Nanostructured surfaces

Nano-structured silicon surface via cavitation processing for the photovoltaic and biomedical application

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Extreme conditions of the ultrasonic cavitation such as local temperature and the pressure are widely used to synthesize nano-materials, to enhance the electrochemical reactions and to modify the surface properties of electrodes, as well as to generate the novel materials in a liquid medium [1, 2]. The ultrasonic irradiation is a powerful tool in promoting of the chemical reactivity in the liquids at solid surfaces also. In our experiments described here, an attempt to drive the chemical and structural transformations on a semiconductor surface by the ultrasonic cavitation effect was made.

The properties of the silicon samples subjected to cavitation impacts have been studied. Boron-doped *p*-type silicon (wafers grown by the liquid-encapsulated Czochralski method, with diameter about 76.2-mm, one-side polished), with a (100) surface crystallographic orientation, were used in this study. It was shown that high-intensity (15 W/cm^2) and high-frequency (1 ÷ 6 MHz) sonication of silicon samples in the liquid nitrogen induces changes of the physical, chemical, and structural properties of semiconductor surface. Optical, atomic force and scanning electron microscopy techniques, Raman spectroscopy as well as energy dispersive X-ray spectroscopy and X-ray diffraction measurements were used. It was found the dendrite-like micron-scale array formation as well as a change of the chemical composition up to the new phase occurrence inside the ultrasonically structured region. The possibility of the multifunctional application of the nanostructured silicon surface is discussed.

1. *Bang J.H., Suslick K.* Applications of ultrasound to the synthesis of nanostructured materials // Adv. Mater. -2010.- **22.-** P. 1039-1059.
2. *Savkina R. K.* Recent progress in semiconductor properties engineering by ultrasonication // Recent Patents on Electrical & Electronic Engineering. - 2013. - **6**. - P. 157-172.