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FORMATION OF MICRO-CONES ON A SURFACE OF Ni/Si STRUCTURE BY Nd:YAG LASER RADIATION

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For formation of micro-cones on a surface of a semiconductor very often are used femtosecond laser induced plasma [1] or chemical vapor depositions with catalytic metal on Si [2]. We propose another method for formation of micro-cones by basic frequency of microsecond Nd:YAG on Ni/Si structure. It was observed self-organization of cone-like microstructures on a surface of Si with Ni covered layer with thickness 30 nm by Nd:YAG laser beam at threshold intensity 3.15 MW/cm^2. The structural and optical characteristics of micro-cones where studied by optical microscope, scanning electron microscope (SEM) and Raman back scattering spectroscopy. Optical microscopy study of the irradiated sample surface by Nd:YAG laser beam has shown formation of islands with diameter less than 1 μm. The micro-chemical analysis by means of SEM has shown that the islands consist of $NiSi_2$ or Ni. It means the new phase of $NiSi_2$ is formed. An evidence of our suggestion is appearance of phonon line at 225 cm^{-1} attributed to Ni-Si vibration in Raman back scattering spectrum. The further increase of the laser intensity and number of laser pulse leads to formation of cone-like microstructures with Ni on the top of cone and maximal height up to 100 μm. The control of micro-cone shape and height was achieved by changing laser radiation intensity and number of pulses. Irradiated region of the structure with maximal intensity 4.5 MW/cm^2 and 22 numbers of pulses, becomes black.

Experimentally we have found a possibility to form "black" silicon for solar cells and silicide - $NiSi_2$ for microelectronics by laser radiation.

References:

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2. Minsung Jeon, Hisashi Uchiyama, Koichi Kamisako, Materials Letters 63 (2009) 246–248