Nanostructured surfaces

Silicon nanostructures produced by modified MacEtch method for antireflective Si surface

S.I. Nichkalo[1], A.A. Druzhinin[1], A.A. Evtukh[2], O.L. Bratus'[2]

[1] *Department of Semiconductor Electronics, Lviv Polytechnic National University, S. Bandera Str., 12, Lviv-79013, Ukraine*
E-mail: nichkalo@gmail.com

[2] *V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, pr. Nauki, 41, Kyiv-03028, Ukraine*

A recently developed metal assisted chemical etching (MacEtch) is essentially a wet etching method that produces anisotropic high aspect ratio semiconductor micro- and nanostructures without incurring lattice damage [1]. For example, MacEtched Si nanowires (NW's) reduce optical loss, enhance optical absorption, and improve carrier extraction for high performance and low cost solar cells (SC). At the same time, high aspect ratio NW's enhance absorption through superior light trapping mechanism, allowing significantly thinner structures thus reduced material cost. This is especially important for Si because of the low absorption cross-section inherent to its indirect bandgap, which requires tens to hundreds of times thicker materials for complete absorption compared to direct bandgap material SC. As it was shown previously [2], micro- and nanotexturization of the Si wafer by CVD grown Si NW's and MacEtched nanopores enhance an optical absorption. However, because of random distribution and non-controllable orientation of Si NW's, as a result of vapour-liquid-solid crystal growth, the efficiency of such SC was still low. In this work we considered and analyzed the technological features of MacEtch producing Si NW's and nanoporous Si with the right size and density. In particular, Si NW's with diameters about 200-600 nm, and nanopores with an average diameter of 200 nm were obtained on Si wafer. Using various patterns formed from thermal evaporated Au thin film and deposited from solution phase Ag network, vertically oriented Si NW's and ordered nanoporous structures were produced. It was found, that optical properties of such structures were significantly improved in comparison to CVD grown Si NW's.

1. *Li X.* Metal assisted chemical etching for high aspect ratio nanostructures: A review of characteristics and applications in photovoltaics // Current Opinion in Solid State and Materials Science.-2012.-**16**, N 2.-P. 71-81.
2. *Druzhinin A., Yerokhov V., Nichkalo S., Berezhanskyi Y.* Micro- and nanotextured silicon for antireflective coatings of solar cells // Journal of Nano Research.-2016.-**39**.-P. 89-95.