Profiles

Lucent, Rogers Look to Nano for Innovation

By Allen Bernard

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Even though Lucent Technologies' recent bad news could spell trouble for its famous R&D facility, Bell Labs' Nanotechnology Research Director John A. Rogers is hopeful his people and projects will escape the budget axe.

On Friday, the company announced an additional 10,000 company-wide job cuts, reduced earnings expectations and $4 billion of additional charges against its third quarter revenues and equity. Not good news, certainly, and coming on the heels of Bell Labs' recent announcement it fired ethically-challenged researcher Hendrik Schön for falsifying data and results, the timing could have been better.

Still, Rogers is hopeful the university-like structure of the labs, where researchers work independently often spending grant money on projects instead of Lucent's cash, will insulate it somewhat from the many troubles of its beleaguered parent company. Also, since Bell Labs is the heart of innovation for the company and nanotechnology is enabling the creation of innovative, novel products already hitting the market, this should somewhat offset shrinking budgets.

"There's real support all the way up to the very highest levels of Lucent for strong robust basic and application research in nanotechnology; that's absolutely clear," Rogers told Nanoelectronics Planet.

With a nod to the realities of today's telecom industry woes, slow economy and Lucent's recent announcements he added: "The support that comes from Lucent is determined at some level by how well Lucent is doing."

Nanotechnology initiatives have already produced products, however. The most recent, a tunable dispersion compensator (TDC), which refocuses and clarifies light signals traveling down fiber optic cables making them easier for detectors to read, is based on printing nanocircuits using rubber stamps molded from silicon masters. Printable feature sizes are as small as 50 nanometers. These stamps allow Lucent to print directly onto optical fibers. This, in turn, enables the fibers to go from passive transmission devices to active network components.

"Our notion, which is new, is just to make the fiber itself active and make it a tunable, integral component of the network beyond just the passive role that it traditionally plays," Rogers said. "So, it's a real, genuine part of Lucent's network and relies directly on ideas of nanotechnology that came straight out of basic research."

The RightWave TDC netted Lucent a prestigious R&D 100 Award for 2002, as well as other accolades. Lucent development partner, E Ink Corp., won the award in 2001 for electronic paper made possible, in part, by Lucent's nanoprinting innovations.

A more recent innovation (only now hitting the scientific journals) combines the printing technology with another nanotech initiative to make optical fibers (which are about the width of a human hair) with nano- to micron-sized tunnels running the length of the fibers. The tunnels are filled with fluid and capped on either end by air pockets. Circuits that act as heaters are then printed over the air pockets. When activated, heated air causes the fluid to move back and forth rapidly. The fiber also incorporates photonic crystals written into the core of the fibers that work in concert with the fluid to form a notch filter.

When spliced into a stretch of standard glass fiber, a 10-centimeter-long section of this "holy fiber" smoothes out energy spikes, or gain, in the lines.

This attenuates the network, increasing robustness and potentially allows operators to increase transmission speeds and dependability. A lot of engineering needs to be done before this latest innovation becomes a product but the science works and prototypes are being tested.

"What this kind of microfluidic device does is it dynamically flattens the gain so it ensures there's an equal amount of power in all the different wavelength channels of one of these multiplexed networks," Rogers said.

Many of the lab's other nano initiatives revolve around developing manufacturing techniques since manufacturing innovations often lead directly to new products and because applications are useless without the means to implement them.

"All of nanotechnology relies critically on the ability to build those structures and the techniques that are used to build them typically determine the kinds of systems you can look at and they also, ultimately, will dictate their potential applications, their manufacturability," Rogers said.

Along with their printing initiative—which is leading Lucent down the path of other nanotech start-ups like Rolltronics, Nanolayers and Plastic Logic into the world of printing active matrix backpanes that enable flexible plastic LCDs—the researchers at Bell are actively pursuing DNA-based nanodrives (a long-term, science-fiction-type of technology); fabrication of metal-molecule-metal junctions for use in molecular circuits; and lasers and photonics research to further Lucent's core network equipment business.

Lucent has already licensed some of these technologies to electronic paper maker E Ink for a stake in that company. But that is a near-term application in the hands of product engineers. What really excites Rogers, who holds a Ph.D. in physical chemistry from the Massachusetts Institute of Technology, and his colleagues are the possibilities being explored today for products 20 years from now. Those are the ideas just barely out of the gate and the ones that keep them coming to work in the morning.

"Research frontiers are probably more in the molecular electronics area rather than plastic electronics," he said. "We're just scratching the surface of what's possible there."

John A. Rogers, nanotechnology research director at Bell Labs, will be a featured keynote speaker at the Nanoelectronics Planet Conference and Expo, Nov. 18-19, 2002, in New York, N.Y. For more information: http://www.jupiterevents.com/nano/fall02/.

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