Nanostructured surfaces

Influence of Si nanowires on solar cell properties

A.A. Evtukh[1,2], P.V. Parfenyuk[1], I.I. Ivanov[2], O.V. Steblova[2], I.M. Korobchuk[2], O.O. Gavrylyuk[3], O.Yu. Semchyk[3]

[1] *V. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine 41 pr. Nauki, 03028, Kyiv, Ukraine, E-mail: anatoliy.evtukh@gmail.com*

[2] *Institute of High Technologies, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine.*

[3] *Chuiko Institute of Surface Chemistry, NASU, General Naumov Str. 17, 03164 Kyiv, Ukraine.*

The vertical Si nanowires have been formed on Si wafers by metal-assisted chemical etching. The formation process included Ag nanoparticles deposition from $AgNO_3$/ HF solution with following etching in H_2O_2/HF mixture. As a result the nanowires (nanorods) with diameter in range from 60 nm to 250 nm and as high as 2.3 μm have been obtained. Such structure of Si surface allows to minimize the light refraction. As can be observed in light refraction spectra, in case of nanowires on Si surface the light refraction was as low as 1 % in wide spectral range (for comparison in case of flat Si surface it is up to 30 %). Optical absorption depends on diameter and periodicity of nanowire arrays. As it was shown in work [1] the optimal light absorption is realized at nanowire diameter to periodicity ratio of 0.8.

It is known that solar cells parameters degrade at higher temperature. The influence of nanowire diameter and periodicity on solar cell temperature has been modeled by us base on the numerical calculation of the heating under influence of light with intensity of 1 kW/m^2. The dependence of solar cell temperature on nanowire periodicity on its surface is shown in Fig. 1. As can be seen, the temperature in case of nanowires is distinctly lower than at flat surface and it decreases with the increase of nanowire periodicity.

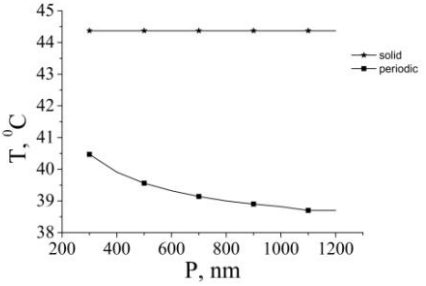

Fig. 1. Influence of Si nanowire periodicity on solar cell temperature (I = 1 kW/m^2).

1. Hu L., Chen J. Analysis of optical absorption in silicon nanowire arrays for photovoltaic applications // Nano Lett.-2007.**-7.-**P. 3249-3252.