Research on New Types of Optical Devices Modifies Optics

July 30 2004

The Defense Advanced Research Projects Agency (DARPA) has awarded an $8 million, four-year, basic-research program grant to the California Institute of Technology to initiate research in photonics technologies. The technical focus of the effort will be on optofluidics, an exciting new research area based on the use of **microfluidic devices to control optical processes**, and which is expected to result in a new generation of small-scale, highly adaptable, and innovative optical devices.

To conduct the research, Caltech is establishing a new center called the Center for Optofluidic Integration. The center will spearhead efforts directed toward a new class of adaptive optical devices for numerous applications in sensing, switching, and communications.

According to founding director Demetri Psaltis, the DARPA-funded center is ideally located at Caltech because the Institute has a longstanding commitment to interdisciplinary research, faculty interaction, and the creation of new technologies and avenues of knowledge. The center will also draw on the efforts of researchers at other institutions, including Harvard University and UC San Diego.

"The basic idea of the center is to build optical devices for imaging, fiber optics, communications, and other applications, and to transcend the limitations of optical devices made out of traditional materials like glass," explains Psaltis, who is the Myers Professor of Electrical Engineering and an expert in advanced optical devices. "A glass lens, for example, is relatively unchangeable optically. Our idea is to use fluidics as a means of modifying optics."

This can be accomplished, Psaltis says, by taking advantage of recent advances at Caltech, Harvard, and UC San Diego in microfluidics, soft lithography, and nanophotonics. The fusion of these three technologies will be the key to developing components that use nanometer-sized fluidic pathways to mix and pump liquids into and out of the optical path.

Among other advantages, this approach allows for the construction of devices with optical properties that can be altered very quickly. The potential products of this line of research include adaptive graded index optics, dye lasers on silicon chips, nanostructured optical memories, dynamic nonlinear optical devices, reconfigurable optical switches, and ultrasensitive molecular detectors. Optofluidics is expected to have a broad impact on areas such as telecommunications, biophotonics and biomedical engineering, and robot and machine vision.

The new center will function as a catalyst to facilitate the technology fusion process. One of the more noticeable effects of the center on the Caltech campus will be the creation of a microfluidics foundry to create optofluidic technologies. In the foundry, researchers will be able to easily design and rapidly create the microfluidic layers that will control the flow of liquids to these new devices.

According to Psaltis, the initial members of the center's research team all offer significant expertise in areas critical to the design and fabrication of highly integrated optofluidic devices. Others at Caltech include Stephen Quake, the Everhart Professor of Applied Physics and Physics, who has invented a number of microfluidic devices for biomedicine applications; Kerry Vahala, the Jenkins Professor of Information Science and Technology and a professor of applied physics, who is the inventor of optical devices such as high-quality optical microcavities; Axel Scherer, the Neches Professor of Electrical Engineering, Applied Physics, and Physics, who is best known for his work on photonic band gap devices, and who collaborated with Psaltis on the successful development of the first photonic crystal laser tunable by fluid insertion; Changhuei Yang, an assistant professor of electrical engineering and expert in biophotonics; and Oskar Painter, an assistant professor of applied physics with a background in photonic crystal lasers. Researchers at other institutions include George Whitesides, the Woodford L. and Ann A. Flowers University Professor at Harvard, who is a pioneer in soft lithography; Federico Capasso, the Robert L. Wallace Professor of Applied Physics at Harvard, who developed quantum cascade lasers; and Shaya Fainman, a professor of electrical and computer engineering at UC San Diego, whose expertise is in nanophotonics.

Source: California Institute of Technology

Citation: Research on New Types of Optical Devices Modifies Optics (2004, July 30) retrieved 18 April 2024 from https://phys.org/news/2004-07-optical-devices-optics.html