Muhammad Rizwan Khalid

Antireflection Patterning of Si for InAsSb Nanowire Infrared Photodetectors

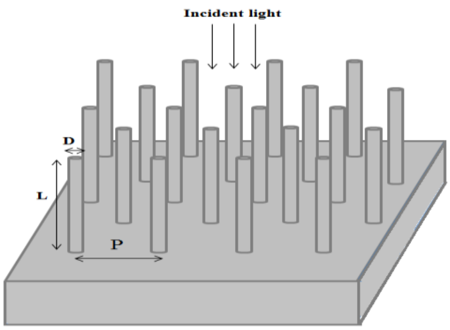
The resonance enhanced wavelength specific transmission of long wavelength infrared radiation LWIR (8-15 µm) through silicon (Si) pillars is reported. High transmittance 94 % of Infrared at the wavelength of λ = 11 µm was obtained from Si pillar arrays having mean diameter 2.48 µm ± 62 nm. Variation in Si pillar diameter gives the high transmission peak at different wavelengths. It is concluded that by choosing specific parameters such asdiameter, length or period the wavelength specific transmission of infrared light through the arrays of Si pillars can be achieved.

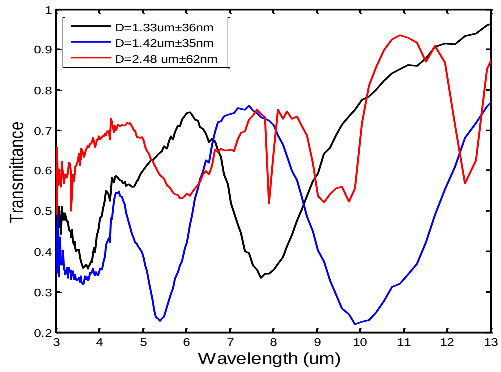
An effective solar cell should convert as much of the solar light into electricity. One way to achieve this is to minimize reflection losses.Wavelength specific transmission of Infrared radiation is also desirable for photodetectors which are used in planes and satellites.The pattering of an optical surface with physical features to get low reflectivity and high transmission of infrared or visible light can be used for antireflective windows for solar cells and photodetectors.Transmission properties of silicon make it suitable for the infrared region. With an indirect band gap of 1.11eV at 300K, Silicon absorb only light with at least that photon energy. Here we present results on antireflective patterning of Si for back side illuminated InAsSb nanowire LWIR photodetectors. Photolithography and dry etching techniques are used to pattern Si into uniform pillars and by using a Fourier Transform Infrared Spectrometer (FTIR) we measure the transmittance. Besides, we use numerical simulations to investigate the dimensions of Si pillars.

Results - Resonance enhanced wavelength specific transmittance of Infrared through Si pillars

Results from transmittance measurements are in good agreement with the numerical simulations. It was found that the transmission of infrared through untreated Si is 53% which is independent of wavelength.

Arrays of Si pillars with mean diameter 1.33 µm ± 36 nm show a transmission peak at the wavelength of 6.2 µm. An Si pillar array with mean diameter 1.42 µm ± 35 nm shows the transmittance peak shifted to a wavelength of 7.5 µm. The results show that the transmission peak position is highly dependent on geometrical parameters of Si pillars. By controlled variation in diameter, pitch or length of Si pillars, the resonance enhanced transmission peak can be tuned at different wavelengths. We conclude that the tunable transmission of infrared light through Si pillars is highly diameter dependent.





Supervisor: **Johannes Svensson**
Degree Project 30 Credits, VT 2014
Department of Physics, Lund University