

Seeing Clear Future for CNT, Eikos Explores Display Markets

One of the most interesting materials under study in the electronics industry today is the carbon nanotube (CNT, or sometimes "buckytube"), a nano-level structure of carbon bonds that give CNT greater strength than diamonds. These hollow tubes, thinner than human hair, exhibit unique electrical properties. They also are conductive.

For a small, privately owned venture outfit known as Eikos, Inc., one of the most promising characteristics of CNT is also one of its most contradictory features. That is, ordinary carbon nanotubes, whether in powder or in paste form, look quite black, but it is possible to create a transparent film of CNT. Massachusetts-based Eikos puts that see-through quality to work in electronic displays. One example is the company's Invisicon transparent conductors. Another is its transparent CNT inks for conductive coatings. Eikos is working on a durable conductive coating that has the potential to replace indium-tin oxide (ITO) films, the company believes. Additionally, according to Dr. Philip Wallis, Vice President of Operations, Eikos offers a version of its CNT ink that is printable in specially adapted ink-jet processes.

Eikos develops and licenses transparent CNT inks for conductive coatings, and supplies its Invisicon transparent conductors as replacement for indium-tin oxide (ITO) films. The company's business model includes licensing its technology and selling ink. Joe Piché, President and Chief Executive Officer, describes the company as "an intrepid band specializing in advanced materials for coating."

One of the drawbacks to conventional ITO films is their susceptibility to microcracking after repeated use. This eventually may prevent touch screens from responding properly, for example.

To overcome the problem of conventional ITO, says Piché, who also is the company's founder, "Our overall goal is to replace transparent metal-oxide semiconductor films...with something simpler...Our wish is to replace ITO everywhere it exists...ITO is a multi-billion dollar industry, so we think we can bite off a piece."

Good Conduct

To carry out that goal, the company's engineers, under the direction of Paul Glatkowski, Vice President of Engineering, have been working to raise CNT conductivity. He notes that carbon, an abundant organic material, is readily obtainable. Indium, though, forms as a by-product of zinc and lead, so its production involves the creation of heavy metal tailings.

Explains Piché, "We buy CNT from many different sources. There's actually a glut of small companies making CNT," because many universities have spun off their research departments for carbon nanotubes, he says. "When we get this material, only about one-third of the nanotubes are conductive; the other two-thirds are semiconductive...Then we clean it up." He says that cleanup involves separating out the semiconductive and conductive tubes, to raise the concentration of conductive tubes in the CNT material. "As a result, the company's coatings have grown in conductivity. "The more we deposit, the more conductive it becomes," says Piché. "We believe by this time next year, we'll have an order of magnitude of improvement in the conductivity."

At the same time, Eikos will work on other improvements to the technology. According to Dr. Wallis, efforts will proceed in three stages. The first step will be to ensure process stability. Next, the company will work to bring the material's transparency to 93 or 94 percent. In the third phase, the engineers will improve the yield.

Far View

So far, Eikos has provided its conductive-film technology for



Joe Piché, Founder, President, Chief Executive Officer

touch screens in desktop and laptop computers, mobile phones, and automatic teller machines. However, says Piché, "The applications are myriad: They go far beyond touch screens...We believe Invisicon will be a key technology for flexible displays."

Eikos' first licensing agreement took place in January of 2004 with Takiron Co., Ltd. of Osaka, Japan, a manufacturer and supplier of plastics, and of electrical and magnetic materials that use plastic. In press releases announcing the deal, Takiron officials said the license

would enable the development of high-transparency conductive films for flat-panel displays and other purposes. Meanwhile, Eikos has lined up nearly half a dozen other companies who are considering signing licensing agreements. "We're never going to do this as quickly as the industry wants. That's why we need big partners," says Piché. For instance, Itochu International Inc. invested US\$1 million in Eikos in 2004.

Other Fields

Piché says Eikos' technology offers customers "ease of manufacturing, production and cost, and the ability to design products that are better than you need." Eikos also has been pursuing business along other avenues, including electromagnetic shields for charge dissipation, and the top coatings on solar panels. For instance, Eikos' technology will work in the roll-to-roll printing processes many solar manufacturers prefer. Says Piché, "We're working with different types of solar manufacturers. We can reduce the cost because of the ease of processing, and we can improve the quantum efficiency."

Eikos has been in business for about nine years, and according to one online report, had 14 employees in 2004. However, Piché sees the company as having broad capabilities in business and in dynamics. "We're a mini-United Nations right now. We've got connections all over the world," he declares. He also is upbeat about the potential, in part because the cost of CNT has been dropping "precipitously," he says. "We believe it will be impossible not to embrace CNT." Of his company's products, he says, "We're giving the artist a new medium, and in this case, the artist is the engineer." □

