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Crossing Disciplines

The 21st Century Engineer's Role as Collaborator

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Breaking Down Barriers

Flexible Display Center Develops Commercially-Ready Display Technology

By Trisha Coffman

Graduate research assistant Jovan Trujillo shows a tantalum pentoxide film covered with more than 2,022 capacitor dots.

"Something good happens here every week."

That can't always be said about the "two steps forward, one step back" world of research and development, but for Greg Raupp, Director of the Flexible Display Center (FDC) at Arizona State University, it's often one exciting breakthrough after another.

The FDC is accelerating flexible display technology—which allows for displays that are lightweight, require little power and are intrinsically rugged—in a collaboration established by the U.S. Army in February 2004, and which also includes 15 industry partners. The goal is to develop commercially-ready display technology that the Army can integrate for its purposes. "Our mission is to broadly advance the technology and break down the barriers to commercialization," says Raupp, Professor in the Department of Chemical Engineering in the Ira A. Fulton School of Engineering.

Commercial possibilities include sturdier displays for cell phones and other handheld devices, "electronic paper," and wearable displays on sleeves for everything from first responder situational awareness to personal fitness, Raupp says. But for the Army, flexible displays are not only about convenience, they are also about safety and facilitating strategy.

As early as this summer, the FDC is delivering prototypes of hand-held devices with rugged flexible-display technology to the Army. "They will incorporate wireless communications and link to Global Positioning Systems. The software will center an individual on the map and include other icons to indicate positioning of their objective, as well as friendlies and foes," Raupp explains.

That sort of real-time situational awareness in the field is one application. Other possibilities include somewhat larger displays for Army vehicle applications and even very large displays that could be rolled up and used as portable command posts.

Last fall the FDC leapt from producing one-inch diagonal displays to those of four-inches. Recent advances in the display pilot line scale will allow for even bigger displays in the coming years. Through "dozens of breakthroughs," the Center has accomplished the fabrication of high-quality thin-film transistors at low temperature conditions that are compatible with flexible substrates. Raupp anticipates exploring color displays in the next year.

"It's amazing how quickly we move," Raupp says. "We get through a cycle of learning in well under a month in process development. Relative to the speed of typical R&D, we're more like a start-up company in the speed at which we work."

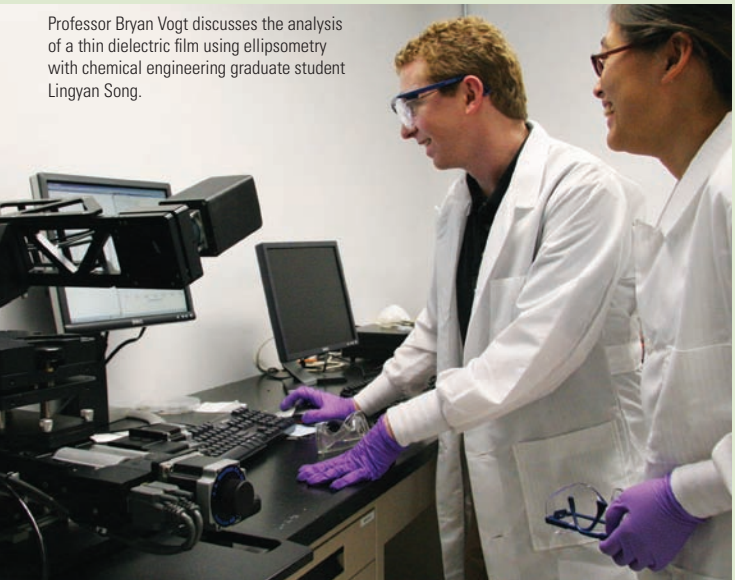
That's one reason Raupp suspects the Army selected ASU: rapid technology development in a pilot line manufacturing environment. "We're not just pushing along flexible-display technology, we're also pushing along manufacturing technology. Not only can we fabricate the device, we can tell you how to manufacture it," he says.

This environment of many technologies brought together makes for a unique educational experience. "Students get exposed to a very dynamic, fast-paced, high-tech development effort that isn't found in a typical university setting. They get immersed in it," Raupp says.

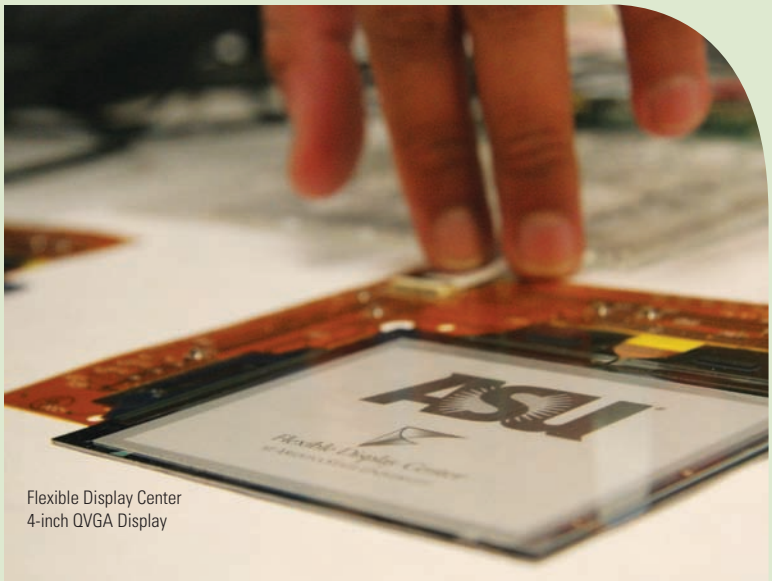
Jovan Trujillo is a chemical engineering graduate student, but he's the FDC's jack-of-all-trades, cross-training with chemical, materials and electrical engineers to improve transistor performance for flexible displays. "It's more challenging to be in a multidisciplinary research project," Trujillo says. "There's a rich assortment of problems for a graduate student to work on. I want to go into industry, so I'll have a broader understanding of these problems and how to apply them to industry."

Trujillo performs fundamental, applied and developmental research in his work on anodically oxidized tantalum pentoxide and its use as a high-κ dielectric, which helps lower the operating voltage of the displays and will allow for smaller transistors for future color displays.

Not only does Trujillo work with others in academia, but also with those industry collaborators offering their technology and know-how. "He gets the help of an entire staff trying to build his process," Raupp says. "We all have the opportunity to collectively advance the technology."



Professor Bryan Vogt discusses the analysis of a thin dielectric film using ellipsometry with chemical engineering graduate student Lingyan Song.



Flexible Display Center
4-inch QVGA Display