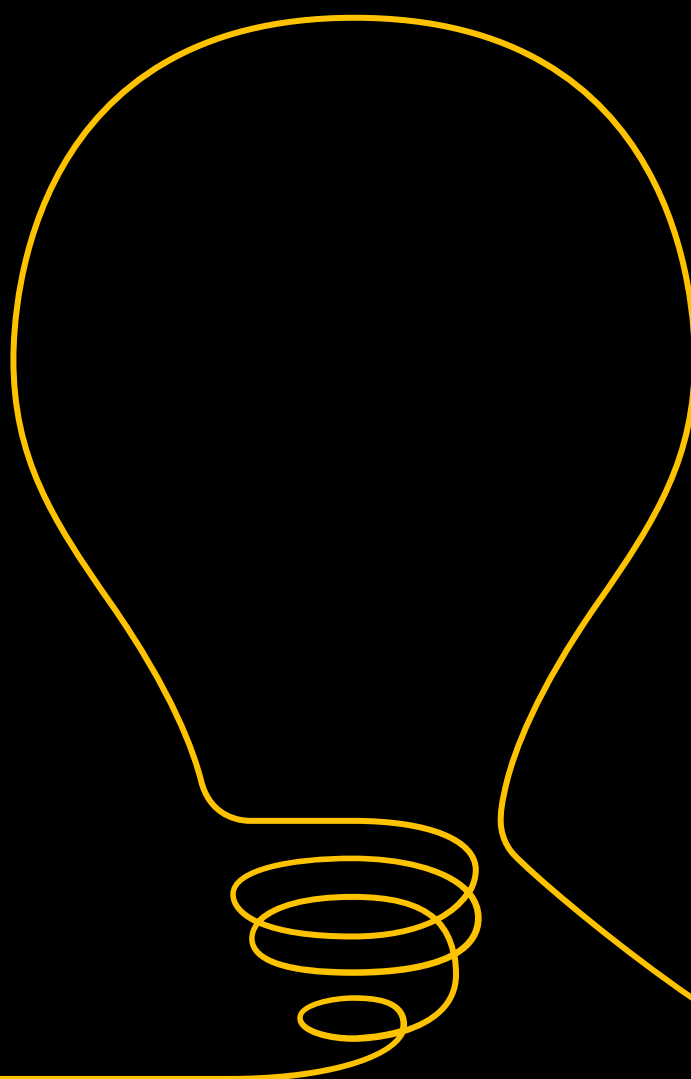


IOP Institute of Physics

Business Awards **2019**



IOP Institute of Physics

www.iop.org

Background

The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland, we seek to raise public awareness and understanding of physics and support the development of a diverse and inclusive physics community. As a charity, we're here to ensure that physics delivers on its exceptional potential to benefit society.

Earlier this year, IOP launched its new strategy, *Unlocking the Future*. In it we set out the part physics can play in helping to solve some of our most pressing global challenges such as an ageing population, the need to decarbonise our economies and ensure the security of food, water and energy supplies. To meet these challenges, we need to build a thriving, diverse physics community; unlock the capability required to realise the benefits of a new industrial era – and ensure the public are able and inspired to play their part in the debate.

IOP members come from across the physics community, whether in industry, academia, the classroom, technician roles or in training programmes as an apprentice or a student. However, IOP's reach goes well beyond our membership to all who have an interest in physics and the contribution it makes to our culture, our society and the economy.

We are a world-leading science publisher and we are proud to be a trusted and valued voice for the physics community.

Welcome



Dr James McKenzie, FInstP

IOP Vice-president for Business

Many of the technological advances, inventions and innovations that make our lives easier and more secure have physics at their core. Physicists working in industry and business are key to the research and development of products and technologies we value and rely on, from large infrastructure projects to goods and services available in our homes and in our pockets.

The success of physics-based businesses is vital to our economy and to society and the Institute of Physics (IOP) plays a vital role in bringing together physicists working in business and industry in global corporations, local companies and start-ups in the UK and Ireland.

One of the key roles of the IOP and its members is to ensure that those with decision-making power fully understand the contribution a strong and connected physics business community can make to the economy and how vital a well-funded, thriving research and development (R&D) base is to the discovery and solutions process.

The IOP's role is to foster, support and connect physicists working in industry and to enable physics-based businesses to thrive by recognising their achievements, supporting their efforts and allowing entrepreneurs and innovators to connect, share and learn.

Tonight's awards are central to this ambition – showcasing and celebrating some of the most innovative and promising from the physics business community and connecting them with decision-makers and each other at this prestigious event.

Our business awards go from strength to strength, and the industries recognised this year include automotive, aerospace, environmental, security, healthcare and the drinks industry. We are committed to developing strong, effective relationships with the winners and opening new opportunities with them through our business innovation and growth network.

I'd like to congratulate all of tonight's IOP Business Award winners and thank the Business Awards judging panel for their expertise and continued support.

Thank you

A message from IOP's president



I have run several businesses that have physics deep in their DNA. I know the challenges and opportunities this brings. It is vital to highlight the development of physics-based innovation and to support the businesses and individuals who drive those advances forward. That is why these awards are so important.

I'm sorry I can't be with you tonight to celebrate the achievements of the companies and individuals awarded but congratulations to all the winners and have a wonderful evening.

Jonathan Flint, CBE

President of the IOP



Business Innovation Award 2019
IOP Institute of Physics

Awarded to small, medium and large companies that have excelled in innovation and delivered significant economic and / or societal impact through the application of physics.



Business Start-up Award 2019
IOP Institute of Physics

Awarded to businesses that have been incorporated for less than five years with a great business idea founded on a physics invention, with a great growth potential and / or the potential of significant societal impact.

Winners

FFEI

Aeristech

Reaction Engines

Elekta

Horiba

Winners

Opsydia

Novosound

VeriVin

Matoha Instrumentation

Business Innovation Award winners

“ Physics is a vital discipline that enables the team at Reaction Engines to develop the Pre-Cooler and SABRE engine. ”

Mark Thomas, CEO, Reaction Engines (SABRE)

“ Aeristech is proud of its game-changing motor control technology and IOP’s recognition gives us even more credibility with customers. ”

Richard Wall, CEO, Aeristech

“ It’s an honour to have been recognised by the IOP for our design capabilities in the field of digital imaging. ”

Andy Cook, CEO, FFEI

“ Rooted in science, Elekta Unity’s physics innovation is focused on enabling precision radiotherapy for patients. We’re honoured by this award. ”

Richard Hausmann, President & CEO, Elekta

Business Start-up Award winners

“ We are honoured and delighted that the IOP recognises the urgency and potential global impact of our work, and we look forward to making the world a better place one piece of plastic at a time. ”

Martin Holicky, Co-founder and Director, Matoha

“ This award is very exciting for a company like Novosound which is based on novel core physics technology. ”

Dr Dave Hughes, Founding Director, Novosound

“ Being selected for an IOP Business Award is great recognition for the tremendous work done by the team at Opsydia. ”

Andrew Rimmer, CEO, Opsydia

Aeristech



The ACT motor is a new class of variable speed motor that has more power for its size than comparable motors; it delivers rapid acceleration, high continuous power output and efficiency. This enables applications in the automotive and fuel cell industries that were previously impossible.



The Company

Aeristech was founded in 2006 to develop fully electric turbocharger technology. In the process it invented the world's fastest electrically-driven centrifugal compressor.

A technology that delivers environmental benefits, with significant savings in cost and energy while allowing applications that were previously impossible.



Aeristech has developed a range of variable speed motor sizes based on Aeristech Control Technology (ACT). Three applications have been commercialised based on coupling an ACT motor to a compressor wheel. The resulting centrifugal compressors spin twice as fast as any other compressors, delivering oil-free air at pressures and in quantities previously only possible if using a positive displacement compressor.

The Aeristech centrifugal compressor has game-changing applications.

As an electric supercharger it can supply the air to an 800cc automobile internal combustion engine that delivers the performance of an engine three times its size, without turbolag. Using smaller engines allows reductions of up to 26% in fuel consumption and emissions. Manufacturers will market mass produced cars with Aeristech compressors in 2020 for the first time. Engine sizes will be 1.0, 1.1 and 1.4 litres.

Fuel cells that use expensive, inefficient positive displacement compressors expend over a quarter of their output on pressurising their inlet air supply. In comparison, an Aeristech centrifugal compressor uses 40% less energy.

Aeristech has developed a range of models suitable for different fuel cell sizes, which can power anything from fork lifts to large vehicles. Seven potential customers are trialling demonstration compressors. The company has been awarded an EU Horizon 2020 of 827,000 to fund further development of its fuel cell compressor design.

Aeristech is also testing the world's first centrifugal compressor for use in industry. The 30kW air compressor has three stages. Using up to 30% less energy than its competitors, it supplies oil-free air at a pressure of 8 bars. Aeristech expect it to change the industrialised production of compressed air.

Elekta



Elekta Unity integrates a high-field MRI system, a state-of-the-art linear accelerator and an adaptive workflow to improve delivery of radiotherapy. This will allow clinicians to target tumours more accurately and personalise treatment for better results.



The Company

Headquartered in Stockholm, Sweden, Elekta is a leader in precision radiation medicine, providing solutions for treating cancer and brain disorders and helping clinicians to personalise patient care. 145,000 patients receive diagnostics, treatment or follow-up enabled by Elekta every day. The company employs 3,700 people around the world, of whom 780 are based in Crawley, UK.

Clinicians see what they're treating more clearly, allowing them to adapt treatment if necessary and ensure the best possible radiation delivery for each patient.



The aim of radiotherapy is to deliver the correct dose of therapeutic radiation to the tumour while minimising the dose to normal tissues, to reduce toxicity. Current practice defines a dose distribution (plan) before treatment begins; this is delivered over several treatment sessions. The plan is designed to irradiate the tumour, accounting for any variation in its position.

Elekta Unity's integrated 1.5 Tesla MRI system supplies better soft tissue contrast images before and during treatment, without increasing radiation levels for the patient. Clinicians can check for any changes in the tumour's shape, size and position during every treatment session. Clinicians can adapt the initial plan and tailor radiation doses to suit each patient's daily condition. Real-time imaging during treatment also allows clinicians to track tumours, and account for any motion of the tumour during treatment. This means that they can not only target radiation more accurately, but also treat tumours in areas that couldn't be reached with conventional image guidance methods, such as the pancreas.

Elekta Unity is the only high-field MR-Linac (combination MRI scanner and linear accelerator) system in the world that allows diagnostic quality images and has the potential for functional imaging. This will help clinicians to assess the response to treatment. It received CE-marking and FDA 510(k) clearance in 2018, as well as regulatory approvals in Canada and Japan in 2019 and is currently in clinical use in twelve hospitals. Elekta Unity has been used to treat more than 400 patients so far; it is the subject of over 200 peer-reviewed publications.

FFEI



FFEI has developed advanced, whole-slide imaging (WSI) technologies that generate ultra-high resolution, colour-calibrated digital images, allowing clinicians to use digital pathology more widely in cancer diagnosis. This is dramatically increasing speed of diagnosis and helping to save lives.



The Company

FFEI designs and manufactures innovative digital imaging technologies, used by its partners to create market-leading life science products. Based in the UK, FFEI has many years of experience developing advanced digital imaging technologies, including leading solutions in cell biology and digital pathology.

Advanced colour calibration and mechanical accuracy that allows clinicians to use more digital pathology in cancer diagnosis, dramatically increasing speed and saving lives.



Focus tracking, colour profiling and mechanical accuracy (for digital image swathe stitching) are the three core capabilities FFEI is using to increase the speed, quality and accuracy of digital imaging.

FFEI technologies allow WSI devices to correct focus in real time to compensate for variances in the thickness of tissue samples. This is achieved using castellated optics and multiple sensors, allowing pathologists to process more slides, more quickly. It also allows WSI devices to scan in both directions and begin capturing data as the scanner accelerates (previous devices needed a constant speed).

Pathologists identify cancer cells using the colour of stains and the contrast between stains. FFEI has developed a colour profiling technology that ensures digitally scanned images are consistent in colour, reflecting what a pathologist would observe viewing the samples with a microscope. FFEI took measurements that allowed creation of an International Colour Consortium (ICC) profile for colour correction. This ensures that the colour displayed is the same as that seen through a microscope.

Linescan cameras contain a single row of pixels used to capture data very quickly. Software reconstructs the image captured line by line as the subject moves past the camera at high speed. Maintaining a constant speed during image capture is essential for quality imaging. FFEI uses an encoder strip on the moving slides to monitor the position of each pixel. FFEI's spatial accuracy technology interpolates the image over a number of pixels to determine the correct spatial location.

HORIBA



The FLIMERA is a novel molecular movie camera that detects the location and dynamics of molecules using their fluorescence emissions. Each camera pixel simultaneously measures molecule timing and intensity. Bespoke software enables real-time video rate studies of the fundamental cellular processes critical to biology and healthcare.



The Company

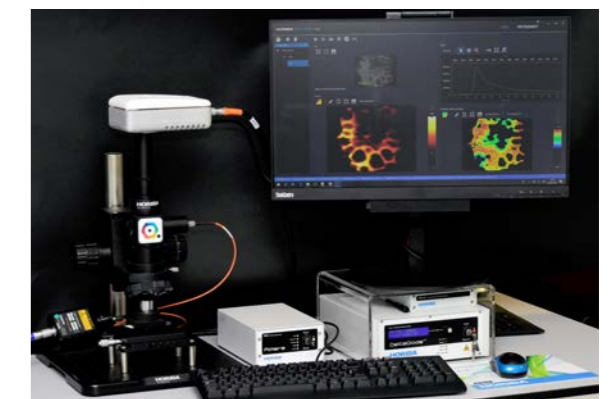
Glasgow-based HORIBA Jobin Yvon IBH Ltd manufactures software and instrumentation for time-correlated single-photon counting (TCSPC). Founded in 1977 as a spin-out from the University of Strathclyde, IBH pioneers commercial TCSPC fluorescence lifetime spectroscopy systems. IBH was acquired by HORIBA in 2003; they now lead the market in fluorescence spectroscopy.

TCSPC detects the arrival times of individual photons in response to a pulse of light, an important photon time-of-flight measurement. It can be used for range finding, and to determine how long molecules store optical energy before radiating it as fluorescence. This is known as the fluorescence lifetime and is dependent on both the molecule and its nanoscale environment. Because of this it can be used to probe molecular interactions that are significant for many biological sciences (e.g. cell and protein interactions) and material sciences (e.g. solar cells).

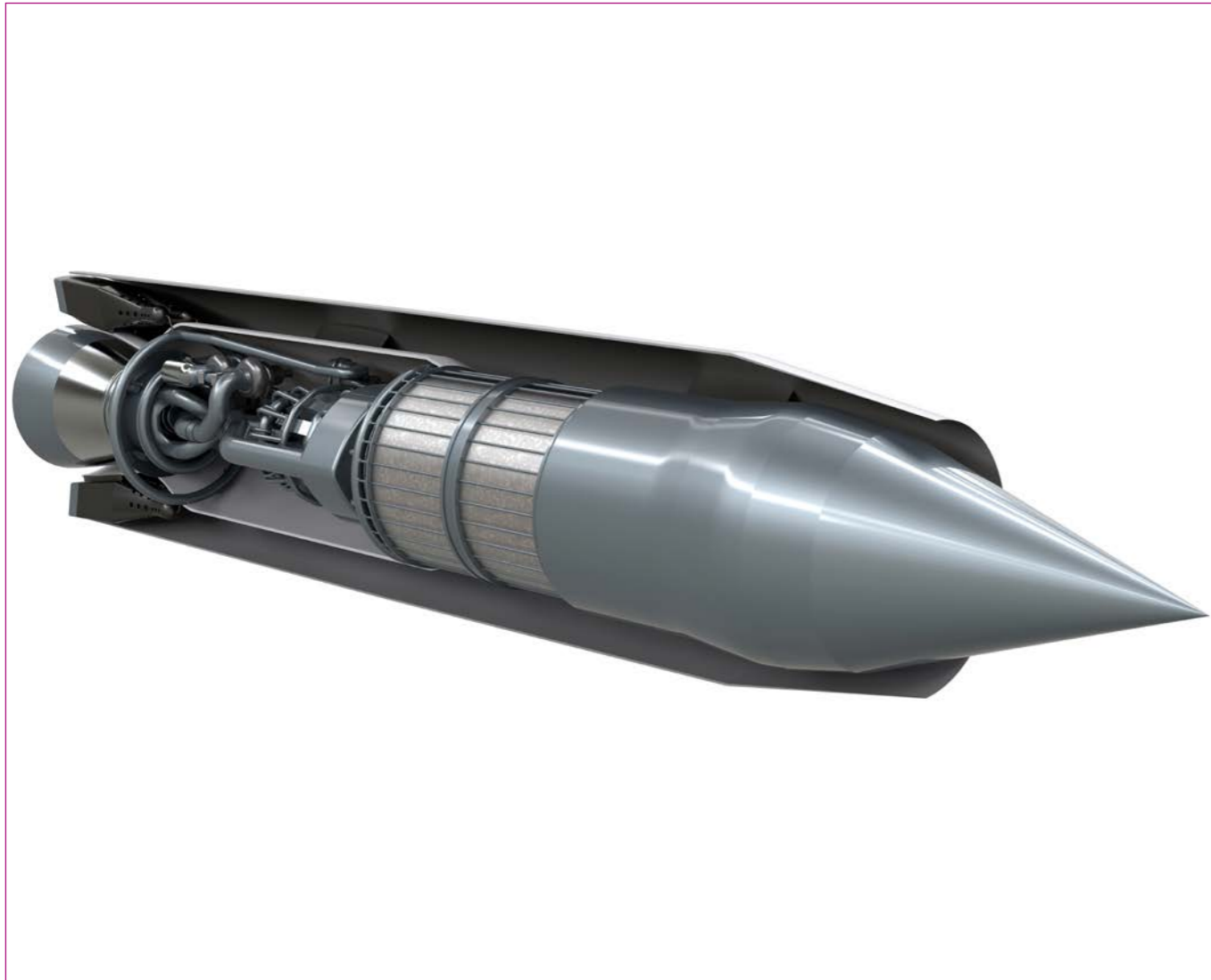
HORIBA has made it possible to combine the single photon detection that is based on single photon avalanche photodiodes (SPADs) with TCSPC's ability to time photon arrival, in a single camera pixel. Recent advances in complementary metal oxide semiconductor (CMOS) technology have allowed a pixel array as small as 192 x 128, where each pixel has an individual detector and its own TCSPC timing circuitry. This architecture allows the camera to produce a large amount of data, which requires processing to provide an image. HORIBA developed bespoke firmware and software that allow the display and recording of video rate (30 fps) images.

HORIBA has packaged the array chip with its commercial software and lasers to produce the FLIMERA wide-field fluorescence lifetime imaging microscopy (FLIM) camera. Parallel fluorescence data acquisition makes the camera over an order of magnitude faster than conventional scanning microscopes using FLIM. The result enables real-time video rate FLIM for the study of mobile samples, such as live cells and fluid biopsy for cancer screening.

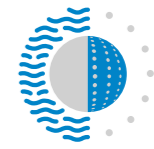
A game-changing technology creating a user-friendly camera that delivers video rate fluorescence imaging of molecular processes for medical research, disease diagnostics, screening and tissue monitoring.



Reaction Engines



SABRE is an innovative new class of aerospace propulsion with the potential to provide efficient air-breathing thrust from standstill to speeds over five times the speed of sound. A new ultra-lightweight heat exchanger, which stops engine components overheating at high flight speeds, is central to the SABRE design.



REACTION ENGINES

The Company

Reaction Engines is a privately-owned company based in Oxfordshire, employing over 200 staff across the UK and US. The company develops the technologies needed for an advanced air-breathing rocket engine class called SABRE (Synergetic Air-Breathing Rocket Engine), a leading contender for the next generation of hypersonic flight and space access vehicles.

Enabling a more reusable, reliable, efficient and responsive rocket engine for space access, through advanced thermal management.



SABRE class aerospace propulsion can provide efficient air-breathing thrust from standstill to speeds above five times the speed of sound in the atmosphere. The SABRE engine can then operate in rocket mode, allowing spaceflight at up to orbital velocity. This is the equivalent of up to twenty-five times the speed of sound. Through its ability to `breathe` air from the atmosphere rather than carry its own oxygen, SABRE reduces weight propellant consumption considerably, compared to conventional rocket engines.

Reaction Engines has now developed a range of ultra-lightweight and uniquely compact pre-cooler heat exchangers that can cool airstreams from a temperature of over 1,000°C to ambient temperature in less than 1/20th of a second.

Individual components of the SABRE engine have been validated in an extensive research and development programme, passing a preliminary design review. Reaction Engines is currently testing its new heat exchanger in the US; the component will be exposed to hypersonic conditions approaching 1,000°C simulating its pre-cooler performance under the high-temperature airflow conditions expected during high-speed flight

Matoha Instrumentation



Matoha Instrumentation has developed a low-cost small-scale infrared materials identification and analysis platform, enabling more efficient manual sorting of recyclable waste.



The Company

Founded by scientists and entrepreneurs from Imperial College, London, Matoha Instrumentation makes infrared analysis and identification technologies affordable for distributed recycling systems and fabrics companies, using recent advances in computing and photonics.

A new platform that allows low-cost solutions for efficient manual sorting of recyclable waste, suitable for use in developing economies.



Matoha Instrumentation has developed a platform for low-cost small-scale materials analysis, enabling identification and sorting of visually identical but chemically different materials for recycling. Matoha has built two products on this platform, one that identifies and analyses plastics, and one that works with fabrics. The platform allows operators in manual material recovery facilities (MRFs) to recover more recyclable waste from mixed recycling.

The patent-pending devices combine near-infrared spectroscopy and cloud-based machine-learning algorithms. Most current large-scale automatic sorting facilities use the same principle of infrared spectroscopy to sort plastic waste but at a higher cost, and Matoha's algorithms make use of modern Big Data principles to continuously analyse, benchmark and improve performance.

The devices will be used in MRFs around the world, particularly in regions lacking the resources and infrastructure to construct automatic sorting facilities. Manual sorters equipped with these devices will have in effect "better eyes" which can identify and differentiate mixed waste.

Matoha Instrumentation plans to use this platform to revolutionise identification, analysis and quality control across a range of sectors.

Novosound



Current ultrasound sensor materials and applications have been limited by the fact that machining and manufacturing methods haven't changed for over 40 years. Novosound uses innovative thin-film processes and technologies to overcome these limitations and drive growth in the ultrasound sensor market.



The Company

Novosound uses thin-film technologies in both current and untapped markets to push the limits of ultrasound imaging and measurement. As the University of the West of Scotland's first spin-out in 2018, it has been trailblazing a new technique to mass manufacture printable ultrasound sensors, with 15 staff and a six-figure turnover.

Harnessing thin-film processes and technologies to create new manufacturing methods, which allow new applications for non-destructive ultrasound-based testing.

Novosound's new thin-film manufacturing techniques open up new opportunities for wearable and embedded ultrasound sensors. This not only solves major problems with current sensor but allows the development of new sensor applications. These include wearable and embedded sensors, in line with the smart and autonomous systems required by Industry 4.0.

Novosound creates sensors for ultrasonic non-destructive testing in the oil and gas, aerospace and semiconductor industries. The company's working with several partners and businesses to jointly develop thin-film technology that addresses challenges in imaging and measurement from these markets. Solutions include the first truly flexible imaging sensor, for detection of flaws and defects in complex geometries (such as wind turbine blades and aircraft wings). Other examples are permanently installed sensors for continuous monitoring of high-temperature assets, and high-resolution probes for acoustic microscopy.

Novosound intends to build a sizeable technology business in Scotland and target the lucrative medical imaging market with this non-destructive testing technology.



Opsydia



Opsydia has created a novel security solution for diamond gemstones based on developments in laser processing, including adaptive optics technology.



The Company

Opsydia was formed as a spin-out from the University of Oxford in 2017; it's set to disrupt several industries by using ultrafast laser technology to create practically invisible structures inside transparent materials. Applications include polymers, manufacturing advanced diamond sensors, and security marking inside diamond gemstones.

Innovative adaptive optics technology allows high-precision laser marking that can guarantee the identification of precious stones without affecting their grade.



Opsydia has developed adaptive optical techniques for use in short-pulse laser processing. This innovative technology allows secure marks and serial numbers to be embedded inside diamond gemstones at the microscale, offering security and traceability without degrading gem quality.

Over 10 million diamonds are individually laser-written every year, placing a serial number on the stone's outer edge. This number confirms the diamond's quality assessment or 'grade' as it moves through the supply chain to the end consumer, determining its value. It's also used to track the stone's provenance; this application is growing as the details are stored in secure blockchain-based solutions. But the security of the serial number is questionable; as it's on the surface it's easily polished away or duplicated on inferior stones, undermining both consumer confidence and ethical gem programmes by the industry.

Opsydia's developments allow accurate laser fabrication inside diamonds, using a high-precision laser and innovative control techniques. These embed laser-written marks and serial numbers below the surface of the diamond, preventing easy removal. Opsydia's patented adaptive optical techniques are critical for precise focusing of the laser, enabling identification marks less than 1/50th of the width of a human hair. These subsurface marks can be so small that they have no effect on the quality or grading assessment of the stone. This is the first technology in the world that can fabricate features inside diamonds at high speed and on an industrial scale.

Opsydia's marking technology has been adopted by one of the leading producers in the diamond industry and the company has received an order for its first marking systems.

VeriVin



VeriVin's through-barrier analyser allows the authentication, characterisation and monitoring of complex liquids without opening their container.

The potential analysis applications go beyond wine and spirits to olive oil, honey and personal care or healthcare products: VeriVin's database could eventually contain optical "fingerprints" for millions of items in each sector.

VeriVin

The Company

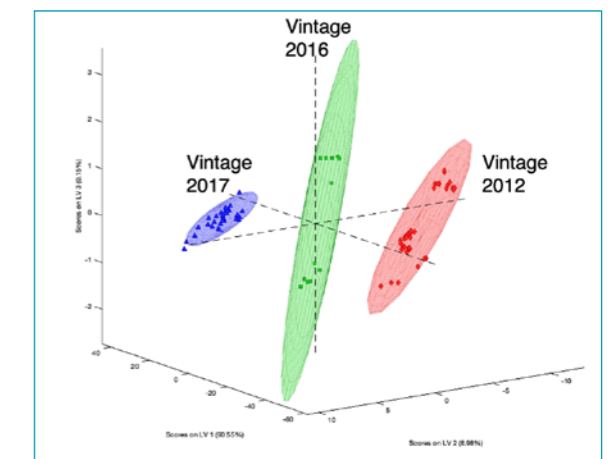
VeriVin is a start-up that has developed a through-barrier spectroscopic analyser for wine, spirits and other complex liquids in sealed containers. VeriVin plans to create a database with the optical fingerprints of millions of bottles of wine, allowing them to be authenticated, characterised and monitored over time.

A spectroscopic analyser that can characterise the liquid content of sealed containers, which, in conjunction with a planned wine ID database, could allow significant advances in non-destructive authentication and quality monitoring.

Applications for VeriVin's technology range from anti-counterfeiting and quality control to profiling and validation (rubber stamping) for wine producers. Its use will lead to a powerful database of ID tags, based on physical data, that could have a major impact on the wine and spirits industry.

VeriVin plans to extract meaningful conclusions from this database by analysing the optical fingerprints acquired for each product in the database, using chemometrics and machine learning. The results of this analysis could go beyond validation and quality control, leading eventually to more accurate pricing and aid in provenance certification, possibly even serving as a comparison tool to help consumers make choices based on physical data.

The technology could allow producers to re-scan bottles year on year, monitoring the development of the contents in ideal storage conditions. A benchmark ID tag could then be compared with the ID tag of a similar bottle in the future. This second bottle might have changed hands several times, have a different storage and transport history, or even be a fake.



Nine years of Business Award winners

Active Needle Technology

Ikon Science

PepsiCo

Aeristech

Innovative Physics

Plastipack

Airbus Defence and Space

Jaguar Land Rover

pureLiFi

Aqua Cooling Solutions

Kromek

Reaction Engines

Aurox

Leonardo

Rolls-Royce

Causeway Sensors

Lynkeos

Silixa

Coherent Scotland

M Squared

Simpleware

Creavo Medical Technologies

Magnox

Sonobex

Displaydata

Matoha Instrumentation

Stream Bio

e2v

MBDA

Tesla Engineering

Elekta

Metrasens

The Technology Partnership

Endomag

MR Solutions

Thornton Tomasetti Defence

FFEI

Naneum

Tracerco

Gas Sensing Solutions

Novosound

Ultra Electronics

Gooch & Housego

Opsydia

VeriVin

Hallmarq Veterinary Imaging

Ossila

York Instruments

Horiba

ONI

Zephir

ICEoxford

Oxford Space Systems

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