SOLID STATE TECHNOLOGY'S

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# WaferNEWS

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**In the spotlight**


Percentage change in FEI stock price, which was $24.98 on February 8, 2005, compared to $23.02 a year ago.

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SolidState TECHNOLOGY



## Army's new mission: Escalate flexible display R&D

*Center targets commercial technologies on coattails of military applications*

It has been a long time—perhaps decades—since the military has been in a position to become a leading driver for potentially huge applications in solid-state technology. Now, however, the US Army believes it can help accelerate development of revolutionary flexible displays for use on the "battlefields of the future" as well as in a wide range of commercial applications during the next 5-10 years.

As part of the "Future Force Warrior" initiative, the Army Research Laboratory aims to dramatically reshape the way combat infantry soldiers retrieve information and view activity in battle, by replacing paper and today's glass-based flat panel displays with rugged flexible displays built on plastic and other types of substrates. These energy-efficient, lightweight displays will be integrated with digital electronics, wireless networking radios, sensors, and power sources, including solar cells. The goal is to deploy battle-hardened display systems, which could be rolled up or folded and placed into pockets—and ultimately, create "smart uniforms" that could have color displays stitched on sleeves for quick and easy access in combat.

To quickly reach that point—within four or five years—the Army Research Laboratory has committed $43.7 million in a five-year cooperative agreement with Arizona State U. to create the newly-opened Flexible Display Center in Tempe, AZ. Total spending on the center is estimated at about $100 million, including contributions by partners. The center also is taking aim at new processes

*J. Robert Lineback, Senior Editor*

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JAPAN NEWS

## Producers pushing silicon levels, but reluctant to invest in poly

Japan-based suppliers plan a 5% increase in single-crystal silicon output this year, to 6330 tons, according to the Japan Society of Newer Metals' (JSNM) annual forecast. Polysilicon production was up 22% in 2004, to 6135 tons, but it will take higher prices to entice suppliers to add any new capacity, say officials from major supplier Tokuyama.

Tokuyama figures the expanding solar power market now accounts for about 30% of the 27,000 tons of polysilicon the world uses in a year, while semiconductor industry demand will grow by 10,000-15,000 tons/year over the next decade. "With that kind of increasing demand you might think we'd be planning to add capacity," Hiroo Momose, Tokuyama director and general manager of the silicon business, told the *Nikkei Sangyo Shimbun*. "But at current prices we won't reinvest. We spent ¥20 billion ($195 million) to add 1500 tons of capacity in 2001. If we made that same scale investment again, it would only bring in ¥6-¥7.5 billion ($60-$75 million) more revenue a year, at ¥4000-¥5000 ($40-$50) a kilogram. That's a bad rate of return." He noted that with wafer demand slowing in 4Q04 and 1Q05, wafer makers aren't likely to be able to pass along price increases in polysilicon until the second half of the year. His company currently is negotiating new contracts with Japanese users for the fiscal year starting in April.

Tokuyama saw an 11% jump in sales, to some ¥48 billion ($470 million), in its

*Dr. Paula Doe, Contributing Editor*

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and materials for what many consider the "Holy Grail"—roll-to-roll (R2R) manufacturing vs. today's wafer or plate-based batch fabrication systems.

"Our goal is to speed commercialization of flexible displays by keeping development centered on commercial standards, which means there will be no issues restricting suppliers or the export of technologies," explained David Morton, displays technology manager for the Army Research Laboratory based in Adelphi, MD. In addition, the center's cooperative agreement defines ownership of intellectual property (IP) rights.

"For the partners [companies, academic researchers, the center, and the Army] ownership of IP follows invention. And what you bring in is yours," he told *WaferNews,* after the Flexible Display Center's dedication ceremony on the Feb. 4. "The center can use all the IP internally. If the center is a significant contributor [to IP invention], it will have rights, too. The IP agreement was critical to bringing in industrial partners."

Freeing up the commercial use of technology from the Flexible Display Center also played a crucial role in recruiting industry partners. In addition to the US Display Consortium, 10 companies have now joined the center, including Ito America Corp. (the US subsidiary of Japan's Ito Corp.) and Schärding, Austria-based EV Group. The center is negotiating with other international companies, including Royal Philips Electronics NV in the Netherlands. "If this was restricted [by classified technology or development], we could not get a company like EV Group to join the center," Morton noted. In addition to EV Group and Ito America, the center's corporate partners include Universal Display Corp., Honeywell, E-Ink, Corning, Abbie Gregg Inc., General Dynamics, and Rockwell Collins.

Industrial partners joining the center are able to use the facility's 43,500-sq. ft cleanroom and 22,000-sq. ft wet/dry labs to support a variety of applications beyond the Army's flexible display objectives. For example, EV Group has relocated its North American headquarters inside the offices of the Flexible Display Center. The company plans to use the center's full fabrication lines and metrology systems to support a wide range of customers in IC packaging, MEMS, and other applications that use wafer bonders, aligners, photoresist coaters, cleaners, and inspection tools, said EV Group CEO Peter Podesser. "For us, this is a great opportunity to expand our resources for customers and to participate in development of new systems and processes for flexible displays," he told *WaferNews.*

> The center is taking aim at the display industry's "Holy Grail" —roll-to-roll manufacturing.

As part of its involvement in the flexible display partnership, EV Group is supplying fully automated temporary bonders and debonders as well as spray coaters for the center's existing 150mm wafer pilot processing line. EV Group also is developing and testing a new large-area spray coater, developer systems, bonders, and debonders for the center's next pilot line, which will produce flexible displays on Gen II substrate plates (14.5 x 18.5 in.). The large-plate pilot line is scheduled to be operational in 2006.

The center aims to make all of its display processes compatible with R2R manufacturing concepts, said Morton. To that end, the center will collaborate with R2R development planned at the Center for Advanced Microelectronics Manufacturing (CAAM), which was announced last month by the US Display Consortium and Binghamton U. in NY. The Flexible Display Center's own R2R pilot line activities could begin within five years, according to Morton, citing the program's original targets.

Overall, the Flexible Display Center's charter is to conduct unclassified R&D in four areas of emphasis: backplane electronics, manufacturing and integration, electro-optics materials and devices, and barriers and substrates. The aim is also to solve critical challenges in performance and manufacturing processes for emissive, transmissive, and reflective flexible display technologies. Initially, the center is focused on prototype production of low-temperature plastic-based flexible displays, made with amorphous silicon on 150mm wafers, but R&D will also explore other technologies, including electrophoretic displays, which are ink-based, and processes for organic light-emitting diode (OLED) flexible displays. Fabrication of the first wafers is expected to be completed this month. By mid-2005, the first functional prototypes of 4-in. diagonal concept devices, with more than 76,000 thin-film transistors, will be available for testing and evaluations.

In 2006, the center will ramp a new pilot line for large-area plate production supporting Gen II flexible displays. The overall goal is to increase the size, reliability, and flexibility of displays, and reach a final display size as large as 15- to 17-in. diagonal. Initial displays will be monochrome, but the center plans full-color flexible displays. Initially, rugged flexible display designs will evolve into conformal displays, then rollable, and finally into foldable devices. — *J.R.L.*