Plasmonics for Nanotechnology

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Nanostructures of noble metals such as Cu, Ag, and Au have strong interactions with visible and near-IR light through the excitation of localized surface plasmon resonances (LSPR). Localized surface plasmons are coherent oscillations of the free electrons in the metal with a frequency in resonance with the incident light. LSPR modes lead to strong absorption and scattering of light in the visible spectrum, which leads to numerous potential applications in solar energy harvesting, photocatalysis, optoelectronics, and biomolecular sensing. The great potential for applications of metal nanostructures comes from the intense electric fields that are generated at the surface, and the tunability of the interaction. The absorption and scattering spectrum is very sensitive to the size, shape, and surrounding medium of the nanostructures. The interaction with light can be tuned across the visible and near-IR spectrum like a radio dial tunes into stations.

The flexibility of nanostructure-light interactions combined with modern nanofabrication tools makes plasmonics very promising to enhance solar energy harvesting and create ultra-low power optoelectronic devices. In particular, closely spaced metallic nanostructures couple the action of LSPR modes with electron tunneling leading to new physics through electro-optic features of the nanostructures. For example, as the spacing between nanostructures reaches 1 nm, new charge transfer plasmons emerge. Understanding these phenomena may lead to new types of solar energy harvesting devices in the infrared region.

This project will utilize nanofabrication and opto-electronic measurements to study closely coupled metallic nanostructures where combined photoexcitation and charge transfer occur. Current emphasis is on the understanding of hot electron generation and charge transfer. Research activities include the design and nanofabrication of plasmonic nanostructures, optical spectroscopy, electron microscopy, and electro-optic measurements.

Please contact Dr. Willis in EII-208 for more information.