

With New Silicon-Based Inks, Kivio is Poised to Make Gains in PE

By David Savastano
Editor

The field of printed electronics (PE) is one of almost limitless potential, encompassing applications ranging from item-level tagging and displays to solar cells and much more. One of the keys to printed electronics is the ability to create low-cost solutions at high production speeds, and that requires highly sophisticated functional inks.

Kivio is one of the emerging success stories in the PE field. In October, the company announced the development of the world's first silicon ink-based RFID tag and the company's printed silicon RFID platform for item-level intelligence. This platform enables the development of affordable item-level RFID intelligence solutions for various markets, including retail, pharmaceuticals, transit, logistics and asset management.

The first products based on this patented platform technology are silicon ink-based HF integrated circuits (PICs) with 128 bits of printed read-only memory. The Kivio HF (13.56MHz) PIC will be the foundation for Kivio's low-cost HF RFID tag family. The innovative features of Kivio's HF PICs include a synchronous tags-talk-first mode of operation, a 106kbps data rate, an integrated capacitor and printed read-only memory.

Kivio has begun customer sampling of its new products in Q4 2008 and will start production shipments in Q2 2009. Initial applications include item-level brand promotions and advertising, authentication, asset management, ticketing and loss prevention.

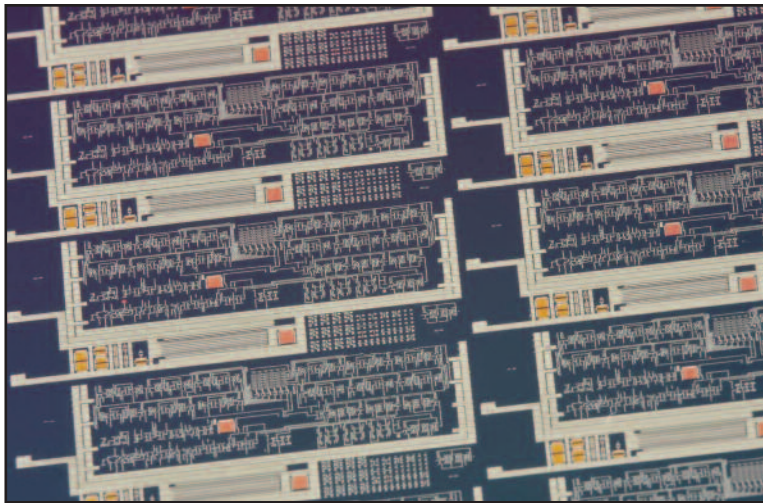
"Printed electronics is no longer a vision – it is here," Kivio CEO Amir Mashkooi told the audience at EPC Connection 2008 in making the announcement.

"While there has been a lot of talk about RFID over the past decade, affordability is the number one requirement

for RFID to displace the barcode for item-level intelligence," said Rob Chandra of Bessemer Venture Partners, an early investor in Kivio, during EPC Connection 2008. "With Kivio's printed silicon platform, we are now ready to truly extend RFID to where it has the largest impact – the consumer."

In order to meet demand for its new products, Kivio moved in April from its original headquarters in Sunnyvale, CA to a brand-new 95,000 square foot facility in Milpitas, CA, including a 22,000 square foot clean room.

There are plenty of believers who are providing financial backing for Kivio. Privately held, Kivio's investors include a virtual who's who of industry leaders and venture groups, including Kleiner Perkins Caufield & Byers, Bessemer Venture Partners, Duff Ackerman & Goodrich Ventures, DEA Capital, Flagship Ventures, Harris & Harris Group, Jerusalem Venture Partners, Northgate Capital, Pinnacle Ventures, Panasonic Venture Group, Mitsui Ventures, Yasuda Enterprise Development and Toppan Forms.



A printed silicon IC from Kivio.

The Origins of Kivio

Kivio's origin can be traced to Joseph Jacobson. An associate professor at the Massachusetts Institute of Technology (MIT), Dr. Jacobson is co-PI of the Center for Bits and Atoms and leads the Molecular Machine Group, and among his other notable achievements, is a co-founder of E-Ink. Dr. Jacobson and the co-founders envisioned printing silicon electronic inks, and Kivio began operations in late 2001.

The key differential for Kivio was the idea of using silicon rather than organic materials. Printed silicon electronics combines the intelligence and functionality of silicon semiconductors and the low-cost manufacturing paradigm of graphics printing.

"Most companies began working with organic materials,

but Prof. Jacobson's vision was to use printed silicon, and he developed Kovio to focus on that," said Vikram Pavate, vice president of business development for Kovio.

Interestingly, Kovio's leaders didn't set out to become an ink manufacturer, but the need for high-quality silicon inks drove them to develop inks.

"Our intention was not to be an ink manufacturer, but no one had ever heard of a silicon-based ink," said Mr. Pavate, who joined Kovio from Applied Materials, Inc. in 2002. "We have now developed various functional inks at Kovio, ranging from silicon, dopants, metals to dielectric inks. They have to be very pure with the right viscosity for jetting or gravure, and we need to manufacture these inks in a scalable, cost effective way.

"We have a great team here," Mr. Pavate added. "A significant percentage of our people are chemists and ink guys, who understand the nanomaterials that go into inks. Our chemists are enabling new products every day."

The choice of starting Kovio in the heart of Silicon Valley was a conscious decision on the part of Dr. Jacobson and the co-founders.

"The idea was to leverage the experience of Silicon Valley, and we have grown from that point," Mr. Pavate said. "We are taking a lot of pride in creating new jobs here in California, creating the next wave. We now have 50 employees as we are ramping up manufacturing."

Mr. Pavate foresees item-level tagging as being a key market for Kovio. While barcodes have been in use for more than 30 years, they are limited in what they can do. RFID using silicon chips offer more services, from better inventory management to the ability to communicate with consumers, but RFID comes today at a higher cost than the market will likely wish to bear.

"If you examine a silicon chip today, it is a fascinating device," Mr. Pavate said. "If you take a step back and look at barcodes, 10 trillion a year are printed. Barcodes are still the workhorse, but a lot of visionary companies want to move on.

"In the late 1990s, RFID began to appear as an option," Mr. Pavate noted. "However, the most fundamental issue about RFID is affordability, such as 10 cent to 15 cent tags on retail products. Silicon chips are very expensive and time consuming to fabricate, and are only made in a few places worldwide. They are also not easy to handle and apply to an antenna.

"By printing, we can reduce the cost of the RFID tag while adding more intelligence," Mr. Pavate said. "It will be a very elastic market; if you can cut the cost to one cent per tag, you can address trillions of tags. There are significant performance benefits; using our technology, the reader can read multiple items at once, and unlike UHF RFID where you need to deploy UHF RFID readers, our tags will be read with your cellular phone."

Kovio also looks to transform conventional passive displays in the advertising, entertainment and education markets into dynamic and interactive signage with wireless interfaces.

"From an applications point of view, our maximum opportunity is in marketing, by getting more information to customers and ensuring the product's authenticity. We will be able to provide item level intelligence, which will help brand owners sell their product to customers," Mr. Pavate added. "For example, pharma industry packaging could use printed silicon RFID, which ensures authenticity, provides more information in a legible fashion and has sensors to tell its efficacy and freshness."

Kovio's additive printed silicon technology is significantly more clean and resource-efficient than conventional silicon technology.

"The environmental effects are also appealing," Mr. Pavate said. "One of the challenges of silicon is the use of hazardous materials and gases. Our platform is additive rather than subtractive, so we can redeposit material where we need it. Our process will use only 5 percent of the chemicals, 25 percent of the power and 0.05 percent of the hazardous gases required to produce silicon chips."

The ability to quickly serve customers is another key to Kovio's future growth.

"It takes 90 days to make a chip, and another month to test it, leading to a six-month cycle for prototyping," Mr. Pavate said. "At Kovio, it takes less than a week to print our sample, which changes the entire service model."

Mr. Pavate said that Kovio's leaders envision their technology as beneficial for the global economy, consumers and the printing industry.

"This will be great for the global economy – one of the visions we have is that it is a localized technology. It can be manufactured locally. The large consumer packaging companies will be able to print these chips locally. Printers and consumers alike will benefit most from our new technology. Printers will be using this technology, and it could be optimized in so many different directions, and it will generate new jobs in the printing industry. One of our customers is Toppan Forms, and I have to tell you their eyes lit up when we showed them our work."

"We are looking forward to working with ink and printing companies, looking to work with visionary companies to scale up," Mr. Pavate added.

Kovio's Future

Printed electronics has excellent potential, and Kovio is perfectly positioned to succeed in this market.

The way I look at this is that it is a classic disruptive technology," Mr. Pavate said. "Forecasters predict this could be as big as the silicon industry within 25 years. I can envision this technology on displays, sensors and RFID. Conventional silicon will still serve the high-end, and the barcode guys will still do well because the infrastructure is in place.

"We are offering a new paradigm, doing it at much lower cost and lower start-up costs for capital," Mr. Pavate concluded. "It's a big wide-open space, with applications as diverse as ticketing, event tickets, marketing and promotions and loss prevention." ■