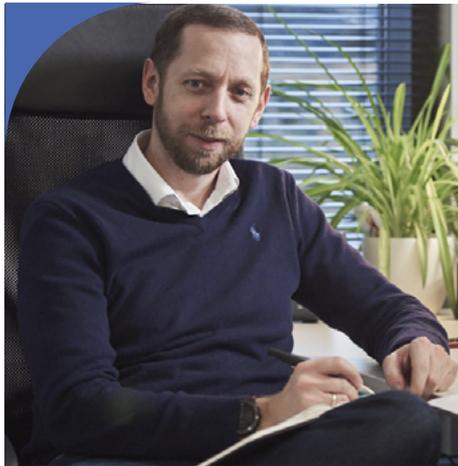




Envisics Takes the Lead in Vehicle Holographic Head Up Displays (HUDs)



Dr Jamieson Christmas.

Head up display (HUD) technology has received significant attention in the last few years, with a number of products now in the marketplace. Although only limited products have emerged at the consumer level, there is considerable activity in this area from a number of companies. One such company is UK start-up Envisics, who have pioneered holographic vehicle HUDs to display essential driving information without distraction.

Holography News[®] caught up with Envisics and visited their headquarters for a demonstration of their latest holographic vehicle HUD that was shown earlier this year at the CES (consumer electronics show) in Las Vegas.

Envisics was founded by CEO Dr Jamieson Christmas – a world leading expert in the field of holography and inventor of over 150 granted patents, and a winner of the prestigious SID Ben Sturgeon Award in 2013 for his significant contribution to the field of displays.

The Envisics journey began in 2010 following the completion of Jamieson's Cambridge University PhD in holographic displays, where he focussed on developing algorithms that enable real dynamic holograms. His technology utilised a special liquid crystal on silicon which, when subjected to an electric field, changes the density of the material and the speed of light.

In 2010 Jamieson founded and self-funded, together with Peter Woodland, Two Trees Photonics (2TP) which focussed on building holographic displays. In the same year, 2TP's holography approach was adopted for vehicle HUDs, with the first HUD prototype built and taken up by Jaguar Landrover.

The laser-based hologram HUD was used by Jaguar Landrover from 2014 and is now in over 150,000 cars. A year later (2015) 2TP was acquired by DAQRI, where Jamieson served as Executive Vice President with responsibility for leading holographic research and the establishment of the automotive business unit.

However, DAQRI's main focus was on the wearable Augmented Reality eyewear rather than the vehicle HUD market. In the meantime, automobile original equipment manufacturers (OEMs) re-approached DAQRI, which in 2018 DAQRI separated its automobile and holographic departments. These became the independent company Envisics, focussing on holographic technology for vehicles.

The company has its headquarters in Milton Keynes, UK and a second facility in Detroit in the US and currently employs 42 people, which it is looking to double by the end of the year.

Continued on page 2 >

Stop Press! ODS Call for Papers Extension

The highly respected and informative *Optical Document Security[™]* (ODS), conference which takes place 29-31 January 2020 in San Francisco, has extended the call for papers until the 31 May.

Many of the most significant recent developments in banknote and identity document security have first been unveiled at this conference, with development and commercialisation partnerships often resulting. With attendance restricted to sector specialists it is the ideal forum at which to announce embryo technologies.

Call for papers

If you have research results, innovative technologies, new approaches or products which move forward, consolidate or demonstrate the best in optical security for banknotes, passports, other identity documents, fiduciary and tax documents, bank documents and any other document subject to fraud attacks, then the ODS participants would like to hear from you.

If you wish to propose an ODS paper, submit a 300-400 word abstract via www.opticaldocumentsecurity.com by 31 May 2019. All abstracts are peer-reviewed and selected by the programme committee – a group of knowledgeable and experienced specialists in optical security from around the world (abstracts under 300 words will not be submitted to the committee).

Holographic Head up Displays (HUDs) *(Continued)*

The company has purposely kept a fairly low profile in this sector, focussing on developing holographic vehicle HUDs that push the technology boundaries, are fit for purpose, and are extensively trialled and tested prior to launch.

Technology

HUDs have been in use in automobiles for over 30 years, with General Motors first introducing them in 1988. They [HUDs] have been shown to have a number of safety benefits, the most obvious one being to enable the driver to remain focussed on the road.

Up until now, the main technologies used in automotive HUDs are LED (light emitting diode) backlit TFT (thin film transistor) LCDs (liquid crystal displays), which often consume significant power due to the low efficiency of the process.

Envisics HUD approach uses their Dynamic Holography Platform that employs phase holography and the use of Fourier based computer generated holograms (CGH) to reconstruct images using only phase information. This approach offers a number of distinct advantages over the main LED/TFT technologies, namely:

1. Improved optical efficiency

Using phase holography enables all of the light energy to be used in the creation of the image. This makes the display more efficient and brighter for low information HUDs.

2. Improved display robustness

In phase-only holography, all points in the hologram plane contribute to each point in the image, thereby enabling the display to be immune to most types of manufacturing defects such as 'dead' pixels

3. Software configurability

Since the viewed hologram does not change position relative to the light source, this provides a manufacturing advantage in that the positional tolerances are less stringent.

4. Lens power

Software can be used to control the lens which can be configured and thereby reduce the number of components and cost.

Computation of the phase CGH involves the use of proprietary algorithms that result in high quality images in real time using low power. The dynamic holography platform does not use holographic films (such as photopolymer film) but instead uses a spatial light modulator (SLM) based on liquid crystal on silicon (LCOS). The LCOS SLM allows the entire 'display engine' to be reduced in size and volume, and also enables the incumbent liquid crystal display assemblies to be used without further investment in plant and equipment.

The net result is that Envisics' automobile HUD provides high magnification, bright, high resolution images and multiple image planes at different distances which can be viewed whether it is day, night, sunny or overcast.

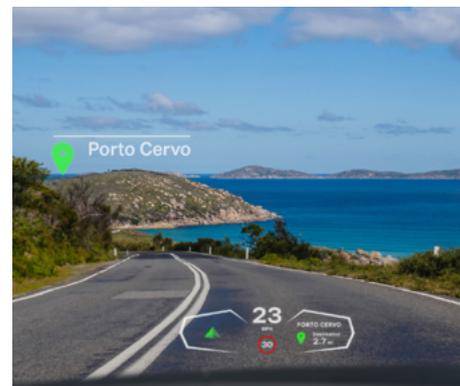
Product advantage

The Envisics dynamic holographic HUD vehicle platform has a number of distinct advantages over conventional digital light source HUD technologies which include:

- **Safety** – no distractions or distortion
- **Augmented reality imagery** – simultaneously observed at different distances, day and night
- **Smaller and efficient** – providing more flexibility and low power consumption
- **Compact optical design with fewer components** – it integrates easily across different manufacturer models, from small city cars to SUVs
- **Sharper** – richer detailed imagery.

Vehicle manufacturers can also tailor the augmented reality experiences to specific models and provide tailored personal preferences to a greater degree, including the use of multiple different colours.

Envisics' business model is to build and supply the OEM car producers with the holographic projection engine and hologram computer chip as a component for integration into vehicles.



An example of Envisics' holographic vehicle HUD.

The future and demonstration

Working with vehicle OEMs, the company's latest technology is now being integrated into the next generation of automotive HUDs which we can expect to see in the next 18-24 months.

Looking further forward, with the forecast increase in the sale of electric vehicles the company is ideally placed with its unique technology and low energy consumption vehicle HUD. However, the company is not resting on its laurels: its third generation holographic HUD is currently in development, which will provide a truly fully 3D immersive experience.

The live demonstration of Envisics' latest product enabled first-hand experience of all of the advantages described for the holographic vehicle HUD. The images were sharp, bright and distortion free. The field of view was perfectly adequate which, combined with the multiple image planes displaying informative driver information, provided the driver with a distraction free user centric experience. Holography News looks forward to further developments from Envisics as they march forward with their ground-breaking technology.

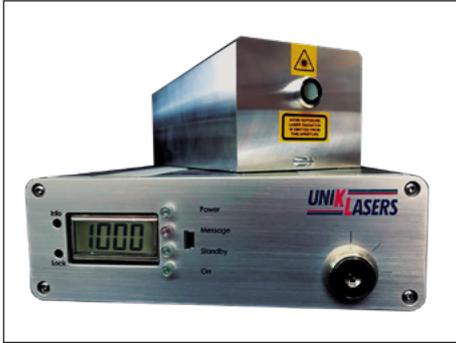
www.envisics.com

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UniKLasers Unveils New Laser Product

UniKLasers Ltd, based in Edinburgh, UK, recently unveiled a new continuous wave diode pumped solid state (DPSS) laser – Solo 640 – 640nm with 1000mW output power suitable for holography and other applications.



UniKLasers' Solo 640 DPSS laser.

UniKLasers was founded by world renowned laser physicist Professor Fedor Karpushko in 2013.

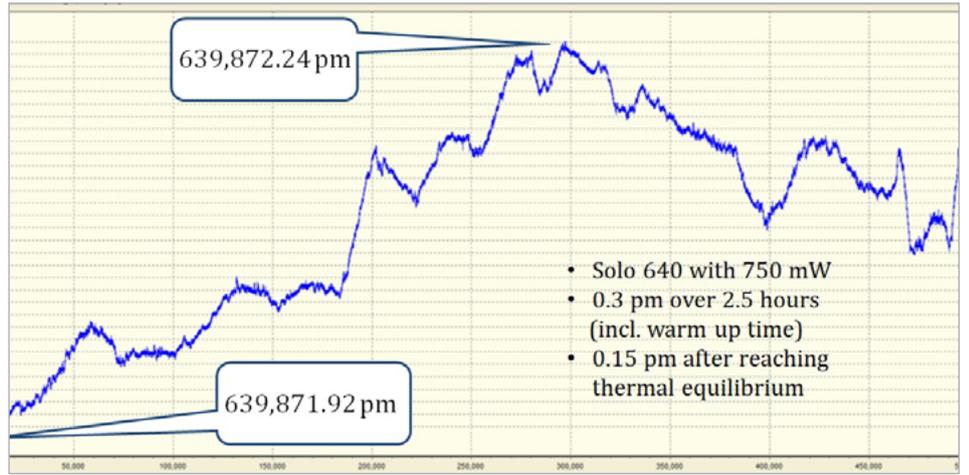
Since its founding UniKLasers has achieved substantial growth, received private and venture capital investments, received support from Scottish Enterprise and won several Innovate UK awards to develop its lasers for commercial use in quantum Technologies applications.

The company's main office, R&D and manufacturing facilities are located in Scotland, where there are a growing cluster of leading edge universities, research and professional organisations in photonics and world-leading laser companies.

The company is well connected and takes an active role in the Scottish photonics community, being closely engaged with the Centre for Applied Photonics in the UK, located in Glasgow, (www.cap.fraunhofer.co.uk) and Birmingham University Quantum Hub (www.birmingham.ac.uk/research/hero/quantum-technologies.aspx). It is a member of Technology Scotland (www.technologyscotland.scot), and collaborates with many Scottish universities, including the Centre for Doctoral Training in Applied Photonics (www.cdtphotonics.hw.ac.uk).

Technology

The company designs and manufactures single frequency lasers in a wide range of wavelengths using a technique called Bragg Range Michelson Mode Selection (BRaMMS), a proprietary pioneering technology platform.



Wavelength stability graph of Solo 640 DPSS laser.

The technique replaces the laser cavity end mirror with a volume Bragg grating (VBG) and Michelson interferometer to select lasing at one of the cavity longitudinal eigenmodes whilst suppressing others. The result is an ultra-stable laser output that is mode-hop and drift free and has a high spectral purity with coherence lengths over 100m. Since the bandwidth of VBG reflectivity is down to ~1nm, it allows users to select a number of wavelengths anywhere within the gain of laser material. This increases the wavelength options available for single frequency performance, at both fundamental and second harmonic wavelengths. The resultant increased efficiency leads to higher available power and reduced thermal management requirements.

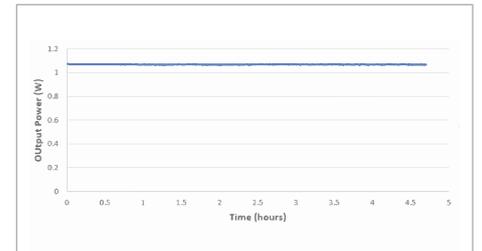
This proprietary patented technology provides reliable, cost effective, compact all-solid-state solutions for both well established and currently unavailable wavelengths in the NIR (near infra-red), visible as well as in the emerging UV (ultra-violet) spectrum range, whilst maintaining environmentally sound methodologies.

Solo 640

The Single Frequency DPSS laser – Solo 640 – exhibits excellent performance characteristics (beam quality, wavelength and power stability) and is particularly suited for holography, which depends on the power, stability and linewidth of a laser to give clear images with a deep field of view.

The drift in the output wavelength is within 320 femtometers over hours of operation, including the warmup time.

The laser output power remains stable within 2% over hours of non-stop operation



Power stability of Solo 640 DPSS laser with 1000 mW over time.

Beam quality measured by the parameter M2, also known as the beam quality factor, represents the degree of variation of a beam from an ideal Gaussian beam. For the Solo 640 this is less than 1.1.

Other applications

Other applications, apart from holography, for UniKLasers include semiconductor metrology, Interferometry, Brillouin scattering, Raman spectroscopy and quantum technologies.

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www.uniklasers.com

Fresnels Inc Moves Forward with New Innovations Division

Effects supplier Fresnels Inc has launched a new division to provide brand enhancement technologies and technical support to the global retail-packaging sector.



Examples of opaque Scarab and Opal foils.

Fresnels Inc was established in 2014 with a mission to use advanced optical technology to strengthen branding for luxury goods and enhance the customer experience. The company promotes and facilitates the international adoption of fresnel lens effects on rigid and flexible packaging using plastic free stamping foils instead of the more traditional laminates.

The technical difficulty of making, and applying, such foils adds to the security of the finished packaging, which is an additional benefit to the brand owner. Amongst its product portfolio is a family of hot and cold stamping foils named *Peacock*™ (see HN August 2018).

Peacock is a transparent foil due to an HRI (high refractive index) coating which allows it to be applied over print. New additions to the family are *Scarab* and *Opal* which incorporate either metallic layers or pigmented layers, allowing them to be used under print. In all cases, the foils may be considered print enhancement tools which impart a dynamic 'wow' effect to otherwise static printed graphics.

The new division is based at Fresnels Inc's headquarters in Shenzhen, China, with two sales offices in USA. It was created to reflect the growing impact of the company's products, specifically as it looks to introduce added value technologies to lift retail-packaging applications to new levels.

The move will focus on providing products that lead to packaging efficiency, value improvement and product enhancement. In response to ecological requirements for recyclable packaging, Fresnels Innovation Ltd facilitates the ability to apply new eye-catching colour shifting effects to luxury packaging through the use of stamping foils and plastic-free transfer films instead of inks and laminates.

Major opportunities in retail

There are large opportunities opening up in the international retail packaging markets, which Fresnels Innovations will be looking to tap into, according to Chief Operating Officer Dr Glenn Wood, who said: 'luxury brands and their packaging manufacturers want to create packs that build a connection with the consumer and evoke the quality of the product through the use of quality materials and refined processes. That's where Fresnels Innovations can fit in. It's a really exciting move that adds to our capacity to bring innovative, recyclable technologies to brand owners.'

Dr Wood also added: 'brands are demanding differentiation in their packaging through the use of eye catching effects that combine elegance with value for money as part of an overall eco-friendly solution. The fact that our optical features also impart a barrier to counterfeiting is an attractive bonus.'

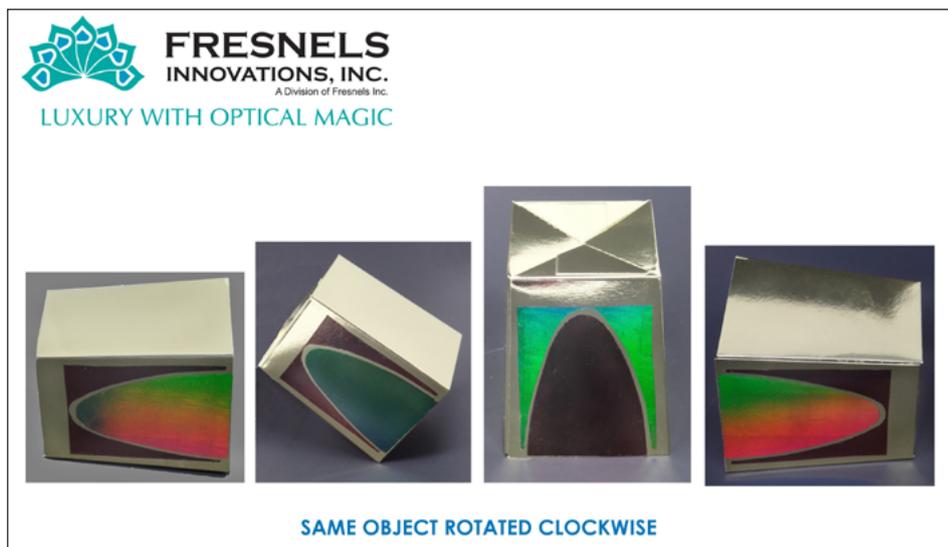
He added that as Fresnels Innovations looks to grow its approach and extend global reach, it would offer customers insight and technical support, enabling them to capture market opportunities and introduce exciting new products.

The new division will leverage its technology to meet the need for high quality, high volume production and short lead times, providing enhanced operation efficiency and cost-effective supply chains to brand owners.

The company will draw on its experience of supplying the Chinese packaging market and the technologically demanding tobacco industry as it continues to roll out and develop its presence globally.

The move will see it utilising Fresnel Inc's current expertise to service the broader western wine and spirits, tobacco, cosmetics and health care markets in addition to the opportunities for the technology in the US and Europe.

www.fresnelsinc.com



SAME OBJECT ROTATED CLOCKWISE

An example of Fresnel Innovations foils on packaging box displaying colour shifting effects when rotated as well as when they are tilted.

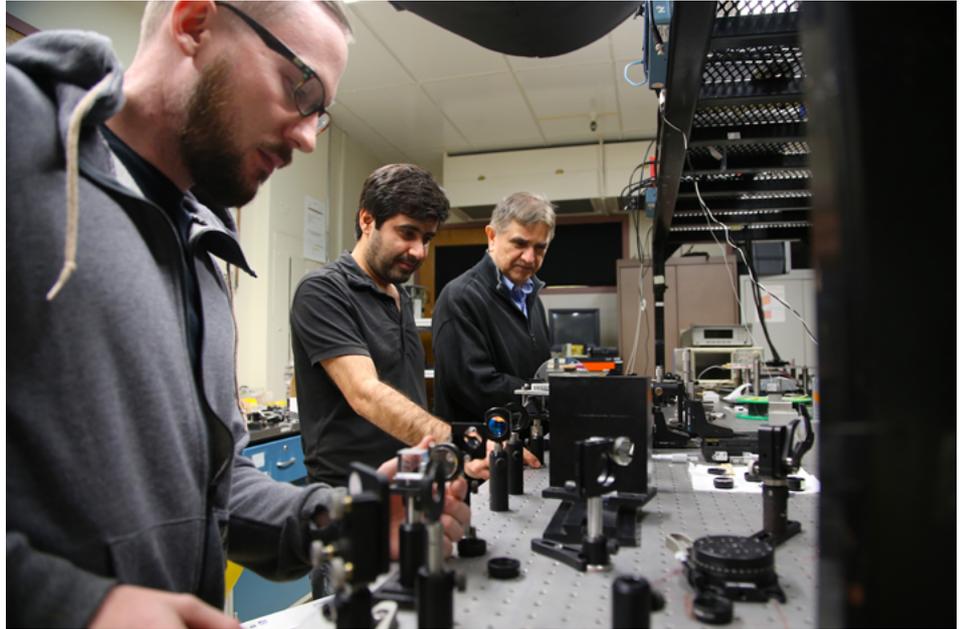
New Start-up for Holographic Video Glasses

New start-up EARDG Photonics (EP) Inc, a spin out from researchers at the University of Arizona College of Optical Sciences, has developed augmented reality display technology that incorporates 3D holographic video for the wearables market.

EP plans to license its new technology to provide augmented reality wearable glasses that will enable users to combine the real world around them and an augmented holographic video display.

The company has three specific inventions that came out of the university's holography research: novel photorefractive polymers, a system for recording holograms, and a means of producing 3D telepresence. By combining the three inventions with new approaches, EP plans to develop its flagship enhanced augmented reality display glasses.

According to Tech Launch Arizona's Amy Phillips, Senior Licensing Manager for the College of Optical Sciences, the licensed technology enables the writing of holograms into a specialised material that has a very fast refresh rate. While standard holographic images are written with lasers into media with permanent or very slow decay rates, the new technology allows for 3-D images to be written and refreshed at 30 per second, a rate that the brain processes as true video.



From left: Doctoral student Joshua Olsen, postdoctoral researcher Veyesi Demir, and professor and inventor Nasser Peyghambarian. (Photo: Paul Tumarkin/Tech Launch Arizona)

'The challenge was figuring out how to record the holograms,' says Phillips, who has helped the researchers define and protect numerous inventions over the years. 'They had to develop a material that holds the image long enough to see, but then extinguishes it fast enough so you can rapidly create the next one.'

With EP taking the technology forward, true augmented reality video appears to be coming into focus, even more so now that the start-up has secured its first investment from UAdventure Capital.

www.uanews.arizona.edu

DigiLens Secures Multi-Million Dollar Investment

DigiLens, a Silicon Valley start-up and innovator in holographic waveguides used for augmented reality (AR) displays, recently announced the closing of an oversubscribed \$50 million investment round. The new investments will enable DigiLens to broaden its development and innovation in high quality, holographic waveguide displays for global automobile, enterprise, consumer, avionics and military brands.

DigiLens has developed a patented optical platform and proprietary photopolymer technology that delivers a unique, low cost contact-copy manufacturing process that enables OEM partners to design and build AR-enabled devices for the global automobile, enterprise, consumer, avionics and military industries. DigiLens' investors include industry leaders UDC Ventures, Samsung Ventures, Niantic Labs, Sony Innovation Fund, Mitsubishi Chemical Holdings Corporation, Continental AG and more.

Chris Pickett, DigiLens CEO said: 'UDC Ventures and Samsung Ventures have recognised through this investment that DigiLens is the frontrunner in waveguide technology and the only waveguide that can get to a consumer price point through its proprietary photopolymer, design software, and innovative manufacturing process. These partnerships provide the ecosystem that enables our technology to go into a variety of different display markets in a variety of different form factors.'

Smart glasses

Earlier this year DigiLens unveiled *DigiLens Crystal* – a cost-effective waveguide-based eyeglass style solution for both industrial and consumer applications. Unlike first generation AR smart glasses that are tinted like sunglasses to compensate for the low efficiency and dim displays, which are not ideal for some interactions, DigiLens' crystal based AR glasses have unimpaired transparency and can be used in bright sunny environments.

Technology license

DigiLens recently licensed its technology to Young Optics, a leading display manufacturer, that uses DigiLens Crystal 25 reference design for AR smart glasses.

'We are excited to partner with DigiLens as they continue to focus on enabling a number of high growth markets with their patented holographic waveguide displays,' said Steven V Abramson, President and CEO of Universal Display Corporation. 'With parallels to our own business, we look forward to working together to bring best-in-class solutions to multiple industries and to collaborate on the future of OLED technology within the augmented and virtual reality display sector.'

The company's mission is to be one of the world's leading waveguide display technology providers, thereby enabling customers to merge the digital and real world imagery that augments. Today the company licenses optical photopolymer and holographic printing tools to leading manufacturers of waveguide optics.

www.digilens.com

OpSec Commits to Three-Year Sponsorship Deal with SFIA

Opsec Security has recently announced a strategic partnership with Sports & Fitness Industry Association (SFIA), a leading global trade association of manufacturers, retailers, and marketers in the sports products and fitness industry.

SFIA seeks to promote sports and fitness participation, as well as industry vitality through research, thought leadership, public affairs, industry affairs and member services.

OpSec's three-year silver partnership will be highlighted at the 2019 SFIA Industry Leaders Summit, which will take place September 25–26 in Baltimore and the 2020 Business & Risk Management Summit next April. OpSec will also serve as an industry expert for the SFIA Webinar Series.

Tom Cove, SFIA President and CEO said: 'the scourge of counterfeited consumer goods is a huge problem around the world, and both hard and soft sporting goods consistently rank among the most highly impacted products. Not only does the problem affect manufacturers financially, but fraudulent products can pose safety risks to users. While manufacturers and enforcement agencies are doing their best to combat the problem, our partnership with OpSec was formed to introduce SFIA members to the most innovative technologies and services available to support the delivery of authentic products into the hands of consumers.'

Rich Cremona, OpSec CEO said: 'OpSec is privileged to become an SFIA Silver Corporate Partner. This new relationship will allow our team to further engage with the decision makers and key influencers around our common goal of eliminating the counterfeiting and diversion of hard and soft sporting goods. OpSec is looking forward to aligning our optical and digital resources together with SFIA members to stay one step ahead of this global problem.'

The SFIA corporate partner program is a collaborative effort between SFIA and up to 15 corporate entities that have demonstrated a leadership role within the sports and fitness industry. The program creates a bridge between industry professionals and the companies most closely connected and committed to serving the sports and fitness industry. The monetary commitments made by these corporate program partners support the broad range of member services and professional development programs created, funded and offered by SFIA to its members.

www.opsecsecurity.com

www.sfia.org

From the Archives

10 years ago...

JDSU Launches Holographic Polycarbonate

JDSU announced a new product aimed at the identity document security market called *Holofuse™*, a polycarbonate film that incorporated a clear holographic pattern into the surface without the use of adhesives. The film was the first of its kind and posed a serious threat to counterfeiters as the partially transparent holographic layer was integral and could not be removed from the rest of the card.

The hologram was cast into a coating which then fused with the polycarbonate. This was then used in the lamination process for PC substrates used for ID cards and some passport data pages. It was also suitable for laser engraving of personal data, all of which made it unnecessary for a separate lamination step following the application of the variable data.

Kurz Offers New Features for Trustseal

Leonhard Kurz developed a variety of new optical features to enhance *Trustseal®* – its flagship brand protection product generated by the same proprietary direct-write technique used to create *Kinegrams®*. The new set of supplementary features comprised a series of lenses and contrasts that in many cases are visible to the naked eye at one angle, but also provide hidden effects that are detectable only with special filters or under magnification

These supplementary features included:

- *Nanopic* – comprising images with a resolution of over 50,000 dpi that could be authenticated with a high powered magnifier.
- Latent *Contrast* – an overt feature that exhibited a positive/negative inversion from dark to light change when rotated at 90°. In the new, latent, version the element was invisible when viewed normally and appeared at a low viewing angle, and again, when the image is turned 90°.
- *DynaKey* – a hidden element that became visible only when a special filter was placed over it. The overlapping *DynaKey* version is superimposed on the main image, without obscuring the main visual design, and shows a striking movement effect when viewed through the filter.

Latent Mirror – a simple, mirrored metallic surface under normal viewing conditions. When the image is viewed at an extremely flat viewing angle rather than front-on, a blue-green design can be seen. When the same oblique viewing angle is maintained and the *Trustseal* rotated by 90°, a dark-bright contrast inversion takes place between the design and the background.

I LOVE NEW YORK Campaign Opts for Holograms

A new authentication programme was launched to protect authorised licensees and official merchandise for *I LOVE NEW YORK*, one of the world's most recognised brands, from unlicensed and counterfeit products in the marketplace.

Central to the programme was the accompaniment of officially licensed products with new hologram hang tags and self-adhesive labels. Bearing the iconic I♥NY logo, these were produced by OpSec and supplied to CMG Worldwide, a premier licensing company.

20 years ago...

Nanocomp Offers E-Beam Origination

Finnish company Nanocomp Ltd, a spin-off from the University of Joensuu, expanded its diffractive optical service to include the e-beam origination of masters for holograms.

The university's Department of Physics had been working on diffractive optics for 20 years, and set up Nanocomp in 1996, granting it access to the university's e-beam system for up to 3,000 hours a year. The company pointed out the advantages of e-beam origination compared to the more conventional holographic processes, including the lower line width. A particular feature of the Joensuu facility was a continuous path control, which moved the exposure stage along a predefined curve, rather than the more usual step and repeat system.

Nominations Open for Excellence in Holography Awards 2019

The International Hologram Manufacturers Association (IHMA) is inviting applications and nominations for the Excellence in Holography Awards 2019 ahead of the annual Holography Conference, to be held 14-15 November in Athens, Greece.

The IHMA represents many of the leading hologram and holography technology developers and manufacturers from across the world. The 2019 awards are to showcase the leading developers in holography technology worldwide and recognise innovation in this 'ever-changing field', the IHMA said.

The award categories include innovations for the best in Holographic Technology, Origination, Display or Emerging Technology Applications and Applied Security, Decorative and Packaging Products.

The IHMA said the award categories cover the full end-to-end spectrum of holographic techniques in origination, production and finishing, with the awards to showcase the best examples of design, artwork and techniques used in holographic origination to the application of holographic optical elements, for example in display screens, lighting, communications and vehicular systems.

The awards will also showcase exceptional real-world uses of security and authentication holograms by a customer.

Any number of applications or nominations can be submitted, either directly from a company or on behalf of another company or project. People or organisations involved in a hologram project may apply for an award and others may nominate holographic projects for an award, as long as details can be given of the user or producer of the hologram.

The closing date for receipt of applications or nominations is 23 August. Only holograms first produced commercially, or holographic processes or techniques introduced after 1 August 2018, are eligible.



The winners will be announced, and the awards presented at a dinner on 15 November during the 2019 Holography Conference.

www.theholographyconference.com

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Publisher: Reconnaissance International Ltd.
Editor: Dr Mark Deakes (right)

Annual subscription rate: £575 plus postage

Subscribers to Authentication News, Tax Stamp News or ID & Secure Document News (20% discount).

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San Jose, Costa Rica
www.reconnaissance.net/hsp-latinamerica/

11–13 JUNE 2019

SECURITY DOCUMENT WORLD 2019

London, UK
www.securitydocumentworld.com

11–13 SEPTEMBER 2019

TAX STAMP FORUM

Budapest, Hungary
www.taxstampforum.com

14–15 NOVEMBER 2019

THE HOLOGRAPHY CONFERENCE

Athens, Greece
www.theholographyconference.com

29–31 JANUARY 2020

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