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AFM-investigations of the surface morphology of V_2O_5 / $A^{III}B^V$ heterostructures

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Vanadium pentoxide deposited on the surface of $A^{III}B^V$ by different methods is an effective chemostimulator of the semiconductors thermal oxidation. The purpose of this research is Atomic Force Microscopy investigation of the dependence of the V_2O_5 / $A^{III}B^V$ heterostructures surface morphology on the method of vanadium pentoxide thin films deposition and conditions of heterostructures thermal oxidation.

The objects of the study were mechanically carved wafers of GaP (100) and GaAs (111) with chemically polished surface. V_2O_5 thin films were deposited by magnetron sputtering (hard method, film thickness 30 nm) and by deposition of vanadium pentoxide gel through aerosol phase followed by thermal annealing (soft method, film thickness 8 nm [1]).

The surface of V_2O_5 / GaP heterostructures formed by magnetron sputtering before the thermal oxidation was smooth, the film had a pronounced grain structure with an anisotropic shape of the grains. The relief height did not exceed 20 nm. After 60 minutes of thermal oxidation in oxygen at 650 °C the surface of films changed due to interactions between the film and semiconductor substrate. The relief height increased to 30–40 nm (Figure 1, a), wherein the surface roughness became equal to 9.07 nm against 2.34 nm for non-oxidate structure (the area scan 3x3 nm^2).

The surface of V_xO_y / GaAs heterostructure formed by the soft method before oxidation had the relief with a height about 10–12 nm, the film had a grain structure with a grain size of about 40–80 nm. As a result of thermal oxidation at 530 °C for 60 min the height of the relief slightly varied (Fig. 1, b), the film remained smooth and the grain structure became less pronounced. The roughness was reduced from 1.60 nm to 0.78 nm (the scan area 3x3 mm^2). Thus, differences in the surface morphology of V_2O_5 thin film deposited on the surface of GaAs and GaP wafers by magnetron sputtering and deposition throw aerosol phase were determined by AFM method. It was shown that the mild method of V_2O_5 deposition provides the formation of more smooth surfaces, both before and after thermal oxidation of V_2O_5 / $A^{III}B^V$ heterostructures.

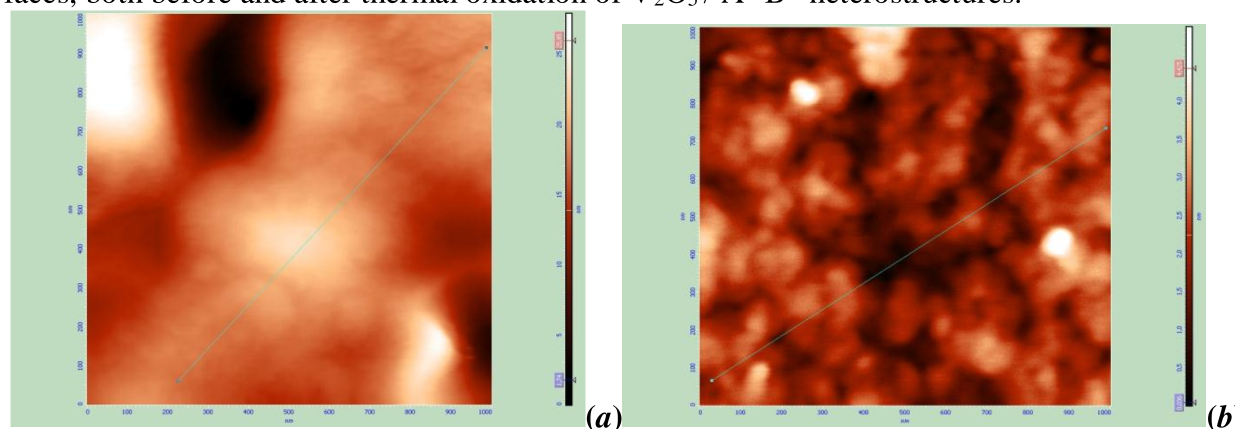

Fig. 1 AFM–images of the V_2O_5 / GaP surface (650 °C) (*a*) and V_xO_y / GaAs (530 °C) (*b*) heterostructures oxidized during 60 min (scanning region 1x1 μm)

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References

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