



Schreiner Group developed a label that provides electronic tamper evidence and can be read using smartphones. (Image courtesy of Schreiner Group.)

## Active & Intelligent Packaging: Digital, Disruptive and Smart!

With digital printing deservedly taking so much of the credit for all it offers the packaging sector, it's understandable that printed electronics (PE), thermochromic and photochromic inks or high-definition QR and bar coding might seem less significant. But in the world of smart packaging, or as it's more accurately known, active and intelligent packaging (A&IP), these and other print-related technologies are having a tremendous impact.

As printing technologies continue to play a central role in A&IP's development, many big brand owners are quickly catching on to its potential for their increasingly complex needs. As they protect their image, brands have to find new ways to engage and protect consumers. This can prove challenging because counterfeiting is rife, supply chains can be very complicated and open to abuse, and gathering better information about consumer behavior is vital.

Additionally, these technologies can address the need for better food security, less waste and more information about origins, allergens and ingredients. For pharmaceutical companies, A&IP offers routes to compliance, authentication and traceability, which are now more imperative — if not yet legal requirements.

In the following, I'll cover how some of these new printing technologies and ideas along with clever uses of graphics and inks are enabling the latest A&IP solutions to hit the market.

### Printed Electronics

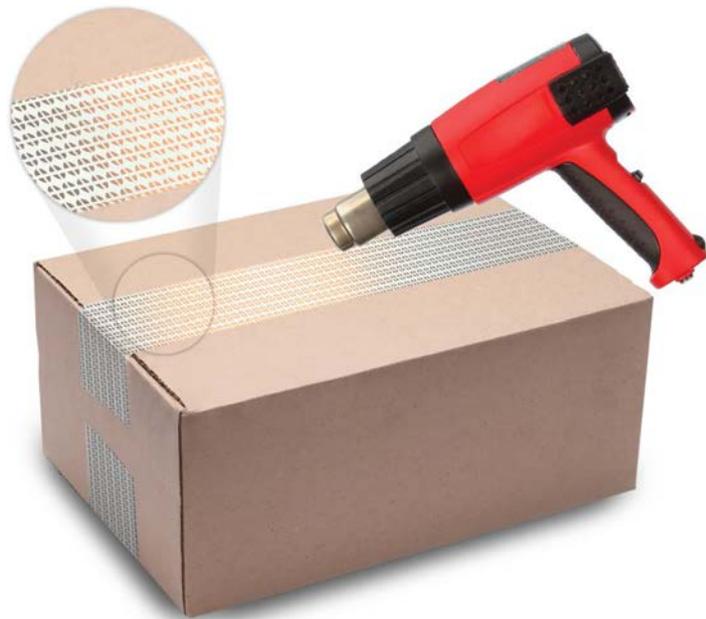
The German medical packaging specialists of Schreiner Group have recently developed a label that provides electronic tamper evidence and can be read using smartphones. It's claimed to benefit manufacturers as well, because integrated geotracking allows them to see where their products are used.

The label, a combination of silicon chip

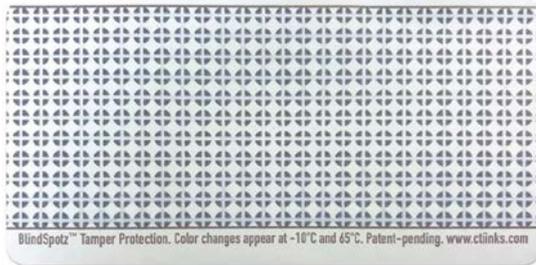
*As printing technologies continue to play a central role in A&IP's development, many big brand owners are quickly catching on to its potential for their increasingly complex needs.*



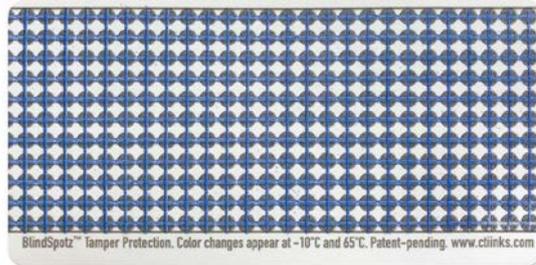
By Andrew Manly, Communications Director, Active and Intelligent Packaging Industry Association (AIPIA)



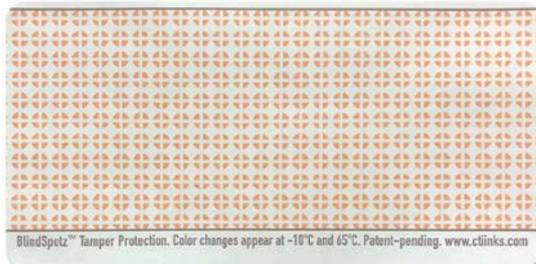
### UNTAMPERED



### FREEZE TAMPERED



### HEAT TAMPERED



and printed conductive track, includes an invisible PE sensor that is severed in a tampering attempt. It indicates tampering in two ways. Peeling the label off the surface produces a void effect as visual tamper evidence. In addition, when scanning the label with a smartphone, a PE sensor signal will indicate a tampering attempt.

In the food sector, the Canadian-based FPIInnovations has developed a printing approach for producing safe microwave susceptor packaging. The unique pattern approach prevents overheating and reduces the risk of the package igniting or scorching, while increasing the heat uniformity of the food.

A susceptor is a material used for its ability to absorb electromagnetic energy and convert it to heat. According to FPIInnovations, by directly printing conductive carbon ink onto cellulose-based substrates, sustainable “active” food packaging is achieved while lowering production costs and streamlining the manufacturing process. This approach — already having successful trials on existing printing presses — offers tuneable heating profiles by adjusting the printing conditions.

### Holograms

The Schreiner Group has also introduced the multifunctional Covert-Hologram Seal with an irreversible holographic effect offering reliable first-opening indication and tamper evidence, along with counterfeit protection. The seal complies with the European Union’s (EU) Falsified Medicines Directive, which has required pharmaceutical companies to include a unique identifier for each pack of medicine they manufacture or repackage by February 2019.

Another example is microholograms, tiny particles that can be added into paper and look like metallic dust to the naked eye. With a magnifier, a user can spot regular shapes and holographic surfaces. Optaglio, a developer from the Czech Republic, claims that forensic inquiry shows holograms, including all visual effects, on each grain.

### Clever Inks

In the summer of 2018, Coca-Cola Turkey launched a promotional campaign making unprecedented use of thermochromic inks to add color, function and fun to 10 new aluminium beverage can designs, produced by Crown Bevan.

Usually only one or two thermochromic

Chromatic Technologies Inc.’s (CTI) BlindSpotz™ features a dual indicator to detect product tampering from heat and freezing. (Images courtesy of CTI.)

inks are combined to communicate temperature changes, but in this instance, the ink technology was applied as a true decorative tool as four separate inks were used for designs that stood out when the cans were chilled. Colorless at ambient temperature, the cans' colorful patterns, including palm trees and sandals, appeared when the drink was chilled and ready for consumption. A total of 70 million units were produced for the campaign.

Elsewhere, U.S.-based Chromatic Technologies Inc. (CTI), expanded its photochromic ink capability in Mexico with a Cheetos-exclusive promotion for Frito-Lay called "Where is Chester?" To grab consumers' attention, the brand used photochromic ink to hide the Cheetos mascot on its bags, making him visible only when the packaging was exposed to sunlight.

"One of the challenges of using smart technology is finding an application that isn't just a gimmick, but that has a meaningful connection to the brand," explained Barry McCann, Product Director, CTI. "The ultimate goal is to lift product sales, but for lasting power, it has to speak to the consumer in a way that reinforces the brand's personality and promise."

In addition to establishing meaningful connections for brands, CTI's technology is helping prevent product tampering. The company says its BlindSpotz™ is the first dual-indicator to detect product tampering from heat and freezing. According to CTI, the use of extreme temperatures (especially sub-zero temperatures) to circumvent traditional security measures on packaging has increased substantially in recent years.

Most tamper indicators only reveal heat tampering, such as using a heat gun to melt glue on packaging tape. "Tamper Freeze" inks turn from clear to blue when exposed to temperatures below -10° C (14° F) while "Tamper Heat" turns gray to orange (or to pink) if exposed to heat greater than 65° C (149° F).

The technology — available in UV flexo and water-based systems — can combat the use of cold spray, freezing or liquid nitrogen to pull apart a money or document bag, remove and replace an expired label or bypass security tape-treated irreversible inks.

### Invisible and On-Demand RFID

During the 2018 Active and Intelligent Packaging Industry Association (AIPIA) Congress in Amsterdam, Japanese company Asahi Kasei introduced a sub-



A new technology by Prisma and Siegwark connects different packaging types to the "internet of things" via a website or app. (Image courtesy of Siegwark.)

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Retailer Albert Heijn's QR code-enabled blockchain pack allows consumers to track its products' journeys to the store shelf. (Image courtesy of Refresco.)

micron roll-to-roll (R2R) technique to achieve an “invisible” radio frequency identification (RFID) tag. Takeshi Kamijo, a member of AIPIA’s printed electronics development group, outlined the roadmap to this transparent antenna’s creation.

The company has also developed a large area seamless roller mold (SRM) using EB-lithography, which includes various mold pattern variations and a unique, high resolution printing process and conductive cuprous oxide ink. Using its new printing technology, Asahi Kasei wants to print a sub-micron copper antenna on PET. The tiny metal mesh on the packaging substrate would be less than 3 micrometres thick.

This transparent metal mesh antenna could be a revolutionary step in the adoption of RFID onto many packs where ‘real estate’ is at a premium. As a result, brand owners and pack designers would be more willing to adopt the device, because it wouldn’t interfere with a long-established brand or pack image.

In another move to make RFID more B2B-compatible, Pinnpoint, a supplier of self-adhesive labels, has partnered with RFID inlay solutions provider Smartrac and laser printer manufacturer Lexmark to create “on-demand” RFID printing. These solutions can allow shippers to automatically view the status of returned goods via RFID tag reads, addressing the growing reverse logistics model for online shopping.

The expansion is part of Lexmark’s effort to provide a variety of solutions for a growing number of potential clients seeking solutions for logistics.

Pinnpoint provides forms and labels for use in the new RFID-enabled printer, as well as software and integration services. The labels, typically sheets measuring 216 millimeters by 280 millimeters with embedded RFID tags, are designed to be affixed to cartons, pallets, shipping containers or goods being shipped to a customer, or be packed with a product during assembly.

### Codes for Blockchains and More

Through a QR code-enabled blockchain pack, Dutch retailer Albert Heijn enables consumers to follow the entire route of its labeled sustainable orange juice product from the Louis Dreyfus Company in Brazil to the store shelf.

“Transparency in the chain is becoming increasingly important. We know all the steps that our products go through to



For Coca-Cola Turkey's summer 2018 campaign, Crown Bevcan produced cans that utilized thermochromic inks. Colorless at warmer temperatures, the cans' image patterns emerged as their temperature cooled. (Images courtesy of Crown Bevcan.)

ensure that they are produced with respect for people, animals and the environment. We want to show these steps to our customers," said Marit van Egmond, Commercial Director, Albert Heijn.

The blockchain was developed in collaboration with technology partner Supply Chain Information Management. The data from the product's various steps is linked and made transparent, allowing customers to use and interact with the QR code on the packaging.

In another example, Multi Packaging Solutions Inc. (MPS), a WestRock company, is making packaging smarter through a partnership with Smartglyph, a United Kingdom-based technology business.

Without any change to the existing packaging or barcode, SmarterBarcodes transform a standard barcode on any product or packaging format into a two-way interactive communications channel. This allows consumers to interact with a brand and product by simply scanning the standard barcode with any mobile device that has a camera.

This technology optimizes the use of existing space and requires no artwork or pack changes. No data is held on the graphic other than a 24-digit number, which is a pointer to a server. It can carry unlimited content.

### The "Internet of Things" Connection

Prismade, a printed electronics specialist, collaborated with ink maker Siegwark on a new technology for connecting various packaging types in a cost-effective way to the "internet of

things" via a website or a dedicated app using a mobile phone.

According to the partners, this technology — a solid anti-counterfeiting solution that cannot be replicated — can work for many packaging types and is easily scalable for mass-production since it is applied via conventional printing processes. The printed structures are also kept invisible to not interfere with a given packaging design.

### Staying Competitive

From the A&IP provider's perspective, supplying the technologies at a scale of production and cost effectively is the key to staying competitive. Some of the latest PE machines, such as those from Kelenn Technologies in France, are using inkjet to speed up the process while Thinfilm and PragmatIC are both producing near-field communication RFID tags printed on roll-to-roll machines at high speed and low cost.

Impossible to copy, the advancements in microprinting and other forms of security-based codes, such as those developed by HP Indigo, are coming more and more to the front line in the fight against counterfeiting. They are truly scalable solutions requiring no additional space on most packs.

A&IP is also addressing sustainability issues, as exemplified by paper-based batteries developed by Stora Enso and BillerudKorsnäs that have the potential to measure temperature, position and transport activity.

As all of these features become more versatile with a reduced impact on brand

image and design, they will surely see a wider adoption and become an imperative part of pack function.

### Impact

These are just a few of the A&IP developments already disrupting the market and enabling niche brands to take on the food, beverage, cosmetics and even pharmaceutical giants in ways they never thought possible. Thanks to consumer engagement features, as well as digital printing technologies, companies can be extremely agile and grab attention — and sales — regardless of their size and advertising budgets.

A&IP is having a profound and wide-ranging impact in almost every consumer packaged goods sector. And with advances in printing technologies, it's a rapidly growing market, set to play a leading role in the disruptive digital age. Needless to say, there is plenty more to come from smart packaging.

*Having joined the packaging sector over 40 years ago, Andrew Manly has held several senior positions in the industry, including the founding CEO of the UK's Processing and Packaging Machinery Association (PPMA). Currently he is the Communications Director and a co-founder of the Active & Intelligent Packaging Industry Association (AIPIA). An experienced journalist and commentator on the packaging sector, he edits the European Aluminium Foil Association journal. A keen observer of the latest market developments, he has visited more than 70 countries lecturing on innovations in the industry and has attended U.S. packaging events since 1988.*