Condensed Matter / Biophysics Seminar

# Plasmonics Nanowires for Optical and Energy Applications


## Prof. Chen Yang, Purdue University


Thursday

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4:00 P.M.

Rm 184 NSH


Structural and compositional complexity in nanowires opens up potentials for new many applications. In this talk, I will discuss our recent progresses on semiconductor-metal-semiconductor core-multishell (CMS) nanowires for novel photonic applications. On-going efforts are focused on CMS nanowires as photoelectrodes for enhanced visible light absorption and high efficiency water splitting (*Nano Letters*, 14, 4517-4522, **2014**) and as potential negative refractive index materials in the visible range (*Scientific Reports*, 4:4931, **2014**). By combining the nanowire geometry with the localized surface plasmon resonance in CMS nanowires, we theoretically demonstrated an effective route to strongly improve absorption within ultrathin (sub-50 nm) hematite layers. We showed a specific CMS structure designed can reach photocurrent densities of ~11.81 mA/cm$^2$, corresponding to a solar to hydrogen efficiency of 14.5%, 93% of the theoretical maximum. We have also shown that CMS nanowires can be designed to exhibit electrical and magnetic double resonance in the visible range. Significantly, slabs consisting of such nanowire arrays have a negative refractive index between 620 and 730 nm with a figure of merit of ~17-25. Collectively, we believe the CMS architecture offers high tunability of the plasmon resonance while ensuring excellent coupling with light, opening up potentials for us to further explore their applications in solar energy and novel photonic applications theoretically and experimentally.



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