Photonic nanostructures for multispectral optoelectronic applications

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Nanostructured materials display light absorption properties that differ substantially from their bulk material due to the size dimension being much smaller than the wavelength of the incident light. On excitation, such nanostructures exhibit an ensemble of radial, Bloch, and Fabry-Perot modes that can be resonantly tuned through the manipulation of structural parameters. The tuning of optical qualities is a powerful tool and has applications in narrowband filtering, spectroscopy, and multispectral imaging. In this presentation, we present two directions of research 1) active Si nanowire spectral photodetectors and 2) mechanically tunable color filters in TiO_2.

As an active detector, we report on a non-conventional radial heterojunction photodiode obtained by a conformal coating of the indium oxide layer on Si nanowire arrays. We achieved a virtual p-n junction using electrostatic doping. We also studied arrays of TiO2 nanostructures fabricated on elastic membranes as robust and mechanically modulable color filters that preserve very sharp, variable frequency spectral bands through the spatially dimensional change of the pitch of nanophotonic structures.