Uniqarta Seeks to Commercialize Solution for Embedding Ultrathin RFID Chips in Paper

The startup says the solution's process is less cumbersome and expensive than other alternatives, and that it is working with a paper manufacturer on a prototype of its first-generation process.

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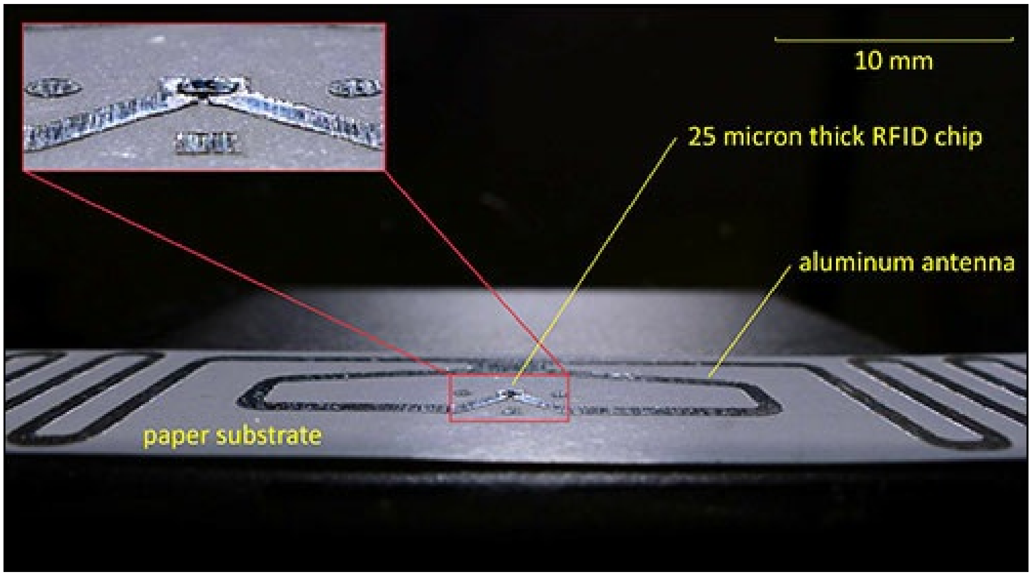
Mar 31, 2015—Uniqarta, a startup based in Cambridge, Mass., is commercializing technology for embedding an ultrathin RFID inlay in standard paper or packaging rather than laminated it between two paper layers. The solution involves EPC ultrahigh-frequency (UHF) RFID chips that are about 0.02 millimeter (20 microns) thick—one-fifth the thickness of most of the smallest existing ICs, according to the company.

The solution will be released in two stages, Uniqarta reports. The company's first-generation process will use a chip that has the same length and width of standard RFID chips—approximately 0.5 millimeter by 0.5 millimeter (0.02 inch by 0.02 inch)—but will be about five times thinner, and will serve as an interim until the firm commercially launches its second-generation process sometime during the next few years. Uniqarta expects its second-gen process to use chips that are about 70 percent the length and width of existing RFID chips—approximately 0.35 millimeter (350 microns) per side. The second-gen process, the company reports, promise to make the embedding of RFID tags into paper less expensive than RFID inlays cost, because they are so small. In addition, the first-gen tag assembly will be accomplished via a modified pick-and-place method, while the second-gen version will use Laser Enabled Advanced Packaging (LEAP) technology, which Uniqarta licensed from North Dakota State University (NDSU).



An RFID inlay made with Uniqarta's prototype first-generation process and a Walki aluminum antenna.

The cost of Uniqarta's first-generation inlay will be similar to that of existing RFID inlays, but will save some money otherwise spent on label conversion, since with the first-gen process, the chip and antenna would be built directly into the paper stock. Both first- and second-gen Uniqarta solutions are intended to bring RFID to items that previously could not be easily tagged, such as small packaging on consumer goods, security documents, money, or paper or plastic cards. Prototype inlays made via the first-gen process are expected to be available at the time of this year's RFID Journal LIVE! conference and exhibition, taking place in San Diego, Calif., on Apr. 15-17. The firm has already provided first-gen prototype inlays to two paper companies and some end users, and is still working with a paper company to provide RFID embedding capabilities to its manufacturing processes.

Researchers at NDSU publicly announced the LEAP method more than two years ago (see NDSU Researchers Develop Method for Embedding RFID in Paper). LEAP development leader and NDSU professor Val Marinov is now Uniqarta's cofounder and CTO. Ronn Kliger, who serves as Uniqarta's CEO, is the other cofounder of the firm, which operates a research and development lab in Fargo, N.D.

"Uniqarta's goal is to expand the reach of RFID technology to applications not yet able to access it due to reasons of cost or form factor," Kliger says. "By embedding RFID functionality within the materials from which many items are made or packaged, we expect to lower the barriers limiting RFID adoption today."

Standard RFID chips etched out of wafers tend to measure at least 100 to 125 microns in thickness, which means that paper must be thick in order to accommodate the chip, or else there will be a discernible bump in the paper. Companies could shave the wafers to make thinner chips, but a chip that measures less than about 75 microns in thickness is too flimsy for the mechanical pick-and-place method used to place chips within inlays. That, as well as the cost of conventional RFID labels, makes the RFID-tagging of some items impractical.

With LEAP, the chips could be thinned to only 20 microns or less, and then be applied via laser technology instead of pick-and-place. However, Uniqarta has not yet scaled up the LEAP process to accommodate standard inlay-manufacturing equipment configured to the company's specifications. What's more, Uniqarta is still developing the laser-based system that would enable the fast transfer of very thin chips to the paper layer.

Uniqarta's Ronn Kliger

In the interim, Uniqarta plans to offer its first-gen version that uses some of technology developed by the NDSU group for the LEAP system. In this effort, the firm has partnered with a paper company that has asked to remain unnamed. The company is working with Uniqarta to create prototypes of the RFID-embedded paper products that the firm would offer to packaging companies or brands that wanted RFID capability in their packaging. The prototypes involve chips that are thinned to about 20 microns, with the thinning process provided by a third-party company. The inlay would be made with an ultra-thin aluminum antenna, known as the Pantenna, provided by Finnish company Walki (see Walki Launches Service Using Lasers to Make Tag Antennas).

With the first-gen solution, the thinned wafer is attached to a "handle" with a heat-release adhesive. The wafer is then applied to dicing tape, and ICs are cut using a dicing saw. The IC and handle are next transferred to the paper substrate via pick-and-place, after which heat is applied to the adhesive to release the IC from its handle, and to paste it onto the substrate and antenna.

Kliger says his company's technology could be used for more than just packaging for consumer products. It could also be utilized to embed RFID inlays in banknotes, legal documents, tickets or plastic credit cards, as well as in smart labels to prove an item's authenticity. Additionally, the technology could be employed to embed Near Field Communication (NFC) RFID inlays into printed materials.

For its first-generation process, Uniqarta has used Mühlbauer equipment to demonstrate ultra-thin inlay manufacturing. However, Kliger notes, the inlay's embedding is accomplished on a papermaking machine.

Kliger has a background in semiconductors as the former general manager of a business unit at Analog Devices. He says he met with Marinov online in 2013 at CoFoundersLab and learned about the technology being developed at NDSU. Together, they launched the company in the fall of 2013 and have spent the past 18 months developing the first-gen version of the solution, in order to get the technology in the hands of end users.

Each installation with a paper product manufacturer will require collaborative effort, Kliger says. "We're not a paper company," he states. Therefore, he expects the firm actually making the paper products to work with Uniqarta on integrating the inlay-embedding process into its own operations.

In addition, Uniqarta expects to release an NFC version of the solution so that passive NFC high-frequency (HF) RFID tags could be embedded in paper products. With NFC, users could then employ their smartphones to read tags in paperwork, packaging or other products.

Once Uniqarta finishes developing the LEAP system and the second-gen process become commercially available, the solution will employ a laser beam to transfer each chip onto a paper packaging material or other substrate. With the LEAP method, the entire silicon wafer is bonded to the handle via the same heat-release adhesive. The wafer is diced and mounted on a glass carrier, and is held in place by a dynamic release layer (DRL). The ICs are then held above the proper position over the paper substrate, and an ultraviolet laser pulse directed at the DRL bonding material creates a blister that deposits the chip into position on the paper. This method is faster than the pick-and-place approach, since it does not require the mechanical process of picking up a chip from one location and then moving it to its position above the paper. Because the second-generation process will use chips that are smaller in length and width than the first-gen version, Uniqarta hopes that embedded RFID inlays made via its second-gen process will cost only about 3 cents apiece.

The company hopes to make at least one first-gen application commercially available, in order to demonstrate market adoption for its technology. "We expect second-gen funding to come from strategic investment," Kliger states, from other companies or venture capital firms. "We have several established companies that have expressed interest in providing second-gen funding."

Uniqarta is also applying for a Flexible Hybrid Electronics Manufacturing Innovation Institute grant from the U.S. Department of Defense, to help finance further development of the technology for use within environments in which a less flexible RFID inlay or other IC could not be used, such as clothing. The U.S. government agency's aim is to bridge the gap between applied research and product development in flexible hybrid electronics, bringing universities, R&D centers and federal agencies together with companies to develop marketable products containing materials that flex.