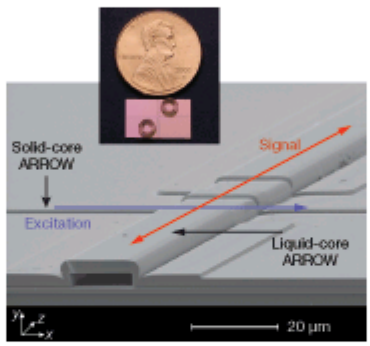
Laser Focus World

PHOTONICS: CIPS 2006 shows breadth of MIT research

Photonics research at the Massachusetts Institute of Technology (MIT; Cambridge, MA) has taken many directions; it is the task of the university's Center for Integrated Photonic Systems (CIPS) to draw them together to form a cohesive, institute-wide research community. At the CIPS Annual Meeting 2006 (May 4-5) held at MIT, Rajeev Ram, director of CIPS, noted in his opening statement that the organization also aims to participate in working groups of companies and researchers in defining the future of photonics.



Two antiresonant reflecting optical waveguides (ARROWs), one solid and the other liquid-filled, cross on a silicon platform. The solid waveguide carries the pump light, while the other bears the analyte. The entire platform, including two ring-shaped fluid reservoirs, is smaller than a penny (inset).

Ram outlined some of the capabilities in photonics that exist at MIT, using the advent of a photonic-crystal illuminator as an example. As a doctoral student at MIT, Alexei Erchak developed a gallium arsenide-based light-emitting diode (LED) with a photonic-crystal structure that boosted light output. The device was designed and tested, manufacturing techniques were researched, and economic analysis was done; Erchak went on to found Luminus Devices (Woburn, MA), where he is currently the chief technical officer. The company produces the PhlatLight, a photonic-crystal LED powerful enough to illuminate high-definition TVs.

Sessions run the gamut

The biophotonics session was introduced by Ram, who noted that the term "biophotonics" has become generic, encompassing things like ordinary optical microscopes; he proposed that the term be defined as "innovation in photonics driven by biology, biotechnology, and medicine." Mehmet Yanik of MIT, in the first talk, centered on the use of femtosecond laser pulses to perform nanosurgery on individual neurons, enabling the study of nerve regeneration. He is currently developing new tools to allow surgery at the tens-of-nanometers scale to enable characterization of synaptic junctions.

Tom Jeys of the MIT Lincoln Laboratories (Lexington, MA) presented requirements for optical bioaerosol sensors, demonstrating that multicolor fluorescence spectroscopy on aerosol particles could discriminate spores from background particles (which has been integrated into a system ready for field use). He discussed his recent work trying to lower the cost of these sensors by moving to UV LED excitation.

Holger Schmidt of the University of California at Santa Barbara presented his silicon-based platform for guiding light within a waveguide containing a liquid core, used for sampling fluids via fluorescence down to the 100-femtoliter scale and making possible single-molecule detection in a planar, integrated platform (see figure). He discussed preliminary results on sensing individual ribosomes with the waveguides.

Harry Lee of MIT discussed recent work at MIT on a microscale bioreactor to facilitate the development of industrial bioprocesses. The microfluidic platform uses integrated fluorescence sensors to stabilize the growth environment of bacteria to enable reproducible development of new biomaterials such as vaccines, polymers, and pharmaceuticals.

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