IBM CORPORATION

Methods for Making New Optical Switches

Information is transmitted in a variety of ways in a developed economy: by surface mail, telephone, facsimile, e-mail, radio and TV broadcast, and data downloading. Several technologies are useful for each type of transmission, and in some instances, both electrical and optical methods can be used. Optical transmission has a signal-quality advantage over electrical transmission in cable TV, telephone trunk lines, undersea cables and other cable applications.

COMPOSITE PERFORMANCE SCORE
(Based on a four star rating.)

No Stars

Faster, Cheaper Optical Transmission of Data

Optical fiber is rapidly replacing metal wires in terrestrial and oceanic transmission, both for voice and data, because of cost savings and improved performance. Optical methods also have a potential advantage for transmitting information from component to component within computers. If optical signals could replace electrical signals in this context, bandwidth could be multiplied many fold, while heat generation and cross-talk — significant problems in computers — could be greatly reduced.

New Optoelectronic Polymer and Prototype Switches

IBM's ATP project aimed to develop optical switches to link the optical fibers running between components in computers. Current-generation switches convert data from an optical to an electrical signal, do the necessary switching, and then convert the data back to an optical signal, a process that involves expensive components and significantly limits the speed of the system. IBM's proposed technology would help achieve the technical advantages of optical signals over electrical signals in computers.

IBM researchers succeeded in developing high-speed, inexpensive optoelectronic switches using nonlinear optical polymeric waveguides suitable for use in the data communications industry. Specifically, the project developed a general method for identifying and synthesizing particular dipolar molecules, known as chromophores, that are chemically stable at temperatures exceeding 300 C. Researchers were able to incorporate these molecules into thermally stable polymers, producing the desired optoelectronic polymer.

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. . . this technology . . . may . . . be useful in telecommunications, rather than computers.

Market Fails to Materialize as Expected

Commercialization by IBM is not expected in the foreseeable future, even though IBM completed working prototypes of polymeric switches. The need for such switches in the envisioned application changed, and a broad market opportunity did not materialize. Technological change in this industry is rapid, and trends can suddenly switch directions.

PROJECT HIGHLIGHTS

PROJECT:
To develop high-speed, inexpensive optoelectronic switches using nonlinear optical polymeric waveguides suitable for use in the data communications industry.

Duration: 8/1/1992 — 7/31/1995

ATP Number: 91-01-0017

FUNDING (in thousands):

ATP	$1,787	44%
Company	2,235	56%
Total	$4,022	

ACCOMPLISHMENTS:
Researchers reduced the size and cost and improved the speed and efficiency of switches for computers and communications systems. IBM produced working prototypes of polymeric switches. Technical progress is indicated by the fact that IBM:

- received a patent for technology related to the ATP project: "Optical photorefractive article" (No. 5,607,799: filed 4/21/1994, granted 3/4/1997);
- published more than 20 papers in professional journals in areas related to the project goals; and
- presented technical results at several professional society meetings and conferences.

CITATIONS BY OTHERS OF PROJECT'S PATENTS: See Figure 2.1.

COMMERCIALIZATION STATUS:
The technology has not yet been commercialized by IBM or others. The market opportunities for the polymer-based switches have yet to materialize.

OUTLOOK:
While predicting the future of this technology is difficult, it may possibly be useful in telecommunications, rather than computers. One potential application is in wavelength division multiplexing (sending light of more than one wavelength through a single optical fiber), where the technology may find cost-effective use in switches and other components.

Composite Performance Score: No Stars

COMPANY:
IBM Corporation, Almaden Research Center
650 Harry Road, K13/E1
San Jose, CA 95120-6099

Contact: Mike Ross

Phone: (408) 927-1283

Informal collaborator: University of Colorado

New Opportunities Arising

The rapid expansion of digital data transmission, however, is likely to open up opportunities for low-cost, high-speed optoelectronic switches in the future, and devices based on polymeric materials are viable candidates. Thus, chances are good that this technology will ultimately be used in important applications. Of the six key researchers on the project, five have left the company for other jobs. Knowledge spillover may occur elsewhere, as these researchers use their knowledge of the technology in new applications. They conjecture that the technology may be useful in the near future in telecommunications, rather than in computers. One potential application, according to project researchers, is in wavelength division multiplexing (sending light of more than one wavelength through a single optical fiber), where the technology might provide significant enhancements for high-speed, broadband telecommunications. Another possible application is in microprocessor chip-to-chip interconnects, but semiconductor industry experts suggest that the need for those interconnects may not become apparent for 10 or more years or might not ever arise.

No broad market benefits have emerged yet, because there are no commercial products incorporating the technology, either in the intended or other applications. It is likely, however, that the rapidly expanding use of digital data communication will lead to opportunities for low-cost, high-speed optoelectronic switches in the future. The ATP-funded technology is a core technology for the polymeric materials and devices that IBM demonstrated, and these products have potential in a number of future applications.

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Through its research under ATP funding, IBM was able to gain access to cutting-edge work being done on optoelectronic devices at the University of Colorado. The support enabled company researchers to publish more than 20 papers in professional journals, enabling the technology to be disseminated among other researchers. The knowledge gains are well documented.

Figure 2.1 Patent Tree for Project Led by IBM Corporation: Citations by Others of IBM Corporation Patents