

DNA-templated silver nanowires on silicon surface

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New challenges of solid-state electronics oblige to search the methods for nanosize devices creation. One way of solving this problem is to use self-organizing processes at the molecular level. Biological molecules are an attractive material for this. In particular, DNA molecule possesses some unique properties: great rigidity of a molecular chain, high charge density and 2 nm diameter of helix. These properties open the comprehensive facilities for manufacturing of new devices on the base of DNA for nanoelectronics. High resistance of DNA complicates its application in electronic schemes. Modification of DNA by metal allows to increase the conductivity considerably. Thus, it is possible to produce ultrathin nanowires from various metals, or nanoclusters on a surface of a DNA molecule. It is called as DNA-templated self-assembly. DNA nanowires can be useful, for example, for manufacturing of field transistors and other elements of nanoelectronic devices, and as high-sensitivity biosensors. The unique method of creation of DNA-sample silver nanowires was carried out in our work. It is based on chemical reduction of binding with DNA silver ions. The special process of DNA fixation on n-type silicon surface makes macromolecules are gathered into fibrils. The realization of metallization process provides the forming of extended nanowires with the length of several micrometers, consisting of Ag^0 clusters with diameter about 30 nanometers. Novelty of a described method consists of two things. First, the using of silicon reducing properties is a key moment of this method. This helps to minimize the number of chemical reagents. Second, the best result of metallization was obtained not for a single DNA molecule but for fibrils of oriented DNA chains generated on silicon surface. So, all that techniques allow to simplify considerably procedure and to achieve more efficiency. The explanation of the possible mechanism of metallization is offered, and, for its proof, the comparative analysis of metallization of DNA molecules fixed on mica, glass and p-type silicon surfaces is provided. Thus we have shown that the concentration of free electrons plays the most important role in the process of metallization. Images of DNA molecules and fabricated nanowires have been obtained using the atomic force microscope (AFM) and the scanning ion helium microscope (SIHM) *.

Reference:

Metallization of DNA on silicon surface, Puchkova A. O., Sokolov P., Kasyanenko N. A., Petrov U. V.// Journal of Nanoparticle Research (in press)

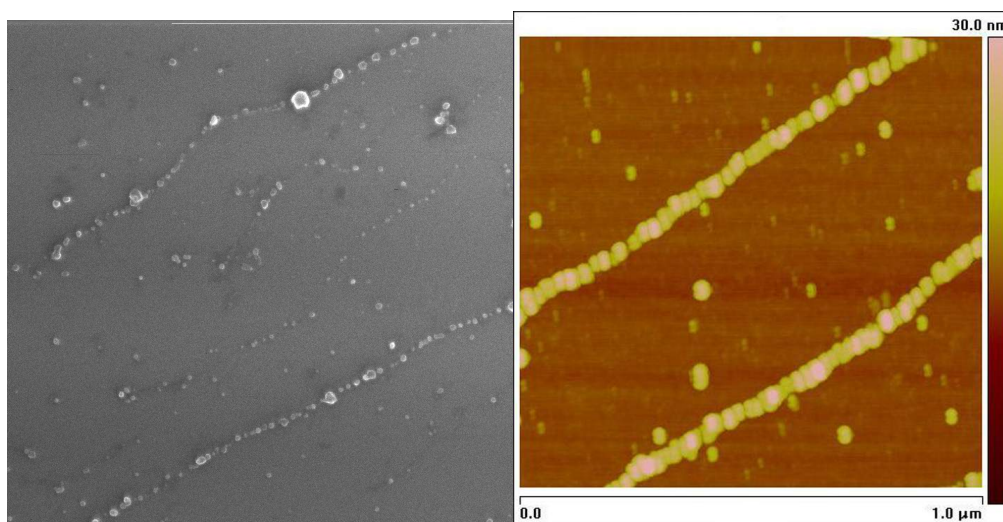


Fig.1. DNA-templated silver nanowires on n-type silicon surface. Left: scanning ion helium microscope image (scan size 1.5 μm); right: AFM image.

(*) Interdisciplinary Resource Center for Nanotechnology of St-Petersburg State University.