Printed Electronics NOW

Articles » Feature

At ASU, Flexible Displays Have Military and Commercial Futures

The Flexible Display Center at Arizona State University continues its five-year R&D on electronic displays that are light, rugged and flexible.

By Jack Kenny

Today's soldiers might have the same discipline as those of yesteryear, but they certainly do not carry the same equipment, and neither does the enemy. Technology's advance has meant that the warriors of today must have the best electronics that their government can provide for them. The weight, therefore, adds up. According to the US Department of Energy, "Many soldiers already carry 100 pounds or more on their backs. Electronic gadgetry can take that number even higher." Batteries are a big part of that weight, which is why scientists are at work on advanced solar cell technology to reduce dependence on battery power.

At Arizona State University's Flexible Display Center, researchers are at work on creating a new generation of displays that will be flexible, lightweight, rugged, and which use low power. They will replace the fragile glass and circuitry in current handheld devices and relieve a soldier of more than just weight.

The idea for the Flexible Display Center (FDC) came from the US Army Research Laboratories, whose scientists had been watching the emergence of printed electronics. "The US Army wanted an operation that looked at the advancement of flexible technology as well as commercialization, all under one roof," says Shawn O'Rourke, director of engineering at the FDC. The center was established in 2004 in Tempe, AZ, USA, with a 10-year contract for support by the army and the intention to build a membership organization composed of corporations that want to stake a claim in the printed electronics movement.

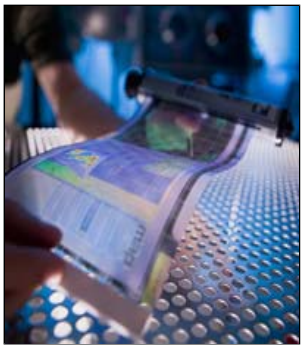
The building has 250,000 square feet of space, including 43,500 square feet of advanced clean room space, 22,000 square feet of wet/dry laboratories, plus office and meeting areas. It is reconfigurable, O'Rourke says, to provide secure space for proprietary programs, with ample capacity to accommodate a specific company's tools, components, production requirements and specifications. The center currently employs about 40 people.

After five years of research and development, the FDC has developed a 3.8" diagonal QVGA (quarter video graphics array) that is comparable in resolution to a PDA. "These have been integrated into several different devices, mostly a type of mobile PDA application," O'Rourke says. "The displays in and of themselves are very thin, lightweight and rugged – much more robust than glass. And they can fit into a cargo pocket. That is a big issue for the army, which wants reduced weight for soldiers and lower cargo volume."

The unit under development at the FDC "uses 50 times less power than a liquid crystal display," adds O'Rourke. "And one of our partners is at work on a version that can wrap around the wrist."

The weight of batteries that soldiers carry today is tremendous. "If you can provide a device that provides real-time situational awareness but with low power usage, it's a tremendous advantage to the foot soldier," he adds. "And all of these analogies apply to commercial space as well: Consumers don't want displays to break. It's always about power, weight and size, how thin can you make it. There is a direct crossover between development for the army and for the commercial world."

The FDC has produced its 3.8" displays on stainless steel and on plastic. The plastic display, a newer development, is now integrating OLED technology.



A critical area in development of any technology is manufacturing, and the FDC has been at work with its industry partners in that department. "We are in the stage of identifying key aspects of manufacturing of these displays, as well as of the supply chain," says O'Rourke. "That's where a large part of the membership fits in. DuPont Teijin makes a substrate that has gone through several revisions in last few years, and is now the pre-eminent plastic substrate for plastic TFTs. There is a strong collaboration across the supply chain."

The center has two pilot manufacturing lines in its plant. One is a 6" (150mm) wafer-scale pilot line for R&D purposes. The other is a GEN2 pilot line for low volume production which runs a substrate that is 370mm by 470mm. "That is the predominant fabrication vehicle for the display ramp-up," he adds. "As we view it, we have the first as a research line, and GEN2 for development."

The approach that the FDC took for its fabrication was this: "Can we develop a technology where we can take a wafer and fix it to a carrier with minimal or no changes?" O'Rourke says that the center has been working in partnership with some companies that provide materials and processes, temporarily attaching a substrate to a carrier, making a TFT array, exposing the assembly to acids, plasmas, high vacuums, and high temperatures, and at the end remove the film easily with no damage to the electronics.

Plastic is an unstable material that can present difficult issues during production. Heat is the traditional enemy of plastic, and can

render it useless unless the plastic is engineered to withstand it. The plastic substrates that the center is working with are put through a low temperature amorphous silicon TFT process, which involves exposure to temperatures between 175° C and 200° C to produce the plastic panel. The plastic film, says O'Rourke, "has been engineered over the last several years to survive this process."

Though the flexible display is still in the developmental stages, interest for commercialization has been shown by several companies, O'Rourke says.
The current economic climate, he adds, does not appear to have discouraged investors in the FDC, because new members are about to be added to the center's two dozen or so member companies and organizations. These include AKT America, BAE Systems, Boeing, DuPont Teijin Films, E-Ink, Etched in Time, EV Group, FlexTech Alliance, General Dynamics, Hewlett Packard, Honeywell, Ito America, Kent Displays, L-3 Communications Display Systems, LG Display, Mocon, Particle Measuring Systems, Plextronics, Raytheon, Surface Science Integration, ULVAC, and Universal Display Corporation.