TruTag Technologies, Inc

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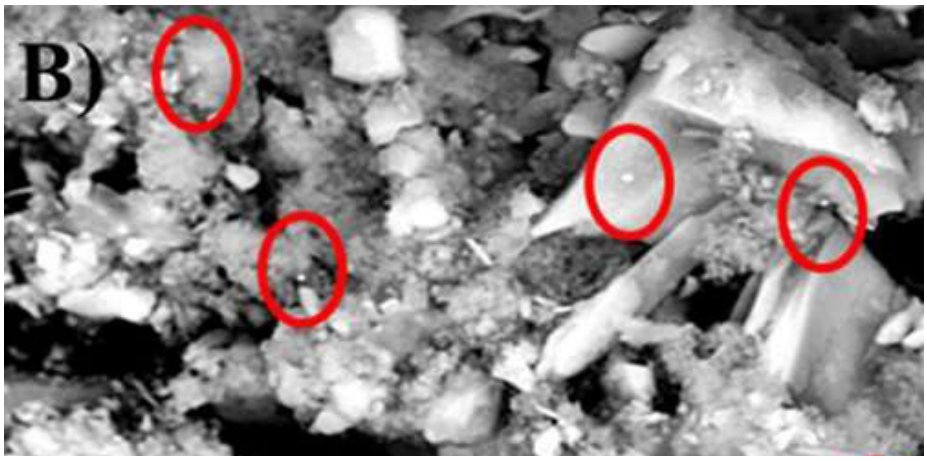
High-Security Nanoparticles Authenticated By Common Sensors



Nanoparticle-based ink, with nanoparticles circled in red (Campos-Cuerva, et al).

Researchers in Spain have demonstrated that transparent ink containing gold, silver, and magnetic nanoparticles can be easily screen-printed onto various types of paper, with the nanoparticles being so small that they seep into the paper's pores.

Although invisible to the naked eye, the nanoparticles can be detected by the unique ways that they scatter light and by their magnetic properties, said the researchers (Carlos Campos-Cuerva, Maciej Zieba, and co-authors at the University of Zaragoza and CIBER-BBN in Madrid).

'We believe that it would be interesting to sell to different manufacturers their own personalised ink providing a specific combination of signals,' said co-author Manuel Arruebo. 'The nanoparticle-containing ink could then be used to mark a wide variety of supports including paper (documents, labels of wine, or drug packaging), plastic (bank or identity cards), textiles (luxury clothing or bags), and so on.'

The researchers claim that whereas previous methods of using nanoparticles as an anti-counterfeiting measure often require expensive, sophisticated equipment, the new technique is much simpler. The nanoparticles are attached to the paper by standard screen-printing of transparent ink, and then authenticated using commercially available, low-cost optical and magnetic sensors.

Although the ink is easy for the researchers to fabricate, attempting to replicate these authentication signals would be extremely difficult for a forger because the signals arise from the highly specific physical and chemical characteristics of the nanoparticles.

Making replication even more complicated is the fact that the combined optical and magnetic nanoparticles are printed on top of each other in the same spot, and this overlap creates an even more complex signal.

The researchers plan to further increase the security of the technology by adding more physical signals – including electrical ones – to the same tag.

GM Patents Security Label Technology

General Motors' subsidiary GM Global Technology has been granted a US patent for what it describes as an improved security label.

The label carries multiple security layers, including a pattern of dots that provides a unique identifier – disguised as an imperfection on a printed label – and also includes raised dots at a specific location that can be used to verify the label by touch.

The idea behind this technology is that counterfeiters will dismiss the pattern of small dots as a printing flaw, whereas inspectors can be trained to look for the presence or absence of the dots.

The full abstract of the patent (no. 9,248,673) is as follows:

'Improved product labels cannot be easily counterfeited. A plurality of small dots printed on the label are interpreted as dirt or flaw or misprint so that the counterfeit label will not reproduce the plurality of small dots. A first image printed on the label and having a first level of spectral reflectivity, and a second image printed atop the first image using ink having a spectral reflectivity different from the spectral reflectivity of the first image. A plurality of very small dots creates a grayscale field, and a symbol printed within the grayscale field of very small dots, thereby creating a watermark of such high complexity that it cannot be counterfeited. A symbol printed on the label, and a raised dot of ink printed atop the symbol at a precise location to be sensed by finger contact and thereby indicate the authenticity of the label.'

TruTag Enters Pilot-Scale Production

During a short visit to Hawaii, *Authentication News*® was able to visit TruTag Technologies' (TT) factory in Kapolei, Oahu, where it has recently commissioned its first large-scale production line for its edible taggants – a major watershed for the company.

Established in 2011, TruTag Technologies, Inc, was originally spun out of Skai Ventures, a Honolulu incubator/accelerator for innovative technology companies. TT has won numerous accolades for its edible, spectrally encoded taggants: in 2014 *R&D Magazine* named it as one of its R&D 100; it was identified as a *Technology Pioneer* at the World Economic Forum in Davos, Switzerland, and also won an Edison Gold Award. Its latest recognition was in February this year, when it was named as one of 47 BIG (Business Intelligence Group) Innovation Awardees.

Commissioning its new production line not only marks a major achievement for the company, but is a demonstration of its confidence in the potential market interest for its taggants, following tests and trials by several companies from the different market sectors. The company has been mainly working in the pharmaceutical sector – where the ability to ingest its taggants has obvious appeal – but it is now moving into various other markets where there is potential for its taggants.

The TruTag solution consists of taggants with nanopores carried on microparticles of silicon dioxide, which reflect a very specific spectral pattern when scanned with the company's portable detectors.

TruTag Technologies' factory in Kapolei, Oahu, Hawaii.

The number of spectral 'codes' that can be created is enormous, so the 'TruTags' can be customised to each customer or product. (See the side bar for an explanation of this technique.)

TT's taggants are made by etching a specific code onto a wafer of silicon, a standard raw material component for the semi-conductor industry. Its production process is carried out in a controlled environment, and involves etching the nano-holes into the surface of the silicon, while implementing very precise uniformity using a proprietary process. After the etching occurs, the material is processed into microflakes to a size to the order of a human hair. Because the etching is uniform to the entire manufacturing batch, each tag particle from the batch contains the exact same code, or pattern.

The final taggant material in finished form is 100% amorphous silicon dioxide, a material recognised by the US Food and Drug Administration (FDA) as GRAS (or Generally Recognized as Safe), a designation for edibility. The new production system and the facility in Kapolei is cGMP (Current Good Manufacturing Practice for pharmaceuticals) compliant.

The core of the system is a new design in etching machines that was developed in-house along with the cooperation of a Silicon Valley supplier. The starting material in wafer format is 200mm diameter silicon wafers, up from the 100mm that TT's prototyping systems could handle, so this has in itself increased the company's production capacity. But the new HVM machine design can handle multiple steps simultaneously, resulting in production capacity increases of more than 50 times in just the last 18 months.

The company moved into these premises in 2013, where it has today a total of nearly 10,000 square feet, including research labs and offices.

It is also now looking to add additional equipment lines in its existing production space to meet near-term anticipated customer demand.There are around 50 staff split between the company's Kapolei Production plant, its Advanced Reader Technology group in Emeryville, California (East San Francisco Bay, on the fringe of Silicon Valley), and its business development offices in Pennsylvania, Texas and Hong Kong.

Contact: **www.trutags.com, www.bintelligence.com.**

TruTag's Technique

TruTag uses the diffraction of light from an array of nano-holes as its key to producing a unique spectral pattern as required by each customer. Controlling the etching in production allows the spacing, depth and number of holes to be specified, while the company also has the ability to create a unique reflected pattern through optical techniques, leveraging the nano-hole structure. When the taggant is illuminated with white light, the result is a reflected unique spectrum that can be read and decoded using advanced optical techniques and software algorithms.

The taggants are distributed randomly in the item – which might be a tablet coating, the medicine itself or the packaging – so that wherever the light falls and from wherever it is collected in the spectrometer, this pattern is revealed.

TruTag has developed several different readers suitable for different environments, the latest being the *Model 4100* hand-held optical detector (see AN December 2015).

Inside this Issue

News in Brief

Illumination from Spectra

UK-based Spectra Packaging has launched a new print technique to help counter brand counterfeiting.

Illuminate is an invisible print technique that fluoresces and is revealed when exposed under UV light. It is described as a 'glow in the dark ink finish that lights up under UV, providing a perfect anti-counterfeit packaging solution for customers wishing to protect their brand'.

Spectra specialises in packaging for the cosmetics and personal care markets, focusing on PET and HDPE containers and closures.

New HologramCap for Packaging

KISICO, the German-based producer of packaging caps and closures, has partnered with Morphotonix, the Swiss-based start-up company that integrates custom holographic-like diffractive elements on 3D metallic master moulds (or plastic injection moulding, compression-moulding, blow-moulding, and thermo-forming), to develop a hologram-topped cap for the packaging sector that is free from additives or inks. The solution is called *HologramCap.*

HologramCap.

The hologram design is integrated into the injection moulding production process for the cap, without the need for any additives, inks, or changes to existing production processes, and can be customised according to customer requirements.

The patented Morphotonix process to integrate the diffractive structures into the cap utilises a nano-engraved mould or insert that can incorporate both overt and covert security features into flat and/or curved surfaces. The insert is harder than steel, is very durable and is used as the replication tool to embed the diffractive security directly into the rigid cap during the production process.

According to Kisico's Technical Sales Manager Clemens Börner, 'holograms, which have long been used on secondary packaging as a means for verification, can now, thanks to Morphotonix' technology, be integrated onto the plastic cap, making the hologram an integral constituent of the primary packaging'.

OpSec to Buy API Security Business

API Holographics has announced it is in discussions to sell its holographic security business (which is primarily located in Salford, UK), to OpSec Security. It is proposed that OpSec, a global leader in protecting, authenticating, and enhancing brands, services and revenues will acquire API Holographics' security business customer contracts and associated equipment to continue that business. The decorative holographic arm of API's business will be retained.

'API's security holographics division will provide OpSec greater capabilities in the manufacturing of foils and laminates,' said Richard Cremona, CEO of OpSec Security. 'Quality security products, responsive customer service and market synergies make this potential acquisition beneficial to both OpSec Security and API customers.'

API Holographics is now consulting with its employees, customers and partners, and expects to complete the process early in April 2016.

New Belgian Stamps Go Digital

Starting in March this year, the new Belgian tobacco tax stamp will be printed digitally and on demand on a Xeikon press, replacing the current stamps that are printed by conventional means.

The new stamps have been designed using Agfa Graphics' *Arziro Design* security software. The software – which is described by Agfa Graphics as a powerful design tool for general security printing and personalisation – was launched last year as a plug-in for Adobe Illustrator (see AN June 2015).

The digital press prints the stamps with hairlines, microtext, security rasters, guilloches, serifs etc. Variable data and a QR code make every stamp not only unique but also traceable. The design also incorporates a concealed image printed in invisible ink that only appears under UV light.

All stamps are printed on FSC labeled paper (Forest Steward Council), in alignment with European and Belgian directives. The previous stamps were the traditional paper-based, wet-glue variety, printed in intaglio.

Arziro Design, which was inspired by Agfa's Fortuna design software for the high-security print market, can create very complex, security patterns in seconds for general security print applications, running on a standard Adobe Illustrator CC 2014 system for Mac and Windows. It is intended for companies involved in the design and production of packaging and labels, tickets and coupons, tax stamps, post stamps, company access cards, bank cards, and general document security such as breeder documents, certificates or diplomas.

CCL Acquires Checkpoint

Label and packaging specialist CCL Industries has announced it is to acquire Checkpoint Systems in a transaction valued at approximately $556 million. The acquisition has been approved by the Boards of both companies, and is expected to close in mid 2016.

Checkpoint is a leading manufacturer of loss prevention, inventory management and labelling solutions, including RF and RRID-based, to the retail and apparel industry. According to CCL, its acquisition represents a unique opportunity for CCL to enhance its breadth and scale, particularly in 'smart' labelling technology.

The acquisition follows those last year of Worldmark, a manufacturer of pressure-sensitive security labels, and Sennett Security Products, a specialist security printer and label supplier (see AN October 2015).

Multi-Security Closures from SICPA

SICPA has introduced a new capsule closure featuring 'multi-layered security solutions to fight counterfeiting, diversion and adulteration' for the wine and spirits sectors.

Compatible with polylaminate capsules and capsule makers' existing equipment, the closure uses patented colour-shifting properties for overt authentication. A semi-covert feature in the form of invisible fluorescent ink is complemented with covert security detected only with a proprietary device. This set of technologies enables end-to-end authentication capability, from the brand owner to the consumer.

Machine-readable datamatrix or QR codes with secured serialisation components can be printed onto the capsules, to act as a unique identifier for each unit and provide track and trace capabilities. This technology, says the company, can also be authenticated via proprietary devices or smartphones.

Today's Authentication Methods for Documents and Products

Part 4: Windows – Seeing the Light!

In December 2015, *Authentication News*® began a series of articles on the characteristics and functions of the different groups of authentication features used to protect today's documents and products.

So far, we have covered three groups of security devices that are carried in the document substrate: watermarks, threads and the various fibres, planchettes, dots and other particles that can be embedded into paper substrates.

This month, we again stay with substrate-borne security by turning our attention to a relatively new type of feature: windows.

It seems strange to regard windows as an authentication feature when they are not (it can be argued) themselves a security feature. In virtually all cases, it is not just the window that provides the authentication but also the feature that is in the window – the two are symbiotic with one enhancing the security of the other. It is a case where 1 + 1 does = 3!

Windows in polymer banknotes

We have polymer banknotes to thank for windows. Polymer film is transparent and has to be coated a number of times in white ink or varnish, described as opacification, before it can be printed. Consequently, it is possible to position a clear window or windows anywhere on a polymer banknote, simply by omitting the white coating from both the front and back of that area.

The first window security feature was launched in the bicentennial commemorative Australian $10 note, issued in 1988 to coincide with Australia's bicentenary. It was the first polymer banknote to go into circulation.

Front and back of the Australian commemorative A$10 note, with clear window containing diffractive optically variable device.

The clear window contained a diffractive optically variable device (DOVD) of Captain James Cook, visible from both sides of the note.

This first polymer note – launched under the trademark name of *Guardian*® – was the culmination of almost 20 years of research by the Reserve Bank of Australia's printer, Note Printing Australia (NPA) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), a government research institution. Their objective had been to create a better banknote to prevent counterfeiting – particularly through the use of colour copiers and other recent technologies.

In the research, polymer had been found to provide an ideal surface for DOVDs, being very smooth and receptive in comparison to the relatively rough surface of and consequently DOVDs were expected to be one of the main security features of Guardian banknotes. The idea to combine a DOVD with a transparent window for this first note was inspirational, as it brought focus to both authentication features.

Following the success of the commemorative banknote, the Reserve Bank of Australia proceeded, between 1991 and 1996, to replace all of its paper notes with polymer notes. New Zealand followed shortly afterwards, launching its new polymer series in 1999, followed by Romania, initially with a commemorative note and then with a new series, to become the third country to have all polymer banknotes.

A common feature of all of these notes was a transparent window feature. The window had the equivalent role of the watermark in cotton (paper) banknotes – an ever-present, known security feature that was the first thing looked for if there was any doubt raised as to the authenticity of the banknote from its printed appearance or feel. Interestingly, both watermarks and window features are inspected by reflected and transmitted light, with transmitted light giving the more positive feedback, and so being the more generally used.

Although the first window in the Australian $10 featured a DOVD, none of the banknotes in the subsequent Australian, New Zealand or Romanian polymer series did. In Australia, all five notes in the new series featured a clear window with a vignette, and in addition an embossed feature in the four highest denominations.

The fact that the windows were in the same position on each note allowed them to be easily checked.

The Australian polymer notes, with the windows and other security features, have suffered little counterfeiting since their introduction. Only in the last two or three years, with the notes approaching 20 years old, has counterfeiting increased to a noticeable, but still very low, level.

The window feature in Guardian polymer notes became their hallmark security feature and – combined with polymer's superior durability compared with conventional cotton paper – led to polymer being more widely adopted.

Types of window

Guardian polymer has four main types of window:

1. **Clear window:** initially windows in Guardian were framed, making them more obvious and at the same time attractive. But as time progressed, the value of windows as a security feature became apparent, leading to the development of new features to go into them. In another development, polymer notes would have two windows, one main window and another smaller window with a different security feature;

2. **Frameless window:** another window design concept was frameless windows – where windows were not framed and so could vary in number, shape, size and position. The Charles Darwin note, with several windows, each with a different security feature, was created to demonstrate this concept, named 'Latitude'.

To date, only Nicaragua's new 200 cordoba note uses the Latitude concept. The new Canadian Frontier Series, however, comes close, as the notes incorporate very wide, vertical, clear windows. The large windows in each banknote incorporate an easily viewable but highly secure, full-colour DOVD, visible on both sides of the note. The series also features a second 'frosted' window in the shape of a maple leaf, which when looked through at a point source of light, reveals the denomination of the banknote.

To date, with all the notes in the series in circulation, virtually no counterfeits have been found. The Reserve Bank of New Zealand is currently in the process of introducing a new banknote series with similar, large, vertical windows to those of Canada.

And it is expected that the Bank of England, which issues its first polymer notes later this year, will do likewise.

Front and back of new Canadian $20, with two windows – images courtesy of Bank of Canada.

3. **Half-window:** half-windows are a variation on clear windows, where only one side of the window area is opacified; one side remains glossy while the other side functions as a normal surface for printing. The glossy surface is difficult to copy using photocopiers and scanners.

4. ***WinBOSS®***: this feature is created by embossing a transparent window using the intaglio process, without ink, in the area of the window. The process is most effective when the un-inked design is a 'transitory image', comprised of perpendicular lines offering a secure latent image that is visible in both transmission and reflection, only at certain viewing angles.

Security features in polymer windows

The different security features that can be contained within a polymer window range from simple printed designs to optically variable devices:

- **Vignettes:** these are printed designs within windows, either transparent or half-windows. The printed design enhances the window by providing a recognisable feature and creates a further degree of difficulty for the counterfeiter. Vignettes can be integrated with other window features such as *G-Switch®, Aurora™, Metalix®* and shadow images to increase the difficulty for the counterfeiter;
- **Shadow image:** like watermarks in paper, shadow images can be a numeral, text, image or tonal portrait, revealed when viewed in transmitted light;
- ***Eclipse®:*** this is a transmission diffractive optically variable device that appears when looking through the transparent window at a point source of light. The feature is both highly secure and highly durable, remaining active even when the note reaches the end of its useful life. The Mexican 50 peso is the first banknote to use an asymmetric structure in the form of a '50' image;
- **Metalix*:*** this, as the name implies, is a printed metallic effect with a striking metallic lustre that offers high resistance to chemicals and oxidation and does not tarnish in use. It can be used in clear or half-windows;
- **G-Switch and Aurora:** G-Switch is a printed, single colour-shift pair, whereas Aurora consists of multiple colour pairs designed to offer advanced effects and is very difficult to counterfeit. Both show the colour changes on tilting. Aurora also appears differently when viewed in reflection and transmission; in a transparent window Aurora is different from either side of the note, eg. two dissimilar colours in reflection transform into two similar colours in transmission.

While Guardian was the only available polymer substrate for 20 years, in 2013 papermaker De La Rue introduced its own version, *Safeguard®*, after a four-year development process. This is now being used by some ten issuing authorities and, like its Australian counterpart, contains transparent windows that carry a range of additional security features.

Windows in paper banknotes

It was inevitable that the success of windows as a security feature in polymer, and its role in helping polymer take market share in the banknote substrate market, would result in changes in the traditional banknote market.

The changes came from two directions: first, from a combination of customers and suppliers working together to introduce windows into conventional cotton-based banknote paper; and second, from developments by a number of banknote paper suppliers to attack polymer on two fronts – windows and durability – by developing hybrid or multi-layer substrates that offered both.

Two essentially different approaches were taken to create windows in conventional banknote paper. The first can best be described as creating the window in the papermaking process and then applying film over the window. The second involved removing paper from the finished banknote sheet to leave apertures, and covering these apertures with film to form the window.

Paper machine-formed windows: Goznak and De La Rue each developed a method of greatly increasing the size of the window formed in the papermaking process, in both cases creating an oval-shaped window over which, on the reverse side, was applied, in line, an imaged film, which could be seen through the oval window on the front of the banknote. De La Rue named its technology *Optiks®*, presenting this as a super-wide thread, and claimed it to have additional security from the naturally decaled edge of the aperture created in forming the paper.

Laser and die-cut windows: Giesecke & Devrient (G&D) was the first to introduce a window – which it termed *Varifeye®* – into a banknote paper substrate, with the Bulgarian 20 leva in 2005. The film used to cover the aperture had a polarisation feature so that two different images appeared with right- and left-hand polarisation respectively, with a green and black striped image appearing if the aperture was placed over a dark surface.

The new €20 and €50

The G&D development established the concept of windows in banknote paper. The potential was apparent and the development of a window feature was taken up by the ECB for its second euro series, the intention being to launch the two most counterfeited banknotes – the €20 and €50 – with window features.

The process turned out to be more complex than envisaged because when the holes had been cut and the film applied over them, the sheets became distorted and could not be printed reliably or at speed. The decision was taken to delay the €20 and €50 notes and launch the more conventional €5 and €10 while the problem was resolved.

The solution lay in applying either a transparent thin film or varnish on the opposite side of the paper to the main foil with security features, thus creating a similar effect on both sides of the banknote sheet and preventing any serious distortion.

Mechanical engineering played a large part in this windows development for the new euro. KBA-NotaSys developed its *OPTI-Windows®* machine – a one-pass technology enabling sheets to have windows die cut and then the OVD film to be applied in register over the apertures, all at 10,000 sheets an hour. This development, along with that of other machines capable of the same task, enabled the €20 and €50 windows banknote project to reach a successful conclusion.

The €20 was launched in November 2015 with a complex, kinetic holographic feature, including a portrait of Europa (matching the watermark) in exact register with the window, and with the whole stripe in exact register with the banknote. The diffractive film feature, *Kinegram Review®*, displays a different kinetic image on the obverse and converse of the banknote, which, in combination with the registered window, presents a formidable challenge to any counterfeiter.

Continued on page 8 >

High-Speed Inkjet Personalisation

By Alan Hodgson, Printing Consultant

In the November 2015 edition of *Authentication News*®, we considered the potential contribution that the new high-speed inkjet presses could make to secure document production. The innovations in inkjet printing technologies needed for these large presses are now making their way from large-scale commercial solutions into desktop systems. The purpose of this article is to show the relevance of these systems, both for the personalisation of individual documents and incorporation into production lines for secure solutions.

This technology could provide significant increases in speed to the production and in-country personalisation of secure documents. The technologies are available from an increasing number of reputable vendors. This could be a good time to consider the potential of these technology platforms for secure document production.

Page-wide array inkjet technology

The key to understanding the significance of this innovation is in the arrangement of the inkjet heads. The clue is in the name – page-wide array.

In a typical desktop inkjet printer the inkjet heads move continuously side to side (known as a reciprocating print path) while the paper is moved in small steps through the printer. In this way the paper is printed in wide lines known as print swathes. The building up of the printed image, swathe by swathe, contributes to the slow speed (and characteristic noise) of these printers. In some cases it can also introduce unwanted print artefacts at the interface between swathes – the characteristic banding structure sometimes seen on inkjet prints.

Now imagine the situation where the inkjet print heads are as wide as the printed page width. The heads can then remain stationary while the paper moves underneath them, leading to the possibility of some very high print speeds – up to one A4 page per second for a desktop printer. This is called an array of print heads as they are commonly constructed from a number of smaller heads that are mechanically and electrically 'stitched' together to produce the array across the page width.

This technology is now starting to move from the large commercial inkjet printers and into desktop units. The implication of this is the fact that the major issues, such as print artefacts and print head maintenance, have been extensively researched and to a large extent fixed in the larger units.

The implementation of on-line print quality assurance into these units is also a plus for the verification of print in secure document printing.

An overview of the technology behind these inkjet head arrays was presented at the Digital Printing conference that took place in Portland, Oregon, USA in September 2015 (see AN October 2015) and summarised at High Security Printing Europe in March 2016.

The implication for secure document production

The implementation of page-wide array inkjet technology into smaller desktop solutions has a number of potential applications in the production of secure documents. The key advantage they bring over existing technology is that they have the potential to significantly speed up the personalisation process.

The majority of the technology from high-speed commercial printing is designed for water-based inks so is most applicable to paper and paper-like substrates. However, there are alternatives available.

Oil-based inks are available on this technology platform and an example is given later in this article. It is also being implemented in UV-cure ink for offset paper, leading to the possibility of using these arrays on polymer products such as ID cards. For other ink types, systems integrators exist who will build print engines into production machines – but at a cost.

It is sensible to consider these implications in three categories as outlined below. This is because the engineering implementations and ink sets are likely to be different.

Distributed personalisation of secure paper documents

A good example of this would be the in-country personalisation of identity documents such as visas and birth certificates. Here, high-speed, sheet-fed desktop printers, designed for paper near to A4 format, could provide a significant print speed increase. The use of pigmented inks for IR visibility and chemical resistance is an attribute here.

Of additional benefit is again the knowledge flowing from the inkjet implementations in commercial printing. Such implementations had the challenge of dealing with inkjet printing onto offset paper, a product somewhat similar in key characteristics to intaglio-printed visas (see AN December 2015).

There are desktop printers designed for office use that would seem to be potential units for this application.

For example, the *HP OfficeJet X* series of printers are a desktop implementation of the inkjet technology used on a larger scale in the *HP PageWide Web* presses (see AN November 2015). A secure print implementation of OfficeJet X models is available from Troy as their *SecurePro Jet X* range and was illustrated in the exhibition at High Security Printing Europe 2016.

Document numbering and packing in a factory situation

Page-wide array technology is already being implemented in centralised and factory-based solutions for secure documents. There are applications where speed is the primary driver, rather than pictorial image quality. Examples include document numbering and addressing of mailing envelopes and labels.

A good example of this is document numbering in colour. The use of oil-based inks in the *Riso ComColor* series of printers, available in a number of sizes, is an interesting option for this. Oil-based inks can circumvent some of the wetting issues of aqueous inks and can provide a high-speed numbering alternative.

High-speed label and envelope addressing machines can also implement page-wide array technology to add production speed. In some cases, systems integrators build an array of smaller heads across the print width to gain speed, and examples occur in high-speed narrow-web label printers, often using UV-cure inks.

An interesting alternative for both paper labels and envelopes is the head technology developed by Memjet. This is another water-based page-wide inkjet implementation using dye-based inks for mail and addressing products.

Variable print on production lines

The examples given above are all stand-alone units – printers that contain their own paper transport unit. However, the technology is also ready for incorporation into production equipment for items such as passport booklets. Some implementations already exist but the recent innovations allow us to add speed and (in particular) knowledge to these.

But it is in the area of new knowledge that these developments can most add value. It has long been known that the distance between an inkjet nozzle and the printing substrate is a key parameter driving image quality. In general the shorter the distance the better the image quality.

This is a challenge when printing within an open booklet, as the pages are rarely as flat as one would expect with individual sheets.

However, as production speeds increase, aerodynamic effects come into play and start to cause increasingly significant effects, both from the moving substrate edges and the effect of inkjet drops from adjacent nozzles. The science behind this understanding can be of great use in inkjet printing implementations and has recently been on show at a number of technical conferences. In addition to the Oregon meeting mentioned above some good presentations on this were made at the Institute of Physics 'Science of Inkjet and Printed Drops' meeting in London, UK last November. I shall be presenting the key elements of this in future Authentication News articles.

Opportunities from this technology

There would appear to be two levels of opportunity from this technology.

The first is from the speed enhancements that these inkjet printers can bring to the personalisation of documents, both in-country and within the production factory. Examples of this would be the personalisation of visas and birth certificates, and labels and envelope printing.

The second is from the knowledge gained and lessons learnt from the development process, as outlined in this article. This knowledge will allow our industry to better understand the opportunities and issues around implementation of inkjet in general for document personalisation.

From the Archives

10 years ago...

Authentix Unveils Complete Item-Level Track and Trace System

***Authentication News*® reported that the authentication solutions provider, Authentix had introduced a new serialised authentication solution, designed to enable brand owners to track products at item level, from manufacture to point of sale, and monitor the distribution of their products for signs of tampering, adulteration, diversion or counterfeiting.**

The solution was designed for implementation at the production level and involved the application to each product, during manufacture, of a unique serialised code, or product ID, backed up by a covert nanoscale authentication mark. The codes contained fixed information, including the item code, date and site of manufacture, as well as variable data such as sequential or random serial numbers. These codes would then be related to unit codes on boxes, cases and pallets and, during the packaging process, the data would be aggregated to capture 'parent-child' relationships.

At each shipping and receiving point thereafter in the distribution chain, the codes were scanned, the information verified and the data archived in a secure central database accessible only to clients, which also recorded reports of evidence of product tampering, diversion or counterfeit. The web-accessible database had a reporting engine that, as well as providing access to the data, generated 'chain of custody' reports that could be used as evidence in legally defensible case files and could also be configured to generate event-based alerts and notifications.

Another feature of the solution was its ability to integrate data from multiple sources and it was also technology 'agnostic', in that the data could be incorporated into the database regardless of the device used to capture the product IDs.

According to Authentix, the new system had been adopted by brand owners, ranging from pharmaceuticals to personal care product providers, who were looking to obtain a clear and real-time view into distribution chains.

'The solution provides companies with a new level of security utilising current proven technologies available for immediate implementation,' commented Majid Fazeli, Authentix' Senior Technical Consultant. 'To ensure flexibility, we designed a scalable, modular system that is RFID-compatible and will be able to leverage this technology when reliability and cost factors are competitive.'

Today, Authentix continues to supply a serialised authentication solution for tax stamps, both in physical and digital tax stamp formats. The solutions provide the ability to monitor each product throughout the distribution chain, from point-of-origin to point-of-sale.

20 years ago...

Wicker Sues US Bureau of Engraving and Printing Over $100 Non-Replicate Technology

In 1996, *Authentication News*® reported that Ralph Wicker, founder and President of the Wicker Group of New York, was suing the US government for patent infringement. He claimed that the new $100 bill used its patented anti-counterfeit technology without a licence. The Justice Department filed counter-motions to dismiss the complaint, saying Wicker was not the sole owner of the technology and failed to include his son, Tom, and others who had claims to the patent.

Wicker held several patents for imaging and printing techniques that prevented accurate photocopying of documents, and the Wicker Group was built on marketing this technology, as a design system, through consultancy and product licences. A key patent was US 5193853, for 'nonreplicable documents and a method for making the same,' issued in 1993.

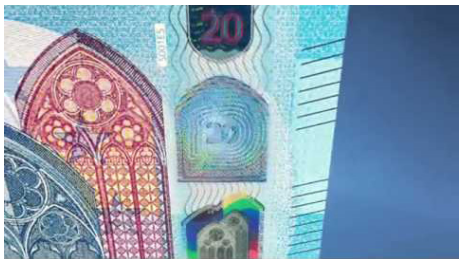
Wicker Group was very much a family affair, with Dave as marketing director, Tom as technical director and Ken on product development. The operations of the group were primarily channelled through their marketing subsidiary, Secured Document Systems, which had licensed over 85 security printers to use its patented techniques.

According to Wicker, the group had been working with the US Bureau of Engraving and Printing (BEP) for several years, transferring the technology to the BEP as a trade secret in early 1991. Wicker claimed it was this technique that made it impossible to counterfeit a new $100 bill on a laser colour copier, and had calculated that over $80 million in royalties was due from the 1.5 billion $100 bills printed with this technology. The Justice Department claimed the anti-counterfeiting technique used on the new $100 bill was not uniquely Wicker's.

Today, the group has transformed into Document Security Systems and David Wicker (previously with Wicker Group) is Vice President of Research and Development.

Today's Authentication Methods *(continued)*

It is highly likely that other countries will adopt a similar windows technology, just like they adopted a holographic stripe after the launch of the first euro series.



€20 – close-up of portrait window (top) and front side diffraction showing rainbow-coloured lines around 20 numeral.

Windows in multi-layer substrates

With regard to multi-layer banknote substrates, there are essentially two types of three-ply substrate: *Durasafe*® from Landqart, comprising a transparent polymer core and two outer layers of paper; and *Hybrid*™ and *Fusion*™ from G&D and Fabriano respectively, which comprise a paper core with two outer layers of polymer. All can have window features (one or more), in which to incorporate security features.

In the case of Durasafe, the windows can be fully or partially transparent, thanks to the process of die-cutting each of the three layers of the composite substrate separately (with partial transparency created by cutting one or two layers only).

One-sided windows (*Viewsafe*™) give a clear view to the inside of the substrate, where threads, watermarks, foils and other overt or covert features can be safely protected inside the composite, while remaining fully visible. Two-sided windows (*Thrusafe*™) are fully transparent where two windows overlap.

Durasafe will be used for the soon-to-be-released new Swiss banknote series. It made its debut, however, on Morocco's 200 dirham commemorative note in 2012 and, more recently, features in the newly launched Kazakhstan 20,000 tenge note.

This award-winning note contains four windows, all formed in either one or both of the outer paper layers.

Conclusion

Given that the use of transmitted light is necessary for the authentication of a watermark – the oldest authentication feature for documents – it has become natural for people to check documents in this way. This may be one of the reasons for the success of windows. The other reason is the development of technically sophisticated and difficult-to-counterfeit security features to go into them.

The symbiotic effect is a winning formula. Unlike the combining and stacking of multiple security features (which can often be confusing), the window is merely a carrier of a security feature, but it enhances its security by its very nature – and by just being there. It's a case of 1 + 1 = 3!

Banknotes are not, however, the only high-security documents to harness the security potential of windows: with polycarbonate increasingly being used for ID cards and passports, the opportunity also exists to incorporate a window. The subject of windows in identity documents will be covered in full, in the next issue of Authentication News.

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