Headlines @Hopkins
News by Topic
News by School
Events Open to the Public
Blue Jay Sports
Search the Site

Contacting News Staff
Receive News Via Email
Resources for Journalists

Virtually Live@Hopkins
Hopkins in the News

Faculty Experts
Faculty and Administrator Photos
Faculty with Homepages

JHUniverse Homepage

Headlines@Hopkins

News Release

Office of News and Information
Johns Hopkins University
3003 N. Charles Street, Suite 100
Baltimore, Maryland 21218-3843
Phone: (410) 516-7160 | Fax (410) 516-5251

December 28, 2001
FOR IMMEDIATE RELEASE
CONTACT: Phil Sneiderman
(410) 516-7907, prs@jhu.edu

Mini-Lasers and Silicon on Sapphire Technology Lead to Speedier and Cost-Effective Interconnects Between Computer Chips

Replacing Wires With Optical Components for High-Performance Chip-to-Chip Communication

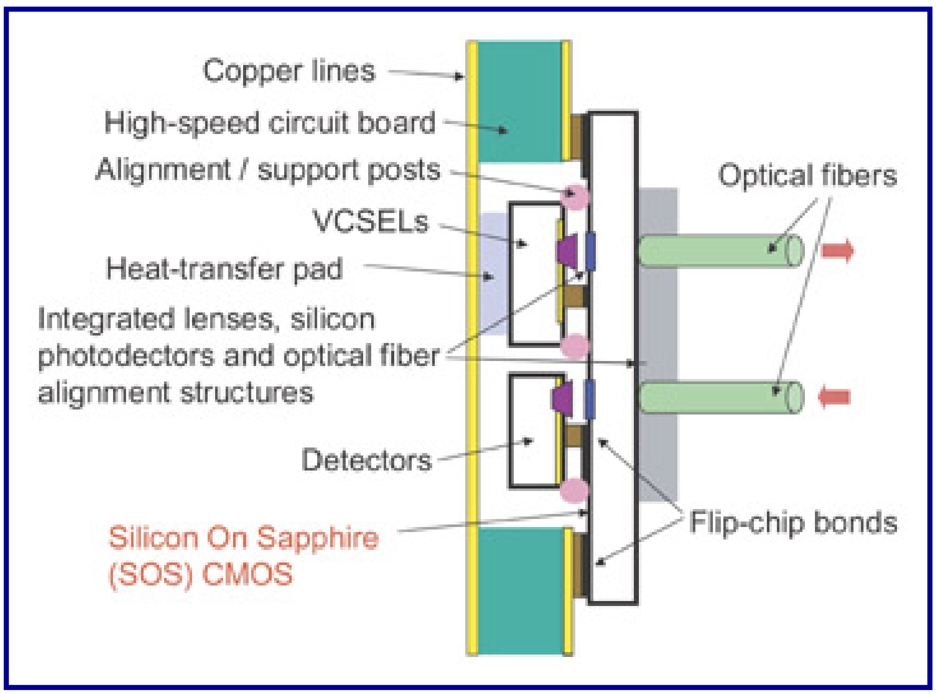
By using light beams in place of metal wires, engineers at The Johns Hopkins University have devised a cost- effective way to speed up the way microchips "talk" to each other. The method, created by a team in the Department of Electrical and Computer Engineering, takes advantage of unusual characteristics associated with silicon on sapphire technology, a new way to manufacture microchips.

"We've developed a very fast and cost-effective way of getting data on and off a chip without using wire," says Andreas G. Andreou, a professor in the department and director of the lab in which the work was done. "It really promises to revolutionize how computer systems for homes and businesses are put together."

Andreas G. Andreou, a professor in the Department of Electrical and Computer Engineering, and doctoral student Alyssa Apsel were part of the team that developed a new microsystem that uses light beams in place of metal wires.
Photo by Jay VanRensselaer

Andreou's team relies on the same fiber optics technology that is used to carry phone conversations across great distances. These components are incorporated into a new type of microchip technology. The microchips inside most modern computers are assembled on thin slices of silicon, a material that is a semiconductor. The Johns Hopkins engineers use microchips in which silicon is layered onto thin slices of synthetic sapphire, a material that is an insulator and also allows light to pass through it.

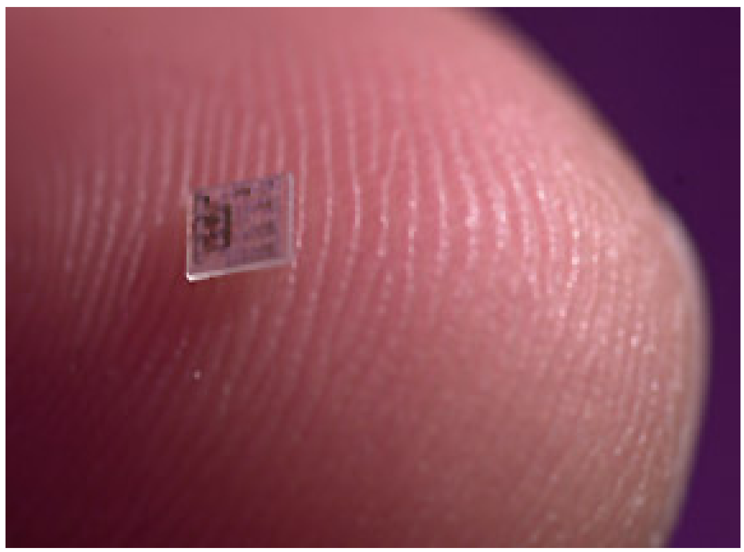
In the microsystem devised by Andreou's team, a signal that originates in a wire is transformed into light and beamed through the transparent sapphire substrate via a laser that is only slightly larger than a human hair. Microlenses and other optical components, manufactured at the same time as the electronic circuits on the microchip, collect the light beam and guide it to another place on the microchip or, using an optical fiber, move it to another chip.



This diagram shows how the optoelectric model is assembled.

At its destination, the light enters a high-speed optical receiver circuit that transforms the stream of photons into a stream of electrons that continue their journey through electrical wiring connected to other computer components. By using optical signals, or simply an unhindered laser beam, the Johns Hopkins researchers believe a signal could move 100 times faster than it does along a metal wire. Also, the optoelectric interface circuits require much less power because the sapphire substrate is an insulating material, not a semiconductor. This property of the substrate reduces the power dissipation that commonly occurs in modern microprocessors when signals travel through wires that have capacitances, which are parasitic components that not only degrade the signals but also increase the power consumption of the system.

The new design is expected to significantly speed the movement of data between electronic components across a single chip and from one chip to another for a simple reason: "Without the parasitic capacitances, it's much faster to send signals at the speed of light," says Alyssa Apsel, a doctoral student in the Anderou lab who helped developed the system.



The Andreou team's microsystem is designed for a chip that is much smaller than a human fingertip.
Photo by Jay VanRensselaer

Andreou and Apsel wrote about the breakthrough in an article published in the November 2001 issue of *IEEE Circuits and Systems Magazine.* Their co-authors were Zaven K Kalayjian, a former Johns Hopkins doctoral student; Phillippe O. Pouliquen, a Johns Hopkins postdoctoral fellow; Ravi A. Athale, formerly of George Mason University and now at the Defense Advanced Research Projects Agency; George Simonis of the Army Research Laboratories; and Ron Reedy of the Peregrine Semiconductor Corp. Also, in the Sept. 13, 2001, issue of the journal *Electronics Letters*, Apsel and Andreou reported on this new design and described a high-speed, very-low-power optical receiver that uses this new technology.

The project was supported by grants from the Army Research Laboratories and the National Science Foundation.

Diagram, technical paper and images of Andreou and Apsel available; Contact Phil Sneiderman.

Related Sites

Johns Hopkins Sensory Communication and Microsystems Laboratory
Andreas Andreou's Web Page
Alyssa Apsel's Web Page
Johns Hopkins Department of Electrical and Computer Engineering

To read a technical article about the Andreou team's Optoelectric Microsystem, see Page 22 in this issue of *IEEE Circuits and Systems Magazine*
[requires Adobe Acrobat Reader]
