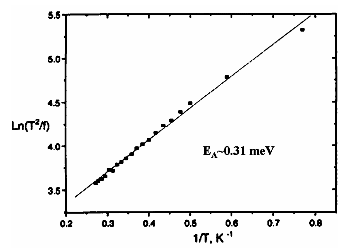


Fig 4. – The Arrhenius plot for the frequency in *n*-GaAs shows the activation energy as low as ~0.31 meV

SELF-ORGANIZED LOW DIMENSIONAL NANOSTRUCTURES

As an attempt to study nanoscale semiconductor structures the method of "self-fabrication" of low dimensional honeycomb-shaped nano networks was developed [14–21].

The electrical transport properties of the carbon networks were studied in a temperature range from 4.2 to 300 K and in pulsed magnetic fields up to 35 T. Carbon networks were found to be the systems with the strong localization. A crossover from Mott variable range hopping to the Coulomb-gap Efros–Shklovskii regime was observed [19].

A rather simple method of fabrication of mesoscopic honeycomb-shaped networks was applied in an attempt to decrease the dimensionality of the 2D gas with electron density of approximately 10^{12} cm^{-2} in GaAs/AlGaAs δ-doped heterostructures. The characteristic size of the hexagonal cells and the thickness of the walls of the network were found to be in the range of 500 and 50 nm, respectively. Magnetoresistance in pulsed magnetic fields up to 35 T, current-voltage $I(V)$ curves and the temperature dependence of the resistance in the mesoscopic networks were measured in the temperature range of 1.9–300 K. Below approximately 20 K, the data follows the Mott variable-range-hopping mechanism for 2D. The observed negative magnetoresistance at low magnetic fields was related to quantum interference in the variable range hopping [20]. The magnetic field induced metal–insulator transition was observed (Fig. 6).

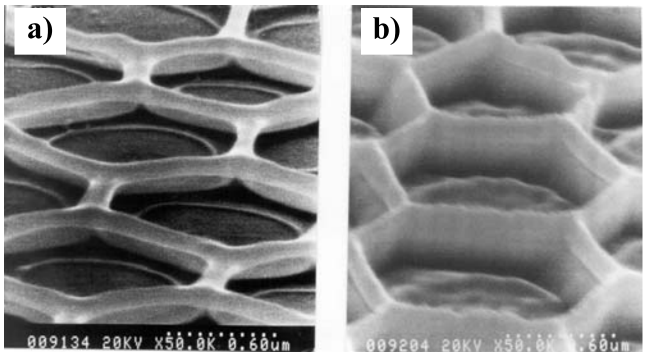


Fig 5. – *a*) SEM image of the carbon honeycomb-shaped nano network, *b*) GaAs low dimensional network after ion-beam etching

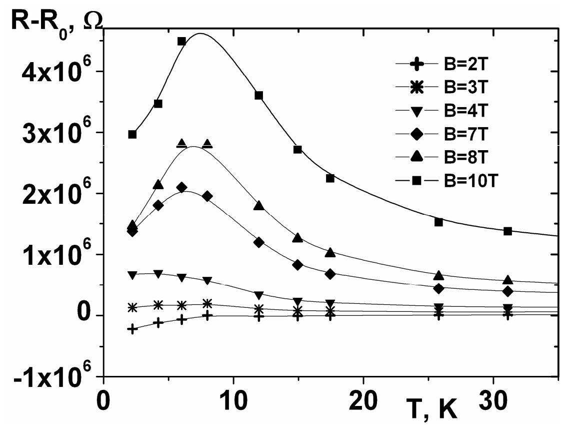


Fig. 6. – The magnetic field induced metal-insulator transition observed in mesoscopic honeycomb-shaped networks

DNA ON SEMICONDUCTOR ENGINEERED NANOSTRUCTURES

We developed a method of nanostructured surfaces on Si substrares for DNA molecules separation according their molecular weights and a method of DNA sharp loading (Fig. 7) [22–27].

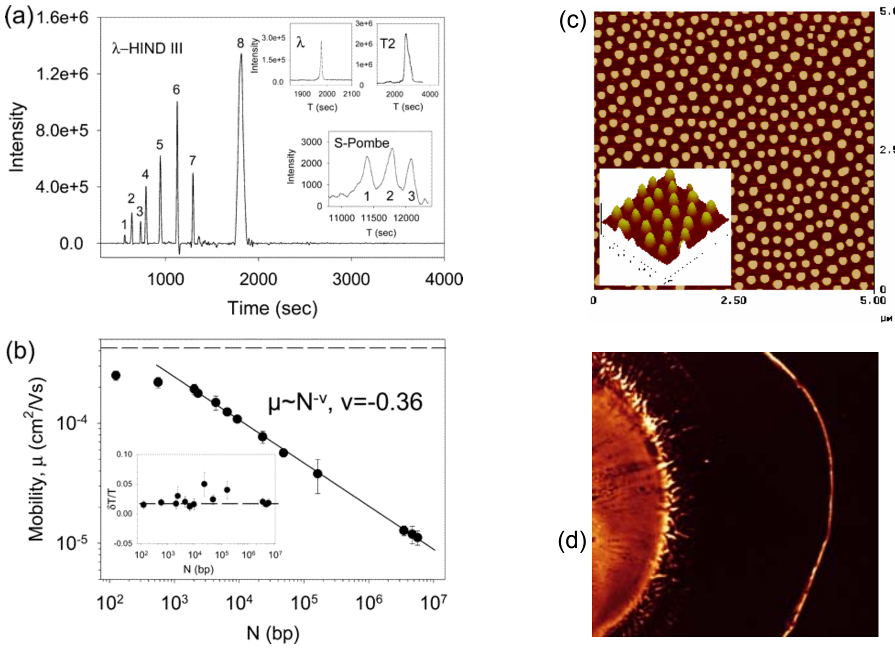


Fig. 7. – (a) The fluorescence intensity was detected as a function of time for λ-Hind III Digest, insets: λ, T2, and chromosomal S. Pombe DNA, (b) The mobility of double stranded DNA (μ) as a function of the molecular weight in base pairs (*N*). The dashed line at the top of the figure corresponds to the mobility of free draining DNAs, c) the AFM image of the nanostructured Si surface for DNA separation; d) the confocal microscope image of the sharp DNA molecules loading due to the effect of "coffee ring"

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МОДЕЛИРОВАНИЕ ПРИБОРНЫХ СТРУКТУР НА ОСНОВЕ ГРАФЕНА

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В докладе рассматриваются результаты моделирования электрических характеристик полевых графеновых транзисторов и резонансно-туннельных диодов на основе графена в зависимости от различных факторов. Результаты получены с применением предложенных моделей данных приборных структур наноэлектроники.