NTERA’s Innovations, Partnerships are Leading to Excellent Opportunities in Smart Cards, Smart Packaging and Smart Object Markets

By David Savastano

If collaborating with industry leaders on promising projects is a clear signal that a company has a strong foundation, then NTERA should have a brilliant future in the printed electronics industry.

Founded as a spin-out from University College Dublin in 1998, NTERA is the leading developer of advanced, fully printable electrochromic materials enabling display and color change applications for Smart Cards, Smart Packaging and Smart Objects. NTERA's NanoChromics Ink Systems enable cost-effective manufacturing of printed electronic NCD displays on a variety of flexible substrate materials using industry standard screenprinting, flexo and inkjet printing techniques and equipment.

Along the way, NTERA has established partnerships with companies as diverse as plastic electronic GmbH, Plextronics, Blue Spark Technologies, GSI Technologies and Novalia, all leaders in their respective fields. With its innovative products and these collaborations in place, NTERA has positioned itself perfectly for future growth in the rapidly expanding field of PE.

The Beginnings of NTERA

Dr. Corr noted that NTERA’s initial mission to commercialize technologies derived from the use of nanomaterials, specifically leveraging the benefits associated with the creation of high surface areas in conducting and semi-conducting films, coupled with functional molecules that enable color change.

In 2007 the company was reorganized and focused completely on the printed electronics sector.

“We realized that this sector had become practical in the context of the ready availability of complementary technologies such as suitable substrates, printable conductors, printable batteries and RFID components,” Dr. Corr said. “At the same time, there was an emergence of companies willing to combine these technologies and create printed products.

“In short, an ecosystem that enables printed electronic products to be commercialized in a sustainable way had emerged,” Dr. Corr added. “Having these technologies available to NTERA meant that we could not only engineer plastic displays to demonstrate a cool new technology, but it could be done with strong commercialization objectives that could be achieved practically. As far back as 2002, NTERA had assembled and demonstrated NanoChromics technology on flexible substrates, but the ecosystem that would support integration and commercialization of these displays simply did not exist.”

Key Markets for NTERA

For NTERA, the key opportunities are found in smart cards and smart packaging.

“We characterize the markets that we serve as Smart Cards, Smart Objects and Smart Packaging,” Dr. Corr said. “The Smart Card market is perhaps, at this point, self-explanatory, with a number of articles citing the use of displays for One Time Passcode
OTP applications for two-factor authentication. Other examples include displays that can show the residual value on a transit card or other stored value cards.”

As for Smart Objects, Dr. Corr said these include products that can interact with their environment in various ways, such as a display that can change color in an RF or NFC environment that can indicate to observers a particular status such as a security breach or the authenticity of a ticket, secure document or an environmental control limit.

“The types of products we have in development with customers range from authentication features on documents which are triggered by RF energy harvesting to battery powered data logging systems that can indicate on the item or pallet level, if a good has been outside predetermined temperature limits during shipment through the supply chain,” Dr. Corr noted. “We are also exploring applications in dynamic price labeling which allows for the prices on higher value goods to be changed remotely within their supply chain.”

Dr. Corr noted that “Smart Packaging is a very interesting area and is currently seeing a lot of activity from the main players in the space,” he said. “We have projects underway that are developing solutions for interactive packaging, including labels and other card-based products,” he added.

As is the case with any company, one of the keys is how it differentiates itself in the market. Dr. Corr said there are several important differentiators, including cost effective manufacturing, simple integration, low power consumption and color, and that NTERA is well-positioned to help its customers benefit in all these areas.

“The cost effective manufacturing benefit derives from having an all-printed display architecture,” he said. “We believe that to really gain the benefits from printed electronics, the technologies must be compatible with additive printing or converting processes.

“Having to pick and place or attach components to circuits leads to two cost elements, the cost of the attachment in itself and a cost in creating a non-seamless interface that gives rise to failures measured by the impact on yield,” he continued. “By printing, many components are created at the same time and the interface between components becomes seamless, particularly when shared conductors are used.”

As for simple integration, Dr. Corr pointed out that printing objects also leads to a greater capability to have flat and flexible form factors and therefore ease of integration into many products. “The history of converting processes is a testament to this and being able to take advantage of printed electronic inlays, overlays and components on the same substrate as other printed objects gives the product designer a better toolset to merge graphic design with electronic design,” he added.

“Of course, without low power consumption, the true benefit of these manufacturing and integration advantages is difficult to realize,” Dr. Corr continued. “Low power enables portability and extended lifetime. Having a technology that is power frugal enables use of various power storing and energy harvesting solutions.”

Dr. Corr said the NanoChromics system can be used with conventional and printed batteries, conventional and printed solar cells, as well as radio frequency systems. This derives from two factors, low voltage operation (the color change is triggered at
voltages below 1 V DC) and a charge storage capability, essentially the NCD device is a color changing capacitor.

“...The result is that as energy is taken on at a low voltage, it is stored in the capacitive reservoir. So there is no need to maintain constant power to color the image on the display as it will persist for an extended period of time (minutes to hours) depending on design. An important feature of this operation is that to switch the devices the supporting circuitry is massively simplified compared to other electro-optic effects that require voltage conversion and other cost-adding elements. We have demonstrated all of these features within our ecosystem as a way to illustrate to product designers the variety of choices they have when developing products.

“Aesthetically, NCD displays have the first obvious feature of being almost as white as paper,” Dr. Corr said regarding NTERA’s color capabilities. “Having a best in class bright background enables high contrast and readability of the display in monochrome. This also enables a base from which various color electrochromic materials can be optimized. Other display technologies have challenges in rendering color in a cost effective manner, due to dark or off-white backgrounds, or a restricted color set. When it comes to graphic icons, branding, and security applications, the availability of different color solutions will be critical, not only in the display itself but to also complement the brand identities and color schemes into which the printed products will be integrated.”

Partnerships with Leading PE Companies
NTERA has caught the eye of numerous industry leaders, and is working closely with its partners. Most recently, NTERA entered into a license agreement with plastic electronic GmbH, in which plastic electronic will design, develop and manufacture prototype printed electronics products using NTERA’s NanoChromics technology at its Linz, Austria facility, starting with a NanoChromics Display Evaluation Kit. NTERA has also had excellent collaborations with GSI Technologies, Plextronics, Blue Spark Technologies and Novalia.

Dr. Corr said that the work with plastic electronic GmbH allows NTERA to continue to support plastic electronic in driving the commercialization of advanced printed electronic solutions.

“Although several applications have been identified that will benefit from printed displays such as OTP (one-time passcode) and other authentication elements, there is a challenge for technology providers to market and promote the form factors and features of printed flexible displays,” Dr. Corr said. “The recent announcement with plastic electronic GmbH of the availability of an evaluation kit enables product designers and electronic companies to have in hand a practical demonstrator of the technology.

“Several of the benefits can be readily seen, i.e., thin, flexible form factor, straightforward design, low complexity electronic control and operation,” Dr. Corr added. “The evaluation kit has attracted a lot of attention and is proving to be a great way to get the technology into the commercial arena at a very low expense to product designers. NTERA’s expertise in such projects extends beyond the supply of inks to the system integrator. The company has extensive experience now in materials, manufacturing processes and electronic design that is leveraged in support of our
customers. Our commercial model involves not only our products (ink systems) but also a comprehensive technical support service to our customers.”

Aside from printed electronic GmbH, NTERA is working with Blue Spark Technologies, a leading supplier of thin, flexible printed battery solutions, to demonstrate the world’s lowest voltage battery-display system. NTERA is also working with Blue Spark and Novalia on a series of innovative projects.

In combining Blue Spark’s battery chemistries and application design capabilities with NTERA’s ultra-thin, color-changing, 1.5 volt compatible display technologies, the companies believe they can provide added value to smart card makers, helping them to reduce material costs and streamline manufacturing, assembly and integration processes.

The companies’ thin battery and electrochromic technologies also have broad applications in other markets, such as smart packaging, interactive merchandising displays, greeting cards, toys and novelty items.

NTERA, Inc. and GSI Technologies, a leading manufacturer of functional printed electronic components, entered into a multi-year license and material supply agreement in late 2008 to produce devices using NTERA’s NanoChromics technology, with an eye toward bringing a range of smart cards to market. GSI has implemented NTERA’s NanoChromics material and technology on its sheetfed and web-fed (roll-to-roll) printing assets.

At the LOPE-C 2009 show in Frankfurt, Germany, NTERA teamed up with Plextronics to demonstrate solar-powered NanoChromics color changing displays, powered by a Plextronics organic photovoltaic (OPV) solar cell printed with Plexcore ink technology.

As for its partnerships throughout the PE industry, Dr. Corr said that PE is an emerging space, which is ideal for collaborative efforts.

“Printed electronics is being redefined beyond the printing of conductive traces and electrochemical materials to the more elaborate construction of multi-layered components such as batteries, diodes, transistors, memory, solar cells and displays,” Dr. Corr said. “As such it is an emerging space. In an emerging space, the incentive for participants is to collaborate to practically assess the value that can be created.

“One of the first goals we set for NTERA after our decision to refocus the business on printed electronics was to determine if there is an emerging, healthy ecosystem that can give rise to this new industry,” he added. “We have been overwhelmed by the positive answer to this question and our relationships with several printing companies, complementary technology companies and suppliers are evidence of this. We are well beyond the ‘if’ now and concentrating on making the ‘when’ as soon as possible. All of our collaborations are moving forward at various rates, depending mostly on the complexity of the product being engineered. Simple battery/switch/display systems are essentially available for design-in right now, RF powered systems are a close follower and more complex designs that require microcontrollers, sensors and software take longer to design and verify but we expect to have products with our technology realized over the course of the next six to 18 months in those categories.”

Expectations for NTERA, PE
Understandably, Dr. Corr anticipates a successful future for NTERA in the coming years.
“My expectations for NTERA are to continue to move along the curve of ever increased complexity in devices and further integration into all-printed systems,” Dr. Corr said. “I believe we have a unique technology that is an ideal fit for this sector, and one that will create a lot of value.”

Dr. Corr also sees great opportunities for PE, particularly as the technology reaches into areas served by printing, ultimately becoming a disruptive technology in the electronics space.

“Printed electronics will produce relatively simple products for the next several years, but these are products incorporated into segments that traditionally do not use electronics, i.e., the printed media,” Dr. Corr said. “This is therefore an area that can absorb the current simple functionality of printed electronics well, provided appropriate cost is considered.

“The idea that printed electronics technologies can enter a space like this with relatively low levels of functionality is a classic element of disruption, and I have no doubt that, in time, as printed electronics matures, we will figure out how to design more complex products and start to disrupt the traditional electronics sectors,” Dr. Corr concluded. “It is likely that in time we will see the use of the term ‘Original Design Printers’ when it comes to the manufacture of electronic products.”