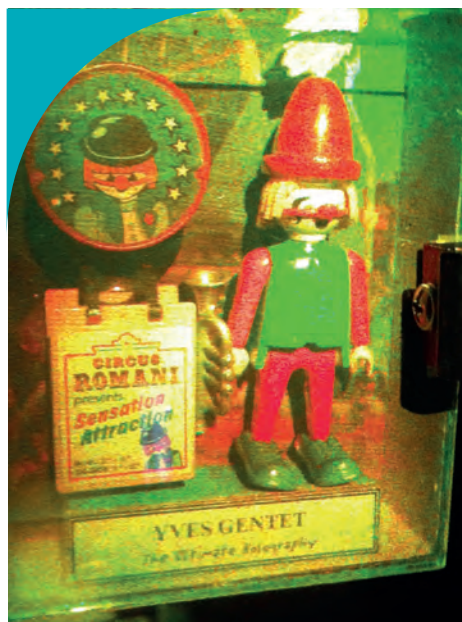


Polygrama & Light Logics Link for Holo-Photopolymer



Genet's full colour Clown hologram reproduced on Darol red and green sensitive photopolymer.

Brazilian holographic photopolymer producer Polygrama, working through its American sister company Polygrama Inc, has appointed Kerala company Light Logics (LL) its exclusive distributor for India, while LL will also coat and distribute the photopolymer on plates and film to a wider market.

Polygrama has developed its *Darol* holographic photopolymer over several years, led by Sergio Oliveira, offering it to holographers primarily as a solution for self-coating on to substrate. It has been well-regarded by holographers who have used it, and the company has been looking for a tie-up to commercialise its coating processes. In 2011 Lynx, the Brazilian distributor of laser and optical equipment, invested in Polygrama (see HN Vol 25 - No 6) to regularise and expand Oliveira's development activity.

Lynx, led by Andre Jacobovitz, has subsequently opened an American company – Lynx US – in Miami, FL, largely as a route to improve the commercialisation and distribution of Darol. Jacobovitz has also established Polygrama Inc as a US company.

A hoped-for deal with Eastman-Kodak for film production didn't materialise, as much as anything because of Kodak's move out of photographic films, so the agreement with Light Logics is Lynx's first significant expansion move since the opening of the US company. While LL is appointed as the Indian distributor, the focus of the agreement is that the company will produce and supply plates and film coated with Darol. Dr Ajith Kumar, CEO of LL, told *Holography News*® that from January 2015 they will be offering Darol coated on to Schott BK7 borosilicate crown glass plates, size 150 x 150 mm. BK7 is a high quality optical glass suitable for use as holographic optical elements, the initial target market for the product. LL plans to introduce 150 mm wide rolls of Darol-coated film later in 2015.

Polygrama will supply both one-colour and two-colour sensitive photopolymer solution to LL. Progress in the two-colour solution for multi-colour holograms can be seen in the recent contact copy of one of Yves Genet's holograms (see photo). Genet, founder of Bordeaux Holografie, produced this master on his Ultimate-08 silver halide emulsion and provided it to Polygrama (Genet's Ultimate emulsion is generally regarded as the benchmark for small grain, low-noise colour reflection holograms – see HN Vol 27 - No 8). The copy is made on Darol red and green sensitive photopolymer, and Oliveira told us that the contact copy 'is as bright as the original on silver halide.'

HoMAI Becomes ASPA

The Hologram Manufacturers Association of India (HoMAI) has changed its name and focus, becoming the Authentication Solution Providers Association (ASPA).

In this one move it has moved away from its single product focus on holograms to becoming the representative association for authentication providers, while also offering membership to organisations outside India. This leaves the International Hologram Manufacturers Association (IHMA) as the only organisation focused on the needs of the hologram industry.

ASPA describes itself as 'the world's first non-profit to comprehensively cover authentication technologies' (which perhaps overlooks the albeit short-lived International Authentication Association). ASPA gives examples of such technologies, in which it betrays its origins by showing holograms and OVDs at the head of the eight listed, which include RFID, nanotechnology, inks, substrates, taggants and labels.

HoMAI was founded in 1998 to represent the nine producers which then comprised the Indian hologram industry. It has been very effective in representing the value of holograms to the Indian national and provincial governments, and has worked closely with the IHMA, operating as a regional division of the international association. All HoMAI members become ASPA members, meaning that the new association launched with 37 members, most of them hologram producers but with a handful of security packaging companies as well.

The re-positioning is a response to the fact that most hologram producers in India are supplying authentication holograms (although there is also significant production of holographic packaging and apparel materials) and the need for authentication suppliers to unite to combat counterfeiting.

Attack is the Best Defence

How many times have you heard someone say that holograms are no longer secure, or that their time as the leading overt authentication feature is over (or soon will be); or that customers track and trace systems and that they will supplant other forms of security? Are you feeling that these sentiments seem to be gaining ground, perhaps even rising to a crescendo. Are you even beginning to believe them, are you starting to doubt the value of holograms because you keep hearing people saying negative things about them? After all, repeat a lie enough times and people start to believe it.

Or are you fighting back? Are you telling people how effective holograms are, that rumour and gossip shouldn't be believed, actual results should? And those results show that holograms remain the single most used overt authentication device, and the reason for that is that they remain the single most effective overt device. But they're not only overt; these days they are multi-function devices which include covert features, codes and smartphone reading capabilities.

Government-issued documents

In the July issue of *Holography News* we reported on the presence of holograms at Security Document World, probably now the leading exhibition and conference dealing with the technologies of ID document protection.

We pointed out that 'holography is indisputably the security feature of

choice to secure the critical personal data in a passport or on an ID card against tampering, alteration, forgery or counterfeiting.' And in this issue we turn our attention to tax stamps, another specialist, government-issued document.

We acknowledge that the information in this issue about the use of holograms on tax stamps was gathered at the Tax Stamp Forum, an event we organise. But this issue features the use of holograms on tax stamps not to promote that event, but to show how widely and effectively holograms are used on this very important functional government document.

Tax stamps serve an invaluable function for governments as the core of their systems for collecting excise taxes on consumer goods such as tobacco products, alcoholic drinks, soft drinks and others. Taxes on the first two of those categories in particular are often very high as a manifestation of policies to deter smokers and excessive drinking. This, of course, provokes consumers to want to find ways to avoid paying that tax, so they can buy their cigarettes or drinks at half or less of the official retail price, which includes the tax. That, in turn, creates an opportunity for criminals, opportunistic and organised, who are adept at finding ways to avoid paying tax – smuggling, counterfeiting, tax stamp re-use, re-filling and so on.

These criminals can quickly make a substantial dent in government revenues from their legitimate excise taxes, which is why tax stamps, their issuance and tax collection systems have become some of the most sophisticated documents and systems. The better the security of the stamp and the systems, the better they deter criminals and the higher the tax revenues.

These sophisticated instruments for tax monitoring and collection feature numerous protective and monitoring features. Tracking codes, originally developed for use in product supply chain security, are now being used on tax stamps. The substrates used – paper or polymer – have intrinsic security features, and advanced security printing processes and inks are used. But the dominant feature on many tax stamps, and the single most used feature on tax stamps, is – you've guessed it! a hologram.

Hologram functions

Governments use holograms on tax stamps because they attract attention, making it more obvious to the consumer that there is a tax stamp on the product; because they are very difficult to copy accurately, so they still deter counterfeiters and other fraudsters. It follows from this that holograms make it easier for inspectors to spot suspect stamps. And, of course, if inspectors do suspect a stamp, they can examine the hologram with a variety of simple and low-cost tools to verify whether it is genuine or not.

Over 100 billion tax stamps are produced each year, so this has become an important market for authentication holograms, even though holograms for tax stamps are very small. And as our report on the Tax Stamp Awards and the case study about the Indonesian tax stamps show, there is no sign of governments reducing their use of holograms on tax stamps.

So next time you hear that holograms are over, that they are in decline, fight back! Use the information about their use on tax stamps (and ID documents, and banknotes, and products) to show that this is far from the truth about the future of holograms. Attack is the best form of defence!

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HoMAI Becomes ASPA (Continued)

Manoj Kochar, of HoloFlex, who as the President of HoMAI becomes the first President of ASPA, said 'We must develop a unified global strategy with powerful industry linkages and knowledge sharing platforms in order to stop this illegal trade effectively. ASPA is a call to unite various authentication solution providers across the world to galvanize our forces and strengthen this shield univocally. ASPA re-aligns our objectives to more accurately represent the transformation of products and services offered by our member companies. Our broader scope also covers a wide array of authentication technologies that have evolved over the years.'

Accordingly, ASPA's vision is 'to become the global voice of the authentication solution providers that facilitate brand protection through anti-counterfeiting, anti-tampering and tracking and tracing measures.'

ASPA has full and associate member categories, with those sub-categorised as domestic or foreign. Non-Indian producers, developers or suppliers of authentication solutions are eligible for full foreign membership, at annual fees from US\$468 to \$1,839, depending on level of turnover, from \$300,000 to \$1.6m. Foreign associate membership is \$562 and is open to resellers, consultants and manufacturing equipment suppliers.

aspaglobal.com

Holograms Feature in Tax Stamp Awards

In the annual Tax Stamp Awards, announced and presented at the *Tax Stamp Forum* in Dubai, September 15-17, all four category winners featured stamps with holograms.

The awards, which were presented by Nicola Sudan, Editor of Tax Stamp News, were judged by an independent panel comprising four experts in their respective fields;

Tomas Garcia Moreno - a specialist graphic security designer; Jeannie Cameron of JCIC International; Hugh Burchett of Cambridge Consultants and independent consultant John W Colledge III.

Best Design

The winner in the Best Design category was Mauritius Revenue Authority (MRA) for its new tax stamps on alcohol products.

The new alcohol stamp has overt and covert security features with a track and trace system. The 40 x 18 mm banderol features a hologram made by Indian company Holostik.

The stamp was first issued in October 2013

on spirits having an alcoholic strength of not less than 20% volume and in containers not less than 200ml and offered for sale in the local market, and follows a similar scheme for tobacco.

According to the MRA, has been effective in preventing counterfeits from entering the country and generally helping the authority to prevent illicit trade in alcohol products.



The new Mauritius alcohol stamp with hologram made by Holostik

Best Innovation

A joint winner in the Innovation category was AM-PG for its VeroCode on Armenian tax stamps, which was mentioned by the judges as a particularly sophisticated unique code. It is a data matrix code, generated by a proprietary algorithm, which features on all of Armenia's latest generation of tax stamps, which are used on some 20 categories of consumer product. VeroCode uses asymmetrical encryption algorithms to ensure the fidelity of the encoding, which

also allows even partially damaged codes to be read. The code can hold a large amount of data and can be used for authentication and tracking and tracing; it serves both functions on the tax stamps. It is read by a proprietary reader or app on a smartphone.

On the alcohol tax stamps it is produced optically in to the hologram (see HN Vol 28 No 8 – previous issue), on other products it is printed on the stamp.



An Armenian tax stamp showing the hologram and the VeroCode

Best Innovation

The second winner for Best Innovation was awarded to OpSec Security and Xerox for the Michigan tax stamp.

This is the first public sector adoption of the SecureITT stamp introduced in 2012 after joint development between the two companies. It combines OpSec's hologram with Xerox's eTRACS track and trace system (see HN Vol 26 No 5).

Numerous and varied data sources were integrated for the Michigan programme to create a complete picture of the tobacco distribution chain, with the intelligence providing total control over the cigarette taxing process and supply chain visibility for the state.



The Michigan SecureITT tax stamp showing the hologram and the eTRACS code

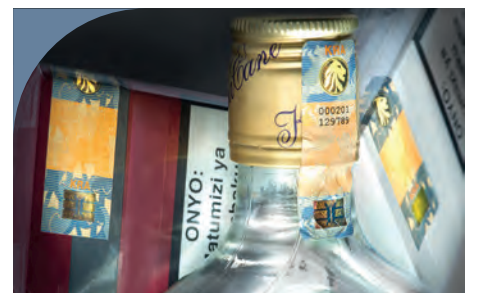
Best Tax Stamp Programme

The award for Best Tax Stamp Programme was presented to Kenya Revenue Authority (KRA) for its Excisable Goods Management System (EGMP), which the Kenyan scheme exemplifies a holistic approach to excise tax collection and monitoring and has a holographic tax stamp at its heart.

Kenya introduced tax stamps on tobacco in 2003, extending them to wine and spirits in 2007, but recognised two years later that revenues were stagnating as tax evaders found the loopholes to exploit.

Following a fundamental review of its systems and methods, engaging with stakeholders and the public, KRA introduced a new stamp in February.

This has overt and covert security features and a track and trace code as the visible core of an enhanced issuance, collection and monitoring system. By June the KRA had seized 300,000 illicit items, prosecuted over 150 offenders and seen spirits revenue alone rise by 53%.



A new Kenyan bottle-sealing banderol showing the hologram and serial number

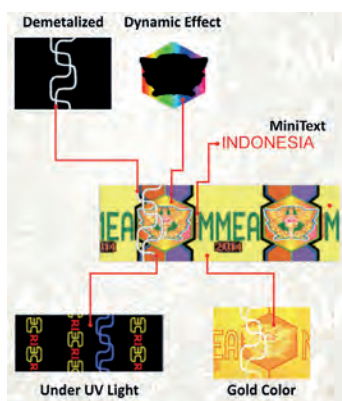
Holographic Tax Stamps in Indonesia Improve Detection

Indonesia has used tax stamps on tobacco products since 1996, with a new stamp introduced in 2010, but by 2012 over 8% of stamps were found to be illicit, leading to a re-thinking and re-design of the stamp.

The new stamp was introduced earlier this year, featuring a sophisticated security hologram and this has already had an impact in making it easier for customs officers and other inspectors to identify suspect stamps, according to Edy Setyo, the Customs Sub-Directorate head.

Background

Indonesia, like many Asian countries, has a very high level of smoking, so there is a corollary high excise tax on tobacco products to try to dissuade smokers, or at least to get them to reduce their consumption. But to little effect. In 2013, according to the ASEAN Tobacco Tax Report, over 67% of Indonesian males smoked, 20% more than in any other country covered in the Report. Interestingly, only 4.5% of women smoked, but the figures mean that over 61 million Indonesians are regular smokers.



The security features on the Indonesian tax stamp hologram

The Indonesian tax on cigarettes and related tobacco products is 46%, around the mid-point of tax rates in ASEAN countries (the highest is Thailand at 70%, the lowest is Lao at 16-19.7%) but high enough that criminals and consumers sought ways to avoid having to pay this tax.

Violations	Hand-rolled Cigarette	Machine-rolled Cigarette (w/clove)	Machine-rolled Cigarette (w/o clove)	Others	Total
Misallocation	0.19%	4.47%	0.4%	0.02%	5.08%
Re-used	0.11%	0.46%	0.01%	-	0.58%
Counterfeit	0.05%	0.41%	-	-	0.46%
Plain	0.57%	1.78%	-	-	2.35%
Total	0.92%	7.12%	0.41%	0.02%	8.47%

Table of types of illicit cigarette tax stamps in Indonesia 2012

Recognising that it was suffering revenue losses, the Jakarta Tax Agency undertook a study in 2012 to quantify these losses. It found several types of illicit activity, including misallocation, re-use, counterfeits and plain paper stamps – the table shows the rates of each for different kinds of cigarette. The total value of lost revenue was estimated at US\$52 million, out of actual revenues of US\$7.6 billion (ie losses were under 1%, but enough to put a hole in government income). The agency therefore set out to tackle these losses, instituting changes in its stamp issuance and tax collection systems, and carrying out a major re-design of the stamp itself to introduce several new security features.

System enhancements

Among the improvements to the issuance and collection system, the Agency introduced a simplified tax structure supported by a system of licensing, production and integrated distribution. All players in the tobacco supply chain now have to be licensed, while all tax stamps are procured by a new company that validates the supplier and the supplied stamps. Law enforcement training and effort has been improved, as has market supervision.

The tax simplification now has three classes of tax, covering different varieties of cigarette, with three further 'unclassified' categories for other tobacco products (including cigars), leaf-covered cigarettes and raw tobacco products, and for customs direct imports. Each class has a different

set of tax stamps, so there are six different designs with three shape variations for each design, for different types of packaging.

New security features

The new tax stamps are supplied by the Pura Group, printed by Perum Peruri on security paper from the Padalarang mill. Pura makes the hologram and other components, as well as being the prime contractor.

The hologram, used as a patch or a stripe across the different tax stamp designs, has numerous security features, including micro-text, de-metallising, UV-viewable content and dynamic effects, shown in the illustration (left). The stamp itself includes numerous security features in the paper (such as fluorescent fibres) and even more in the printing. These include micro-text, colour-switching inks, chemically reactive inks, guilloche printing and raster security patterns. There are also numerous UV-visible features in all components and a QR code on some of the class designs.

It is too soon to have statistics on the impact of the new tax stamp, but as Christian Lydiarto of Pura has shown in his paper at the Tax Stamp Forum (and subsequent correspondence on which this article is based) customs and enforcement officers are pleased to have the additional features, particularly the hologram as it is a strong visual indicator to them for suspect stamps.

puragroup.com.

Polygrama & Light Logics (Continued)

LL will also build equipment for the commercial production of photopolymer holograms for security and authentication applications, targeting tax stamps in particular. Kumar has a strong history with tax stamps, having encouraged the adoption of holographic tax stamps by

Kerala state in his pre-LL days, when he was running the optical team at the Centre for Development of Imaging Technology (C-DIT, the State's specialist R&D facility). He led the design, origination and production of the hologram for the State's tax stamp while at C-DIT.

Both parties have high expectations for the partnership, which they see bringing 'a set of new products to the global holography industry.'

www.polygrama.com; lightlogics.in; ultimate-holography.com

Profit Warning from De La Rue Wipes 30% off Company's Value

De La Rue plc, which battles it out with Giesecke & Devrient to be the world's largest commercial banknote printer, surprised the London stock market on Friday September 27 with a trading statement containing a profit warning.

The company also produces banknote and security document paper, banknote sorting machines and security documents including passports, tax stamps, security threads and authentication labels, as well as having its own hologram origination. It has its own production facility, producing largely for De La Rue-produced documents but also with external customers.

At its AGM in July the Board stated that, 'based on production and shipment schedules agreed with customers, it was expected that the performance of the Group would be more than usually weighted to the second half of the current financial year.' However, in the trading statement just released, it said that trading conditions across the Group have deteriorated such that expectations for the current and next financial year are now lower.

In indicating performance within the company, it said that in the Currency division, its main business sector covering banknotes and banknote paper, 'the challenging market conditions reported at the AGM have deteriorated further with lower prices and reduced margins in both banknote print and paper'.

In its Solutions division it indicated that the rate of growth in new business had been significantly slower than expected and at lower margins. In the International business of Identity Systems, the trend towards 'e' passports from machine readable passports had been disappointing. In addition, a number of prospective orders in the pipeline had not been put out to tender as expected, but have been extended with the incumbent supplier.

Within the Security Products business, growth in Government Revenue Solutions was slow and had not mitigated the declines in some of the other product lines. The Cash Processing Solutions business was on track to achieve its target of breakeven this financial year.

The Board stated that as a result of these trading conditions and despite achieving further cost reductions, it expected 'for the current year both underlying operating profit and underlying profit before tax will be approximately £20m lower than that reported for 2013/14 (2013/14 underlying operating profit £89.3m, underlying profit before tax £77.3m).'

It further stated '... the Board expects the current difficult market conditions to continue in the 2015/16 financial year. ... More recent pricing pressures together with certain contractual price reductions, which will come into effect in 2015/16 on a number of long-term contracts, will impact margins and profitability further.'

These profit falls come as Martin Sutherland, the Group's new Chief Executive, joins the company. Given that De La Rue's shares are down to trading levels not seen since November 2010, which prompted a bid from keen French rival Oberthur, and given that this is now the third profit warning in two years, there is renewed speculation about a potential takeover. Martin Sutherland's primary task could be fighting for its independence.

delarue.com.

Absolute Imaging Gets Patent Rights

An extended dispute between James Fischbach's Intrepid World Communications and Absolute Imaging (AI) regarding ownership of patents and patent applications has been resolved by the Circuit Court in the State of Michigan, concluding that AI has the right to the patents.

This is a timely decision as one of the applications in question published in June as US 2014/0168734, *System and method for autostereoscopic imaging using holographic optical element*.

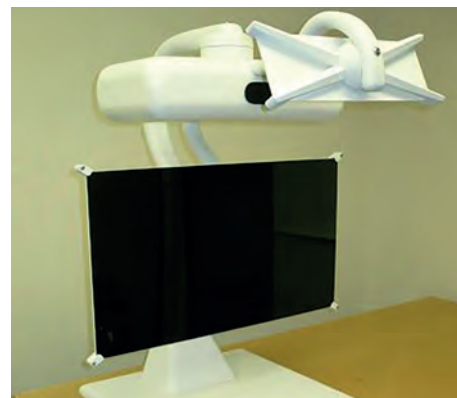
This dispute goes back to the aspiration of James Fischbach to develop a full-motion volumetric display system that could respond to input in real time. He set up American Propylaea, his first company to develop such a system in 1994. But that failed in 1997, so he established Intrepid Global Images 3D as a subsidiary of his holding company, Intrepid World Communications (see HN Vol 21 - No 4), partnered by Richard Kughn through his company Kughn Absolute Holdings and Absolute Imaging. A sister company was established in the UK, Intrepid Europe, in partnership with Hans Bjelkhagen and David Ratcliffe.

Unfortunately Intrepid Global Images also failed, but not before it had been granted one patent (US 8,284,234, *Endoscopic imaging using reflection holographic optical element for autostereoscopic 3-D viewing*) and had applied for several US and WIPO patents, covering its innovations in autostereoscopic imaging. The applications in dispute were US 12,883,348, *System and method for autostereoscopic imaging*; US 12/948,360, *System and Method for Autostereoscopic Imaging Using Holographic Optical Element*, and their related PCT/WIPO applications, 2011/050911 and 2011/061196. US 2014/0168734 is an updated version of 12/948,360, with Hans Bjelkhagen and Mark Dell'Eva credited as inventors. Bjelkhagen is named on all the patents and applications, some with Dell'Eva, some with Fischbach.

Absolute Imaging is now in receivership, so the referral to the Court was prompted by both parties' desire to claim ownership of the IP and so benefit either by retaining the IP or receiving income from any sale.

As it is, AI now has permission to bid for its own IP, using a process called *credit bidding*, when it bids using the funds it is owed by the bankrupt company.

The current application for an autostereoscopic system describes a no-glasses monitor system, as shown in the illustrated mock-up.



Demonstration mock-up of the Bjelkhagen/Dell'Eva autostereoscopic H0E-driven imaging system.

Middle East & Sanctions on Russia Take Their Toll

At the end of the last period most markets had rebounded around 3-5% from a significant fall with its nadir on August 8. This which placed them back to where they were before they fell. However, we noted that some experts were predicting a major slowdown in the world's economy – not just because of the Middle East and Ukrainian conflicts directly – but from the trade restrictions being placed on Russia, whose trade with the west and in particular, with Germany, is now significant. The fear was, and is, that the restrictions could take the Eurozone back into recession.

Thus it is interesting to note that in the last month the markets in Europe and the USA have remained stable, with the exception of the London market. This fell 2%, mostly from the fall-out from the Scottish Independence referendum on September 18, whereas the markets in China and Japan have gained significantly (+3% and +6% respectively). Meanwhile, the Hang Seng in Hong Kong has fallen 6% due to the unrest there over the nominations for the local leader.

Two of our monitored companies have suffered major falls in value this month as they issued profit warnings.

K Laser continue sales gain

K Laser recorded sales in May, June and July well above the same period last year, with gains of 15.2%, 13.1% and 12.1% respectively. In August its sales were 17.6% above last year, taking the YTD sales figure to +5.5%. But its share price improved only slightly (+1%) in the period, taking its market value to TW\$2.71 billion.

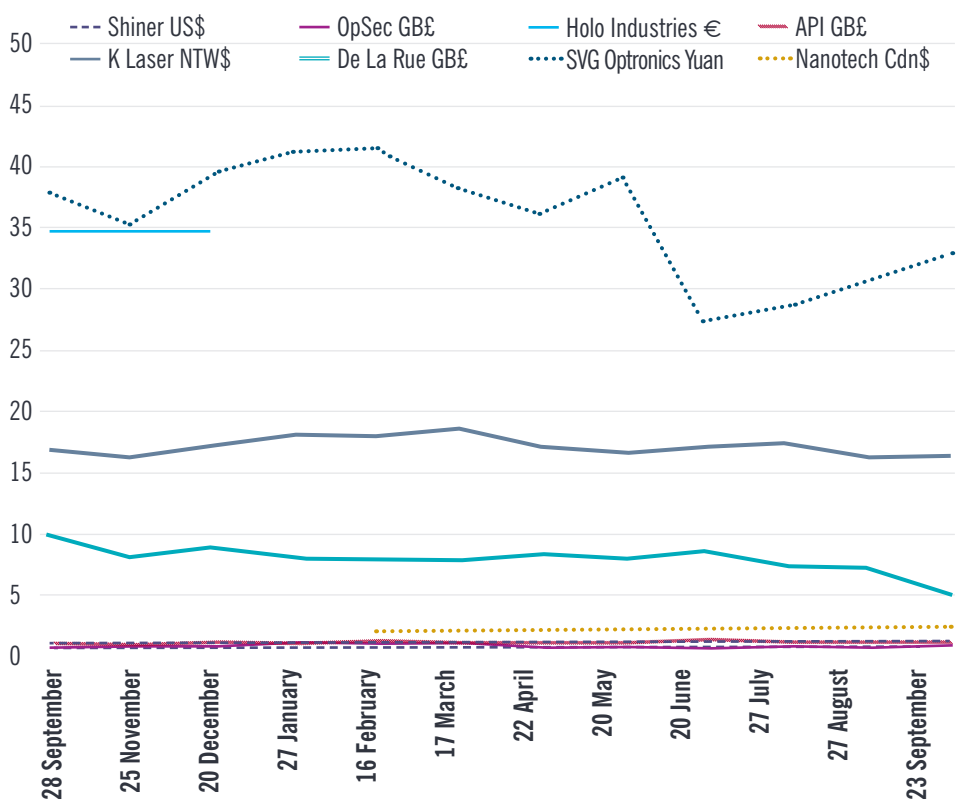
SVG Optronics continues gains

SVG Optronics's market value increased 4% this month, taking its share price and market value to CHY33.22 and CHY3.09b respectively.

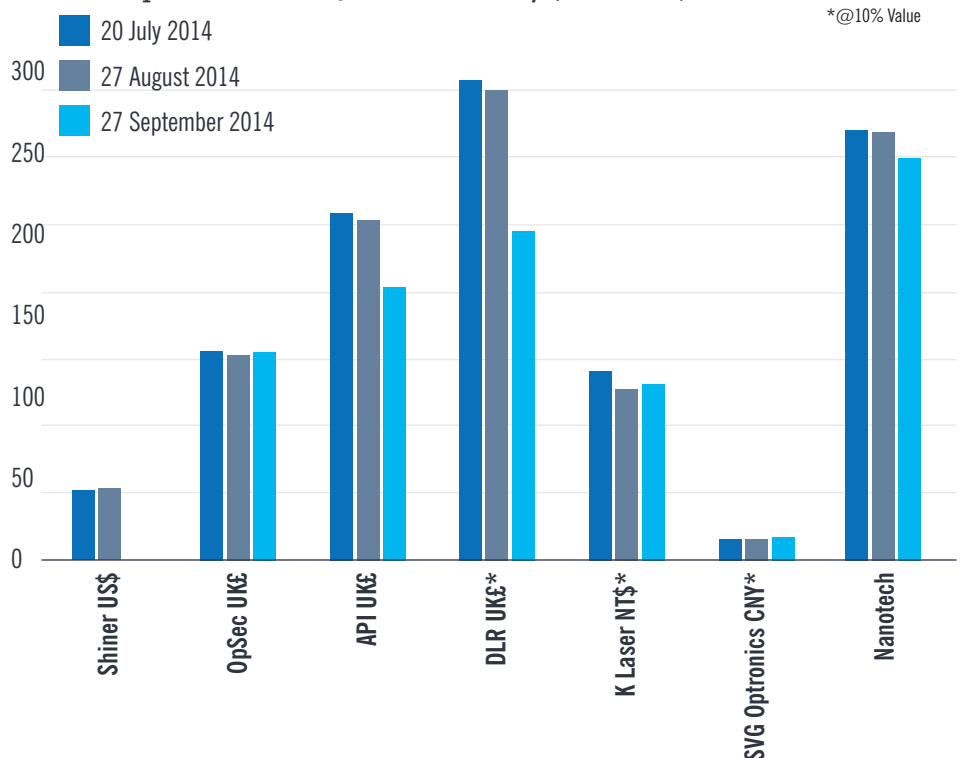
De La Rue falls 30% on profit warning

At the end of last month DLR announced the appointment of a new Chief Executive and early this month won the contract to manage the Bank of England Printing Works for the next ten years. The share price rallied somewhat. However, on Friday September 26, the company announced a substantial profit warning due to market conditions (see full report page 5), stating that profits would be affected not only this year but most likely next year too.

Share Price in Quoted Currency



Market Capitalisation in Quoted Currency (£ millions)



The company also announced that it was considering cutting its dividend – which is a fairly drastic step. Not surprisingly, the shares nose-dived, falling 30% in the day to a value of 504p, 50% below their price (1012p) at the same time last year. This is the third profit warning in two years – placing the company in a very vulnerable position. The new CEO joins in October – he has a tough job on his hands.

OpSec share price static

The new CEO has been at OpSec for two months now. But he has not yet stuck his head above the parapet and, in consequence, the share price has remained static. The market, having nothing to go on, is in a wait-and-see situation and it may stay that way until the interim results are announced, normally in November or December. The company's market value is still £31.9m, which is 40.2% lower than 12 months ago. In the year it has underperformed its market by 38.5%.

API falls on trading statement

In June API released positive results and announced that it would re-commence paying dividends. The company's share price improved (+9.6%). In July and August its share price fell by 5.4% and 5% respectively, reducing its market value to £53m as its Foils Americas business continued experiencing difficulties. Then, in a trading statement on September 3, the company indicated that despite the recovery in its holographic business, this would be insufficient to make up for the significant shortfall in profit in Foils Americas so it was downgrading its forecast and both first and second half results would be below last year.

As a result its share price fell 17.9% to 55p, reducing its market value by £10.8m to £42.2m, an under-performance of 26% in the last 12 months compared with its market.

Shiner again in decline

Shiner's share price declined 10% to 36 cents this month, decreasing its market value from \$11.0m to \$9.9m.

Nanotech stable

Nanotech's value fell 4.1% this month, despite the completion of the acquisition of Fortress Optical Technologies, which was announced and reported last month. Its market value fell C\$3.6m from C\$66.6 to C\$63m. In the last 12 months it has outperformed its market by 4.5%.

From the Archives

10 years ago...

Smart Holograms Funds UK & US Expansion

Smart Holograms, a Cambridge University spin-off which is developing holograms for use as sensors in the life sciences, has recently raised £5m which it is using to fund further research in new, larger premises, and to establish a US company, Smart Holograms Inc, as reported in the September 2004 issue of *Holography News*.

Smart Holograms grew out of collaboration between Jeff Blyth, specialist holographic photo-chemist, and Chris Lowe, Professor and Director of the Institute of Biotechnology at Cambridge University. The company is developing Denisyuk (white-light reflection) holograms which respond to the presence of specific molecules by changing colour or even changing image, as a result of either the change in the frequency of the

hologram's fringe pattern or a change in monomer shape in reaction to the subject molecules. Sensors covering a wide range of bio-molecules and vapours are under development, but the company has developed prototypes to detect microbial metabolites for measuring infectious diseases and glucose; for monitoring blood sugar levels in diabetics.

Smart has already established relationships with the US bio-science industry and felt the need to have a domestic US operation, which will be based in the Boston, MA, area. Meanwhile, it is also expanding its UK research facilities with a move into a 3,000 sq ft (280 sq m) building in the Cambridge Science Park to house its 10-strong research team.

Ed: Sadly, Smart Holograms closed down a few years ago.

20 years ago...

Progress in Holo-Data Storage

The September 1994 issue of *Holography News*® included an update on developments in holographic data storage, begging the 2014 question: how much further forward are we now?

A team at Stanford led by Lambertus Hesselink has demonstrated holographic storage and retrieval in a lithium niobate crystal at video rates, using error correcting codes to trade off data capacity for bit error rate. Although of very limited capacity, this is a significant step in showing the viability of the concepts and in allowing the evaluation of performance of all components in the system.

The holograms were formed in a 2 x 1 x 1 cm lithium niobate crystal in which only 0.1 cm³ was used for data storage. Data was encoded with a 480x440 pixel liquid crystal array. The storage mechanism uses charges excited by light and then trapped in the photorefractive medium which modulates the index of refraction by the electro-optic effect to create the storage hologram. Multiple holograms, each corresponding to a page of data, are recorded using multiplexing by varying the reference beam angle. Readout is by re-illuminating the crystal with the reference beam and sensing the reconstructed data page with a CCD array.

Tamarack has assembled the optical head for its jukebox holographic storage system called Multistore, which consists of thirty floppy disks. Each is 2^{1/2}" square, coated with DuPont photopolymer, on which are recorded about 3,000 holograms of

1mm spot size, each hologram a stack of 40 angle-multiplexed pages, each page containing a 256x256 bit array.

The optical head is the most complex and the key element in the system. Tamarack has written and retrieved holographic data through the head, thus verifying the operation of some key technologies. These key technologies include:

- Angle multiplexing using 12 mm mirrors on a miniature galvanometer to direct the laser beams to precise pages in a given site on the optical media;
- Image formation through a spatial light modulator and retrieval through a charge-coupled-device (CCD), both integrated into the optical head.
- Successful functioning of the associated electronics.

The complete Multistore will hold 20 gigabits in its 30 floppies. The photopolymer material must be completely written and fixed at one time, so in operation, enough data is collected in a temporary memory to write a complete 40 hologram spot. Servos move a floppy into place, rotate the floppy to the correct radius, move the head to the correct spot on the radius and a mirror sets the laser reference angle to pick the correct hologram on the spot. The 256x256 bit hologram page is then read out to the CCD.

The Holography Conference Adds Anatomy Paper

Javid Khan of Holoxica will give a presentation at The Holography Conference 2014, showing how digital holography is suitable for use in medical diagnostic and surgical purposes by providing true volumetric images.

He will reference Holoxica's Anatomy hologram, a life-size triple-channel hologram of the human body, showing muscle structure, organs, arteries and nervous system, which was made with the School of Biomedical Science at Edinburgh University to teach medical students. As the hologram has been shortlisted for an IHMA Award it will be on display at the conference.

Another addition to the conference programme is the participation of Rich Cremona, the new CEO of OpSec, who will offer his newcomer's perspective on the industry.

The event takes place in Istanbul, Turkey, December 3-5, and these papers are added to an already strong programme of 23 papers and a panel discussion.

The programme comprises half-day sessions titled Security Holograms, Developments in Hologram Production, Innovations in Hologram Applications and Into the Future for the Holography Industry. Papers are as diverse as Kurz's latest holograms for banknotes to Morphotonix' methods for making surface-relief chocolate moulds, or the use of holographic optical

elements in vehicles to DiArts new origination system.

At the time of writing, nearly 100 people have signed up as delegates, with a record 15 sponsors and exhibitors in the accompanying trade show. In the trade show you will be able to see new substrates for surface relief holograms, new origination and production equipment, recent developments in hologram display systems, new security hologram techniques using photopolymer, security coding systems for holograms, along with examples of recent techniques in hologram design and use.

The conference period includes the Annual General Meeting of the International Hologram Manufacturers Association and the announcement and presentation of the annual IHMA Awards for Excellence in Holography. In a new move, the Awards ceremony will take place as the conclusion of the first day of the conference, and it will be followed by a champagne reception to congratulate the winners. Afterwards, BEP Hologram, the platinum sponsor, is hosting the conference dinner, with traditional entertainment, at the Feriye Restaurant, a restored 18th century palace on the Bosphorus.

In addition to BEP as platinum sponsor, the event is supported by two gold sponsors, AM-PG Group and Bowater Holographics, and four silver sponsors – DiArts, Giriaj Foils, the IHMA and MTM. Additional



The Feriye Restaurant, venue for the Conference Dinner, hosted by Platinum Sponsor BEP Hologram.

exhibitors are: Advanced Track and Trace (secure coding), Ceres Imaging (hologram display system), Combustion Ingenerios (surface relief holograms), Computer Holography Centre (e-beam originations), Difraks Sol (origination system), Optrace (secure coded photopolymer holograms) and Polish Holographic Systems (origination systems). Space remains available in the exhibition – contact conference organisers Reconnaissance for details if you want to show your products or services to this unique gathering of hologram professionals and haven't yet reserved your space.

Register for The Holography Conference at the event website or contact Reconnaissance International for more information.

www.theholographyconference.com;
info@reconnaissance-intl.com.

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CARTES
Paris, France

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03–05 DECEMBER 2014

THE HOLOGRAPHY CONFERENCE
Istanbul, Turkey

www.theholographyconference.com

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HIGH SECURITY PRINTING ASIA
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www.hsp-asia.com

08–12 FEBRUARY 2015

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