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Semiconductor Nanowires: Engineering Light at Nanoscale

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Semiconductor nanowires funnel light at certain wavelengths due to resonant excitation of optical modes. This results in enhanced optical absorption which can be used to engineer exciting optical properties. In this talk, we will describe the various optical properties that arise from the resonant excitation by comparing experimental optical absorption studies in different semiconductors including silicon, amorphous silicon and gallium arsenide. We will also demonstrate novel devices using these optical properties including multispectral absorption, biochemical sensors, enhanced photo thermal conversions and resonant conversion of amorphous silicon into crystalline silicon. We will show that the resonant wavelengths depend nearly linearly on the diameter of the nanowires. Further, near field coupling between nanowire in an array result in excitation of photonic Bloch modes resulting in red shifting of the resonant wavelengths from the waveguide modes. We will also show nanowires as short as 150 nm exhibit optical mode excitation and strong longitudinal modes. These optical properties can be used to generate exciting new applications and we will demonstrate optical biochemical sensors with a refractive sensitivity of $1E-5$ using low cost LEDs for excitation and a camera as a detector. We will also demonstrate a platform for colorful solar cells where certain wavelengths are reflected to generate the color but overall absorption is nearly doubled with respect to a thin film solar cell.

Semiconductor nanowires provide an exciting platform for engineering different optical absorption profiles.

Biography:

Simarjeet Singh Saini is an Associate Professor at University of Waterloo in the Department of Electrical and Computer Engineering. He is also the co-founder and Chief Scientific Officer for Savormetrics Inc., a start up company developing low cost optical solutions for determining quality of food. Further, he is the co-founder and Chief Technology Officer for Nanolytix Inc., a start up company developing optical sensors for water quality measurements. He has a Doctorate from the University of Maryland and a B.Tech (Hons.) from the Indian Institute of Technology, Kharagpur. He has published over 200 papers in areas involving photonics integrated circuits, semiconductor nanowires, optical biochemical sensors and high power lasers.