Institute for Optical Sciences (IOS)

Professor Naomi J. Halas will visit the Institute for Optical Sciences from October 20 to 24, 2008 as part of the Institute’s Distinguished Visiting Scientists program.

Naomi Halas is currently the Stanley C. Moore Professor of Electrical and Computer Engineering and Professor of Chemistry at Rice University. She received her undergraduate degree in Chemistry from La Salle University in Philadelphia, and her master’s and Ph.D. degrees in Physics from Bryn Mawr College, the latter while she was a graduate fellow at IBM Yorktown. Following her postdoctoral research at AT&T Bell Laboratories, she joined the faculty at Rice University. She is best known for her invention of nanoshells, a new type of nanoparticle with tunable optical properties especially suited for biotechnology applications. She has been the recipient of an NSF Young Investigator Award, three Hershel Rich Invention Awards, the 2003 Cancer Innovator Award of the Congressionally Directed Medical Research Programs of the Department of Defense, and the 2000 CRS-Cyggnus award for Outstanding Work in Drug Delivery. She was also awarded “Best Discovery of 2003” by Nanotechnology Now, the world’s leading nanotechnology news and information site, and was named finalist for Small Times magazine’s 2004 Nanotechnology Researcher of the Year. Dr. Halas received an honorary doctorate of science from La Salle University in 2007. She is the author of over 100 peer reviewed publications, has presented over 170 invited talks, and has nine issued patents. Dr. Halas is a Fellow of the American Physical Society, a Fellow of the Optical Society of America, a Fellow of the SPIE, and a Fellow of the IEEE. She is also the founder and Director of the Rice University Laboratory for Nanophotonics (LANP), a multidisciplinary research network whose mission is the design, invention, and application of nanoscale optical components.

Prof. Halas will give 3 lectures during her visit, described below:

**Lecture 1 — Plasmonics: merging nanoparticles with light**

Monday, October 20 at 4 p.m.
McLennan Physical Labs, Room 202
60 St. George Street

In recent years we have shown that certain metallic nanoparticles possess plasmon resonances that depend very sensitively on the shape of the nanostructure. This interesting observation has led to a fundamentally new understanding of plasmon resonances of metallic nanostructures- “Plasmon Hybridization”- where the collective electronic resonances in a metallic nanostructure are understood to be a classical analog of the single electron quantum states of simple atoms and molecules. This paradigm explains the tunability of nanoshells, a dielectric core, metallic shell nanoparticle which is the simplest nanostructure with tunable plasmon resonances. More importantly, it provides a nanoscale “design rule” for understanding the plasmon resonances in an entirely new family of plasmonic nanostructures, and for the coupling of plasmonic nanostructures to meso- and macroscopic structures such as nanowires or thin metallic films, manifestations of the spinless Anderson model in plasmonic systems.

**Lecture 2 — Nanoscale optical approaches for molecular sensing and recognition**

Tuesday, October 21 at 3 p.m.
Galbraith Building, Room 221
35 St. George Street
Conceptually, we can envision metallic nanostructures as nanoscale optical components that can guide, focus, or otherwise manipulate light at subwavelength dimensions for a remarkably diverse range of applications. A variety of surface enhanced spectroscopies such as Surface Enhanced Raman Scattering and (SERS) Surface Enhanced Infrared Absorption (SEIRA), can exploit these types of designed metallic nanostructures as tailored, high-performance substrates yielding large and highly reproducible enhancements. These capabilities present many new opportunities to interrogate and manipulate molecules, even build new, all-optical nanoscale devices and hybrid materials that combine molecular and plasmonic properties in new ways. We will discuss several examples: combining SERS and SEIRA to detect unknown molecules, a high-resolution, all-optical nanoscale pH “meter”, nanoparticle-molecule complexes that can provide optical signatures of aptamer-based molecular recognition and DNA-drug interactions.

Lecture 3 — Merging Nanotechnology with light for Biomedicine

Thursday, October 23 at 3 p.m.
Koffler Institute, Room 108
569 Spadina Avenue

Just beyond the wavelengths of visible light, the near infrared region of the optical spectrum provides a window into the human body. In this region of the spectrum, known as the “water window”, light penetrates several inches into body, making virtually all soft tissue of the body optically accessible. This has opened up the possibility of developing optical addressable diagnostic methods, devices, even therapies that are essentially noninvasive. An example of this is Optical Coherence Tomography, an emerging technology useful for near infrared imaging of tumors. Our work over the past several years has involved the development of Nanoshells, a new type of nanoparticle that we have designed to selectively absorb or scatter light in this special wavelength region. With bioengineers, we have developed a suite of applications for Nanoshells in the human body, for use in drug delivery devices, as instantaneous tests for specific trauma or disease markers in physiological fluids such as whole blood, and as a novel, nanoengineered cancer therapy. In my talk I will describe these applications and discuss how they may change the way that doctors practice medicine.

The IOS Distinguished Visiting Scientists series is organized with financial support from the Ontario Centres of Excellence.

For more information on this lecture series please contact Emanuel Istrate.