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Nanoprofiling of GaAs Surface in a Combined Low-Temperature Plasma for Microwave Devices

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Abstract : In this paper, the problems of existing methods of profiling and surface modification of nanoscale arsenide-gallium structures are analyzed. The use of a combination of methods of local anodic oxidation and plasma chemical etching to solve this problem is considered. The main features that make this technology one of the promising areas of modification and profiling of near-surface layers of solids are demonstrated. In this paper, we studied the effect of formation stress and etching time on the geometrical parameters of the etched layer and the roughness of the etched surface. Experimental dependences of the thickness of the etched layer on the time and stress of formation were obtained. The surface analysis was carried out using atomic force microscopy methods, the corresponding profilograms were constructed from the obtained images, and the roughness of the etched surface was studied accordingly. It was shown that at high formation voltage, the depth of the etched surface increased, this is due to an increase in the number of active particles (oxygen ions and hydroxyl groups) formed as a result of the decomposition of water molecules in an electric field, during the formation of oxide nanostructures on the surface of gallium arsenide. Oxide layers were used as negative masks for subsequent plasma chemical etching by the STE ICPe68 unit. BCl_3 was chosen as the chlorine-containing gas, which differs from analogs in some parameters for the effect of etching of nanostructures based on gallium arsenide in the low-temperature plasma. The gas mixture of reaction chamber consisted of a buffer gas NAr = 100 cm^3/min and a chlorine-containing gas $NBCl_3$ = 15 cm^3/min at a pressure P = 2 Pa. The influence of these methods modes, which are formation voltage and etching time, on the roughness and geometric parameters, and corresponding dependences are demonstrated. Probe nanotechnology was used for surface analysis.

Keywords : nanostructures, GaAs, plasma chemical etching, modification structures
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