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Self-organized nano-voids in irradiated SiGe/Si hetero-structures for plasmonic application

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The formation of new Si-based materials with enhanced light absorption is of great importance for the development of high efficient photodetectors and photovoltaic devices. Light scattering and excitation of localized surface plasmons due to interaction with nano-cavities, metallic nano-shells and nano-particles leads to enhanced light absorption. The present study is devoted to strain-assisted formation of 2D array of optically active nano-voids and dots self-organized nearby to p-n junction.

Strained layers of Si/SiGe(Sn)/Si are grown in a solid-source MBE machine. The samples are then irradiated with H^+ or He^+ ions followed by high temperature annealing to create the layer of nano-voids and segregation of metallic impurities into the voids. Optical measurements of the Si/SiGe(Sn)/Si samples show a successive increase of the reflectivity in the spectral range of 800-1800 nm after deposition, irradiation and high temperature annealing.

We will briefly review the effects of strain-driven nano-void formation in Si/SiGeSn layers, gettering and segregation of impurities and formation of buried nano-shells and nano-dots of Ge, Sn and Au in Si layers. It will be discussed in the talk that metallic nano-shells possess tuneable optical resonances. By varying the relative core and shell thicknesses, the absorption and scattering properties of metallic nano-shells can be varied in a broad range. Finally, special attention will be devoted to possible plasmonic structures for enhancement of the efficiency of Si-based devices.