Department of Chemistry
UNIVERSITY OF WISCONSIN-MADISON

Department of Materials Science and Engineering
UNIVERSITY OF WISCONSIN-MADISON

Department of Chemical and Biological Engineering
UNIVERSITY OF WISCONSIN-MADISON

The 2018 Edward Noble Kramer Distinguished Interdisciplinary Lecture

presents:

Naomi J. Halas

Professor
Department of Electrical and Computer Engineering
Rice University

From Faraday to Tomorrow: The Growing Importance and Impact of Metallic Nanoparticles

Metallic nanoparticles, used since antiquity to impart intense, vibrant color into materials, then brought to scientific attention in the 19th century as “Faraday’s colloid”, have more recently become a central tool in the harvesting of light energy for an ever-broadening range of applications. By showing that the shape of a noble metal nanoparticle determines the wavelengths of light it can absorb, we introduced the concept of a tunable optical resonance controlled by the collective oscillations of the nanoparticle’s conduction electrons: its plasmon resonance. By tuning the nanoparticle resonance just beyond visible light, into the near-infrared region of the spectrum, we showed how the highly localized heating due to light illumination could be used for photothermal cancer therapy. Now, years after its initial demonstration, this approach is being used in humans for the precise and highly localized ablation of cancerous regions of the prostate, eliminating the highly deleterious side effects characteristic of conventional prostate cancer therapies. By expanding our choice of metals from noble to far more earth- abundant elements, like aluminum and copper, we can expand this range of applications even further. Photothermal effects can be harvested for sustainability applications, which we have recently demonstrated in an entirely off-grid solar thermal desalination system that transforms membrane distillation into a scalable water purification process. The plasmon oscillations of metallic nanoparticles can also provide nonequilibrium, “hot” electrons that can, in concert with photothermal effects, drive endothermic chemical reactions under surprisingly mild, low temperature conditions. Within the context of plasmon-driven chemistry, we can begin to clearly distinguish between nonthermal and thermal processes in chemical reactions on metallic nanoparticle antenna-reactor complexes.

Tuesday, September 18, 2018
Talk at 2:30 p.m.
Room 1610, Engineering Hall
Reception at 3:30 p.m. in Cheney Room, 1413 Engineering Hall