# VTT Is Developing Printed Sensors

Such technology could be used to make hybrid RFID tags that marry silicon RFID chips with printed sensors and antennas.

By Rhea Wessel

June 11, 2007—If and when passive RFID tags ever become printable, the tags will not replace their silicon cousins, according to Heikki Seppä, a research professor at the VTT Technical Research Center, a nonprofit independent contract research institute in Finland.

"If they come," Seppä told attendees earlier this month, at IntertechPira's Printed RFID conference in Frankfurt, Germany, "printed RFID tags will only partly replace silicon-based tags. It is more likely that new applications for item-level tagging will be generated by the technology." In the meantime, VTT is developing a printed sensor for companies that could be used to make hybrid RFID tags designed to marry silicon RFID chips with printed sensors and antennas.

Printed passive RFID tags, Seppä postulated, will have limited use because many applications require long-distance reads. Such tags are likely to have short read distances if composed of polymer transistors, which operate at a low speed due to the limited mobility of the transistors' electrons. That, he said, is why printed RFID tags may only partly replace silicon-based high-frequency (13.56 MHz) tags. In the long run, Seppä noted, they could also partially replace UHF tags, though he said that day may never come.

"It will be a very long time before we can print a high-frequency tag," Seppä said, adding, "Of course, something may happen in the research labs. We're trying to make transistors out of nanoparticles." Nanoparticles represent a "promising new opportunity" for replacing polymers in transistors, he stated, because they offer greater possibilities for creating a surface for more highly conductive materials than polymers do; in addition, he added, the material could have better mobility than that of polymers. He cautioned, however, that the concept still must first be tested.

"We start with nanoparticles," Seppä said, "then we sinter them, and then we have more mobility." When nanoparticles are sintered, they are heated until the particles adhere to one another. "By sintering," he explained, "you are making a real connection between particles. They are connecting together physically, and then they're conductive."

Standards are a second hurdle facing the development of printed RFID tags. Now that the EPC Class 1 Gen 2 standard has become widespread for silicon-based tags, researchers in plastic RFID are aiming to meet these standards in producing a tag. "It will be difficult to meet these standards," said Seppä, indicating that separate standards for printed RFID tags would benefit the market.

Although the idea of low-cost, printed RFID tags fits neatly into the vision of a world of ubiquitous computing, in which everyday objects interact with one another and people, Seppä doesn't believe such technology will ever be as widespread as silicon-based tags—nor, he added, does it need to be. "The price of silicon tags is low enough for many applications," he said.

Rather, Seppä said, he imagines hybrid tags might emerge, consisting of silicon RFID chips integrated with printed antennas and printed sensors. According to Seppä, sensors such as one that records the highest temperatures to which a tag was exposed can currently be printed, and printed antennas are already common. For now, however, printed sensors are not a focus of the printed electronics market, since no such market yet exists.

VTT is developing a printed sensor, Seppä said, adding, "The question is, is there a market? We cannot find a market for printed RFID sensors before we have widespread RFID infrastructure." He pointed out that in this area of printed RFID, developers also lack a standard for the interface between sensors and RFID tags.

Bruce Lyne, president of Sweden's Institute for Surface Chemistry (YKI), also attended the pRFID conference. He agreed with Seppä that developers of printed RFID tags should not build an equivalent printed tag based on the model of an EPC Class 1 Gen 2 tag. Instead, Lyne stated, they should consider the problem from the other direction—that is, they should determine which design for printed tags offers the most promise, then build that tag, worrying about standards later.

RELATED_ARTICLES Asked how close the market presently is to offering a printed RFID tag, Seppä said, "We are rather far away. The question is whether we will create new standards or work toward existing standards." If researchers in the field create new standards for a printed tag, he noted, fully printed tags will not arrive on the market relatively soon. "If we try to keep existing standards as they are they, we are far away."

At the conference, German company PolyIC reported that it had demonstrated two organic RFID tags—one with 32 bits of memory, the other with 64 bits—in a clean room. Separately, Seppä said VTT researchers have printed electric coding with conductive ink that can be read with a sweeping technique, or a contactless read in which a specially created interrogator is placed close to the tag and moved along its entire surface. "For me," Seppä said, "this is already RFID."

Copyright ©2005 RFID Journal, Inc. All Rights Reserved