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Emerging Semiconductor Nanostructures for Photonic and Piezotronic Devices

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Semiconductor nanostructures are attractive for high performance electronic and photonic devices. A review of our work on low dimensional semiconductors including 2D transition metal-dichalcogenides for emerging photonic and piezo-phototronic devices will be presented. Semiconductor nanowires and their radial heterostructures have been demonstrated to be useful for nanophotonic applications. Our results on single Si nanowire based polarization sensitive near-infrared photodetector exhibiting ultra-high responsivity will be discussed. Tunable light-matter couplings in dissimilar constituents (metal & semiconductors) play a leading role in the development of two-dimensional (2D) quantum hybrids along with their applications in Si-photonics. Wafer scale, vertical 2D/3D hybrid heterojunctions using two-dimensional metal dichalcogenides layers and nanocrystals have been realized on 3D Si platforms. The heterojunctions exhibit excellent photodiode characteristics suitable for multifunctional devices with significantly enhanced spectral response, making them attractive for Si CMOS compatible photonic devices. On the other hand, the results on ultrafast pump-probe spectroscopy will be presented to detect the generation and evolution of individual bright exciton-plasmon polaritons (bright plexcitons) in self-assembled size-tunable Au nanostructure-layered WS₂ quantum hybrids. Finally our recent results on the use of piezo-phototronic effect controlling the interfacial carrier dynamics to achieve next generation optoelectronic devices will be discussed.

Keywords: Semiconductor, SiGe, Nanostructures, Si heterostructures

Biography:

Prof. Samit K. Ray is currently a Professor in the Department of Physics, IIT Kharagpur. He has previously served as the Director S. N. Bose National Centre for Basic Sciences, Kolkata, Dean (Post-graduate & Research Studies), Head, Department of Physics and founder Head, School of Nanoscience and Technology, IIT Kharagpur. His research interests are in the area of semiconductor nanostructures, quantum dots, photovoltaics and nanophotonic devices. He has also served as a visiting faculty/scientist at the Tokyo Institute of Technology, Japan, University of Delaware, USA, University of Texas at Austin, USA, Queens University of Belfast, UK and Chang Gung University, Taiwan. Prof. Ray is a fellow of the National Academy of Sciences India, Indian National Academy of Engineering, West Bengal Academy of Science & Technology and is the recipient of INSA Young Scientist Award, UGC Homi Bhabha Award, MRSI Superconductivity & Materials Science Senior Award etc. He has published more than 380 research papers in peer reviewed journals, seven book chapters and co-authored a book on "Strained Silicon Heterostructures: Materials and Devices" published by IEE, UK.

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