Nanostructured surfaces

Nanoscale Pattern Formation on the Surface of HgCdTe Produced by Ion Bombardment

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Low-energy-ion bombardment of semiconductors can lead to a remarkable variety of self-assembled nanoscale patterns whose electronic and optical properties are different from those of bulk materials and might find technological application. The first type of the discovered structures was the periodic height modulations (“ripples”). According to the Bradley-Harper theory, ripples are a result of a surface instability caused by the curvature dependence of the sputter yield. Ion implantation in HgCdTe (MCT) is commonly used method for fabricating IR sensitive photovoltaic devices. In the work reported here, we focused on the use of ion beam radiation to fabricate nanostructures on the HgCdTe surface for creation of a new class efficient photo-converter.

Presented in this work are the results concerning formation of nano-heterostructures Ag_2O-$Cd_xHg_{1-x}Te$ ($x = 0.2$) on the surface of a ternary compound $Hg_{1-x}Cd_xTe$ ($x \sim 0.223$). Modification of this ternary chalcogenide semiconductor compound was performed using the method of oblique-incidence ion bombardment and normal-incidence ion bombardment with silver ions, which was followed by low-temperature treatment. The energy and dose of implanted ions were 100 keV and $(34.8)\cdot 10^{13}$ cm^{-2}, respectively.

Optical, atomic force and scanning electron microscopy methods were used for the surface topography characterization. The structural properties of MCT-based structure was analyzed using double and triple crystal x-ray diffraction to monitor the disorder and strain of the implanted region as a function of processing conditions. It was found the presence of some features on the impedance hodograph indicating a characteristic resonance levels for the charge transfer process in nano-structured material and, as a result, an appearance of the inductive type impedance.

The observed effect of nano-structuring can be useful from the viewpoint of developing a new class of electro-optical facility based on MCT that possesses a necessary combination of optical, electro-physical and photoelectric properties.