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Investigation of profiling of silicon surface by local anodic oxidation nanolithography for memristors crossbar architecture creating

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To date the need to improve the lithographic methods in the production of nanoelectronics elements in order to ensure the accuracy and reproducibility of the nanoscaled structures is a fundamental problem in this field. One of the most promising lithographic procedures is local anodic oxidation (LAO) providing high levels of spatial resolution and reproducibility, as well as the direct modification of the substrate surface without the need for supplementary operations typical of photolithography. We offer a methodology for developing a method for creating a crossbar architecture.

The nanoscaled profiling of a silicon 5 (111) n-type substrate surface is studied by the LAO. First, the substrates were subjected to the LAO nanolithography in the atomic force microscopy (AFM) contact mode on an Ntegra probing nanolaboratory (PNL) (NT-MDT, Russia) using NSG 10 cantilevers with a conductive Pt coating. Varying the voltage pulse amplitude from 5 to 12.5 V and the humidity from 30 ± 1 to $70 \pm 1\%$ during the LAO is a promising way to form oxide nanostructures(ONS) with heights from 0.5 ± 0.3 to 2.1 ± 0.1 nm and profiled nanostructures (PNS) with depths from 0.4 ± 0.3 to 1.5 ± 0.2 nm on the substrate (Fig. 1).

The results can be applied to the development of technological processes of the element base of silicon-based nanoelectronics using the probe nanotechnologies.

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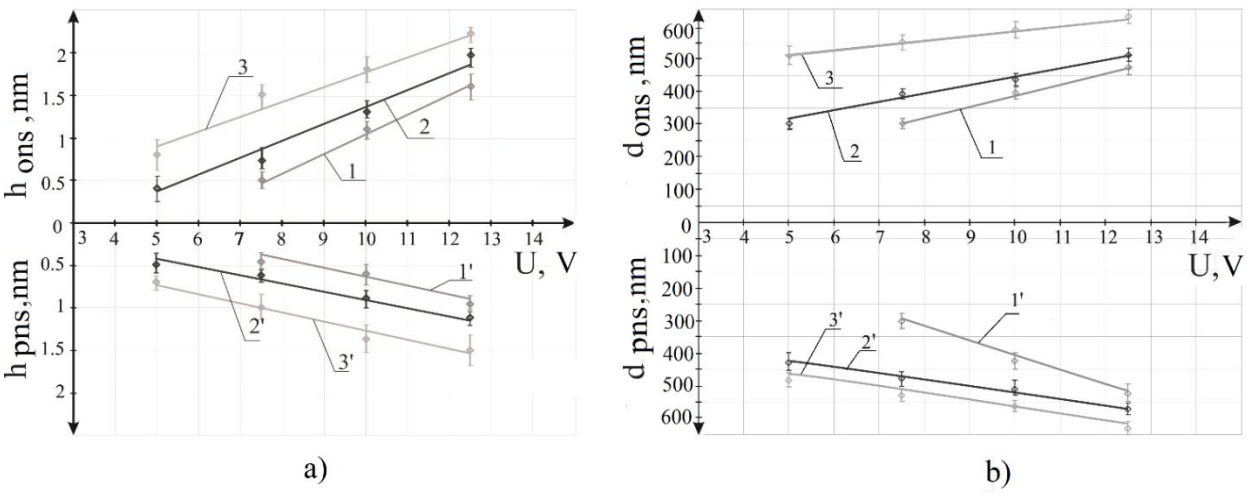

Figure 1. Geometric parameters of nanostructures vs. voltage amplitude during LAO at various values of relative humidity (*1*, *1'*, $30 \pm 1\%$; *2*, *2'*, $50 \pm 1\%$; *3*, *3'*, $70 \pm 1\%$): (a) heights of ONSs (*1-3*) and depths of PNSs (*1'-3'*); (b) diameters of ONS (*1-3*) and PNS (*1'-3'*).