Manipulating Light at the Nanoscale: From Energy Conversion to Nanomedicine

Rizia Bardhan

Upon illumination, metal nanostructures with subwavelength dimensions couple incident photons to conduction electrons giving rise to localized surface plasmon resonances (LSPR). By altering the morphology and composition of metal nanostructures, these LSPRs can be manipulated to generate unique optical characteristics that can be utilized for a range of technological applications from nanomedicine to solar cells. In this talk I will demonstrate that LSPRs in metal nanostructures can either result in light scattering which can be efficiently harvested to enhance the efficiency of emerging photovoltaics (PVs). Alternatively, metal nanostructures can also convert incident light to heat which can be harnessed to induce photothermal therapy and light-triggered drug delivery to treat tumors. This talk will highlight some of the recent work by my group in plasmon enhanced light harvesting in dye-sensitized solar cells (DSSCs) and organic photovoltaics (OPVs) resulting in 25-35% improvement in power conversion efficiency. We have also performed transient absorption spectroscopy to probe the fundamental underpinnings of plasmon enhanced phenomena in solar cells. My group has also developed theranostic plasmonic nanostructures that can simultaneously target, diagnose, and treat cancer cells *in vitro*. We have combined gold nanostructures with thermosensitive liposomes loaded with anticancer drugs for multimodal chemo-photothermal therapy *in vitro* activated by near-infrared light. My group has also demonstrated the efficacy of plasmonic nanostructures for dual-modal imaging *in vivo* combining the high sensitivity of surface enhanced Raman spectroscopic imaging with the high resolution of photothermal optical coherence tomography.