Professor Naomi Halas is the Stanley C. Moore Professor of Electrical and Computer Engineering at Rice University, where she also holds faculty appointments in the Departments of Physics, Chemistry, and Bioengineering. She is best known as the first person to demonstrate that controlling the shape of metallic nanoparticles determines their color. She pursues fundamental studies of plasmonic and nanophotonic systems and their applications in biomedicine, optoelectronics, chemical sensing, solar steam generation with applications in off-grid water treatment, and most recently, plasmonic photocatalysis. She is author of more than 300 refereed publications, has more than 20 issued patents, and has presented more than 500 invited talks. Dr. Halas is a founder of Nanospectra Biosciences, a Houston-based company developing ultralocalized photothermal therapies for cancer, and Syzygy Plasmonics, a company developing photocatalysts that enable chemical reactions of industrial importance at temperatures far below current technologies.

The 2018 Edward Noble Kramer Distinguished Interdisciplinary Lecture

Professor Naomi J. Halas
Rice University

Tuesday, Sept. 18 at 4:00
1610 Engineering Hall

Reception 3:30 Cheney Room 1413

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 19^{th} 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.