Sample Preparation Methods

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Sub-10 nm nanomodification of GaAs nanowires with Helium ion microscope

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The development of the methods of local modification of the crystalline nano-objects without damaging their crystal structure can open a great opportunity for the study of more subtle physical effects and to manufacture new types of nano-devices.

The most direct way to modify the shape of nanowires including the drilling of nanoholes is ion beam sputtering of the material. This technique when used with commonly available Ga-FIB does not allow one to modify the whiskers with the diameter of few tens of nm due to a big interaction volume caused, In turn, by a big ion mass and strong ion backscattering. Another problem of nanomodification is a damage of treated surface.

In this work we performed experiments on nanomodification of GaAs nanowire with lighter ions-Helium – with the help of Scanning Helium Ion Microscope (HeIM) - Zeiss Orion (Fig. 2). In spite of the fact that sub 10-nm sputtering in HeIM was previously described [1], destruction of lattice and formation of amorphous layer nearby treated area is still not clearly understood.

The samples under the modification were GaAs nanowhiskers of different crystal structure (sphalerite, wurzite, core-shell etc) with the thickness of 50-100 nm and the lengths of 1-10 um.

The experiments included the drilling the openings under diverse angles with respect to crystal axes and the analysis of the resulting structure with HR-TEM (Fig. 2).

For the first time we showed that holes with the diameter as small as 10 nm surrounded with the amorphous layer is 2-5 nm thickness can be easy obtained by proper chosen parameters of the experiments. More detailed description of the experimental procedure, its advantages and limitation will be presented at the Conference.

1. Experimental data presented in this work were obtained using the equipment of Interdisciplinary Resource Center for Nanotechnology St. Petersburg State University, Russia [2]. This work is supported by a grant RFBR No. 12-02-01132-a.
2. .D. Winston, B.M. Cord, B. Ming, D.C. Bell and all J. Vac. Sci. Technol. B 27, 2702 (2009)
3. .Htpp://nano.spbu.ru

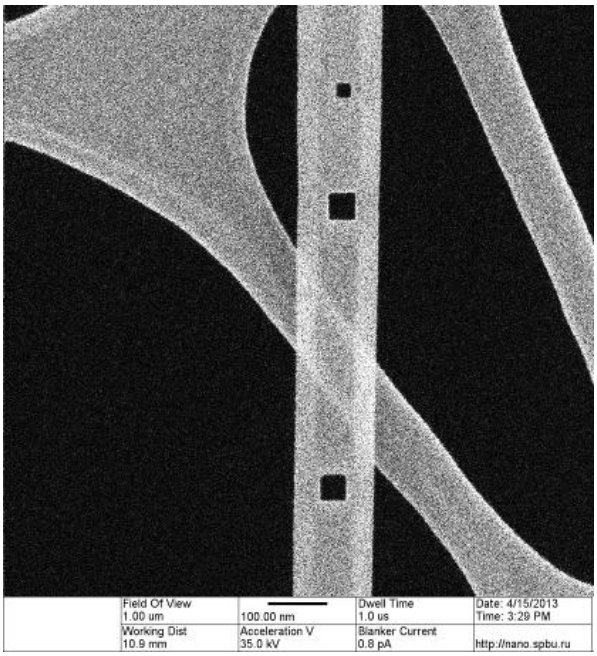

Figure 1. HeIM image nanomodification of GaAs nanowire.

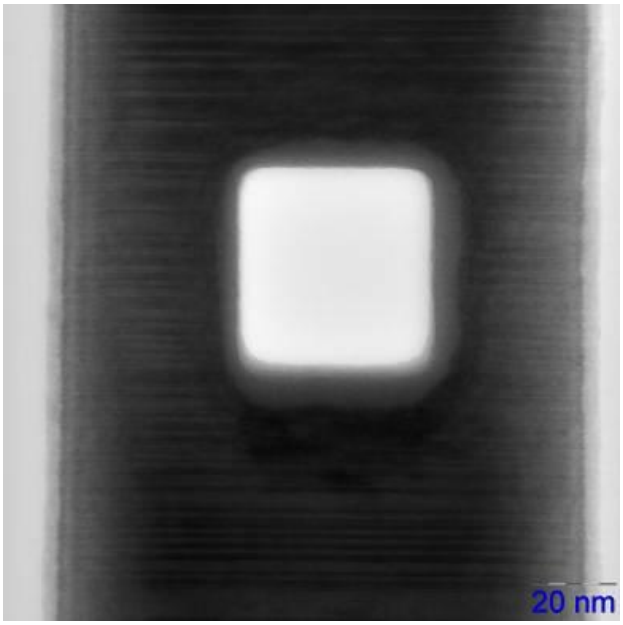

Figure 2. TEM image nanomodification of GaAs nanowire.