### Properties of systems with carbon nanotubes based on the swift heavy ion track technology

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Investigations of electronic elements with nanometric carbon-based materials are very prospective at present. These systems can have a number of functional advantages as being compared with traditional semiconductor systems. On this concern a development of methods of the carbon nanotubes (CNT) synthesis in nanopores created by the swift heavy ion tracks technology in $SiO_2$ on a silicon substrate is important. This method is connected with irradiation of $SiO_2$ thin layers by Au ions at energy of 350 MeV and fluence of ~ 1E9 cm–2, when latent ion tracks are formed there. Subsequent chemical etching leads to the formation in silicon oxide of conical nanopores with average diameter ~ 150 nm and density of ~ 1E8 cm–2, in which Ni clusters were deposited electrochemically. Investigations of CNTs growth processes in nanopores by the PCVD method has shown that structure and type of carbon-based systems depend on a degree of nanopores filling with Ni catalyst. In the case of a not complete filling (about 50%) of nanopores CNTs appeared, and at a complete filling of nanopores SiC wiskers growth have been observed. This fact was confirmed by Raman spectroscopy studies. Samples with CNTs have demonstrated a high efficiency of field emission, with the threshold less than 1 V/μm. A light emission of CNT array was found which showed high stability and homogeneity. Optimal values of interelectrode distance and applied voltage which provide a large light emission area were determined.

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## Session «Nanostructures synthesis and characterization II (ISTC Workshop)»

### SERS substrates on the base of semiconductor self-assembled quantum dots Ge-on-Si nanostrustures to characterize inorganic microcrystals

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Semiconductor self-assembled quantum dot Ge-on-Si structures were successfully employed as Surface-Enhanced Raman Scattering (SERS) substrates to characterize ultramarine blue inorganic art pigment. This nanostructures were grown by chemical vapor deposition (CVD) with using $SiH_2Cl_2$ and $GeH_4$ as reactive gases in an H2 atmosphere at ptot = 0.1 Torr. In the result of self-assembled process the germanium pyramids with a square base has been formed on the silicon surface. After vacuum deposition of Au on top of these structures, they allow to detect SERS spectra of ultramarine blue inorganic art pigment. The observed enhancement factors are different for different bands ranging from approximately one order of the magnitude for the principal bands to two orders of the magnitude for overtones and linear combinations of principal modes. Theoretical modeling predicts 10^10-fold enhancement in close vicinity of a silver spherical nanoparticle (0.24 nm) with rapid decay of enhancement factor to 1 in the range of approximately 50 nm. Experimental enhancement factor is treated as overall effect within the small portion of every microcrystal in the close vicinity of silver nanoparticle(s) and exceeds the value of 10^6. These results can be considered as importance extension of traditional surface enhanced molecular Raman spectroscopy towards bigger inorganic probes and purposefully used in cultural heritage examination.

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