MATERIALS SCIENCE and ENGINEERING SEMINAR

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College of Engineering
DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

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Sensors Designed Using Specialty Optical Fibers

Optical fibers have many advantages in a wide range of applications, and they are good candidates for performing sensing applications. Examples of their advantages include that they are insensitive to electromagnetic interference; have low power losses; have large bandwidths and can operate at high speeds; are durable, reliable, flexible, and inexpensive to manufacture; are lightweight and have very small diameters; can be used for communications as well as a range of other applications; and are environmentally friendly.

Research with undergraduate students at Swarthmore College has resulted in successful demonstrations of sensors using two types of specialty optical fibers: four-core fibers (standard fibers have a single central core where light is guided; these have four cores at their center) and photonic crystal fibers (with air gaps around the central core). Images of the signals emerging from four-core fibers, which are interference patterns of the outputs of the cores, are altered when the fiber is bent or twisted, and can be calibrated to the degree of the bend or twist. Magnetic field sensing has been demonstrated using photonic crystal fibers (pcf) in an interferometric configuration, where a length of pcf is used to form each arm of an interferometer. In one arm, the pcf is infused with magnetic nanoparticles suspended in a solvent; in the other arm, the pcf could either contain the solvent alone, or just air. When a magnetic field is introduced across the arm containing the nanoparticles, the index of refraction in that arm changes, thereby affecting the intensity of the output of the interferometer to a degree that depends on the strength of the applied magnetic field.

In this presentation, designs of bend, twist, and magnetic field sensors will be described. Results for bend and twist sensors will be presented, and preliminary results for the magnetic field sensor will be shown.

BIOGRAPHY

Professor Lynne Molter earned her B.S. in Engineering and B.A. in Mathematics from Swarthmore College, and her Sc.D. in Electrical Engineering from MIT under the guidance of Professor Hermann A. Haus. As a graduate student, she divided her time between the MIT campus in Cambridge, MA, and Lincoln Laboratories in Lexington, MA, where she fabricated optical waveguiding devices in $LiNbO_3$ and InP as part of her doctoral research. After joining Swarthmore as an Assistant Professor of Engineering, she also became a consultant at the Army Research Laboratory in Fort Monmouth, NJ. She was awarded an NSF Presidential Young Investigator Award to establish and equip her Optics and Photonics Laboratory at Swarthmore College. Most recently, she was named the Henry C. and J. Archer Turner Professor of Engineering. Over 125 undergraduate students have joined Professor Molter as Research Assistants in her lab.