MICROSTRUCTURE AND OPTICAL PROPERTIES OF THE BLACK SILICON LAYERS

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In order to achieve a high efficiency of semiconductor solar cells and for many optoelectronic applications, it is necessary to reach low spectral reflectance of the formed structures. Several methods can be used to form such structures. The formation of antireflective layers is often used in industry. Reflectance is reduced only within the narrow wavelength range in this case. In our research projects, we use techniques of anisotropic alkaline etching for the preparation of pyramidal textures on Si. Spectral reflectivity decreases to 10% level. Simple and cost-effective procedures of the structure forming are based on the chemical etching of Si surface in a solution with a catalytic effect of metals. By using these etching methods the spectral reflectance substantially decreases in a wide interval of wavelengths. In this work, methods of chemical etching in HF + H2O2 solution with catalytic effect of Pt and electrochemical etching of Si in solution HF + ethylalcohol were used in the preparation of nanostructures on silicon surface. In order to optimize the structure formation process, it is necessary to monitor the development of the microstructure of the samples and their optical properties. The non-Euclidean fractal geometry methods were used in the study of microstructure development. The optical properties of the formed porous black silicon layers were modeled in multilayer geometry using several effective media approximations. By using this approach for describing the dispersion properties of the dielectric function the porosity distribution in volume of inhomogeneous layers was determined. The development of the optical properties of the structures during the forming procedure is directly determined by the changes of the microstructure in the individual steps of etching.