

To Boldly Go... Qioptiq Space Technology vital to space mission success



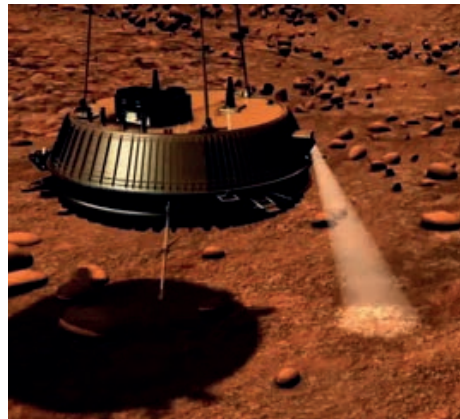
Our ancestors looked to the sky at night, fascinated by the heavenly bodies, asking questions and seeking answers. Space today plays a more crucial role in our daily lives than at any other time in our history with many questions still to be answered.

Qioptiq have a long history associated with seeking those answers. Our heritage goes back to the early days of space exploration having first produced products in 1969 for a Ministry of Defence (UK MOD) program to supply a space qualified glass. We have now been supplying the space industry for well over 40 years and continue to be world leaders in the design and manufacture of highly specialised optical space components supplying ultra-thin coverglass and Optical Solar Reflectors (OSR) for use on satellites.

Qioptiq has provided the unique solar cell coverglasses and OSR for a myriad of programs supplying ultra-thin coated glass which protects the solar cells in the harsh environment of space and OSRs for thermal management. The Qioptiq protected cells provide power for space craft. Any damage to these could result in the mission failing so our products are vital, a fact recognised by a key customer, EADS Astrium, in 2012 with the award of "Master Supplier" status. The reliability promised through Qioptiq heritage is primary in this field as once a launch is complete failure of the power systems or over heating of the craft would be catastrophic.

Over the years Qioptiq products have been used on a substantial number of major satellite programs, including Space Telescope, Mars Exploration Rover Mission, TDRS, Intelsat, Globalstar, Iridium, Kepler, Messenger and Huygens*.

**Huygens is designed to explore the surface of Saturn's moon Titan and is named after Christiaan Huygens, a Dutch astronomer who discovered Titan in 1655. Saturn's largest moon, Titan, is one of the most Earth-like worlds we have found to date. It has a thick atmosphere and organic-rich chemistry and is the only other world we know of that has stable liquid on its surface.*



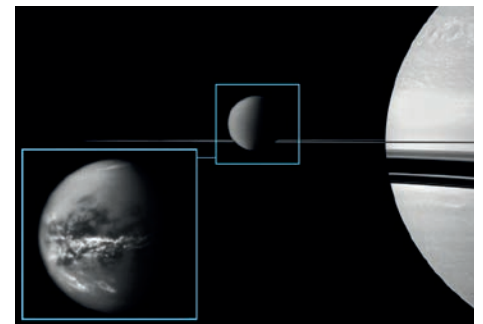
Huygens probe touch down on Titan

Huygens was released from the international Cassini spacecraft on Christmas Day 2004, arriving on Titan three weeks later with Qioptiq products proving vital to mission success. The probe was designed to perform an in-depth study of the clouds, atmosphere, and surface of Titan, plunging into a planetary atmosphere farther away from Earth than any other deep space probe had gone before.

Qioptiq hold a unique place in the space industry operating one of the world's only production facilities producing ultra-thin glass specifically for the space industry. Developments in coatings and production techniques keep us at the forefront to assist our customers in answering some of the mysteries of space.

Contact: Craig Taylor craig.taylor@uk.qioptiq.com

Images courtesy of NASA



Titan seen against the rings of Saturn

EPSRC Research Grant for Space Application – with partners CSER Glyndŵr University, Qioptiq Space Technology, Surrey University and Surrey Satellite Technology

The Centre for Solar Energy Research has been awarded a research grant from EPSRC on "High-power, low-weight, flexible thin film photovoltaics for space application".

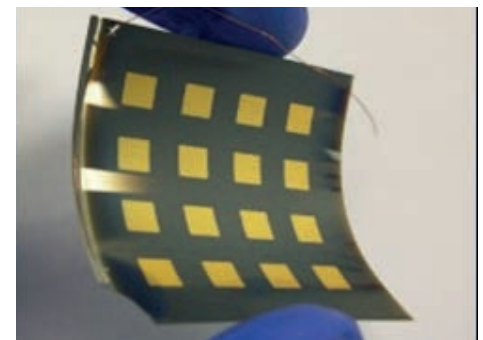
The Centre for Solar Energy Research (CSER) at the OptIC Glyndŵr St Asaph campus have been informed by EPSRC that the grant proposal, "High-power, low-weight, flexible thin film photovoltaics for space application" has been approved for funding. This is a 36 month grant with partners: Glyndŵr University (CSER), Surrey University, Qioptiq Space Technology and Surrey Satellite Technology. The project is led by Glyndŵr (CSER) with Professor Stuart Irvine as the PI and Dr. Dan Lamb as the Researcher/co-investigator. The latter category has been created by RCUK (Research Council UK) to recognise the leadership role of senior researchers. Dan is a Research Fellow in CSER and successfully led the proposal writing team. The value of the grant is £592,507 with a total of £342,315 coming to the Glyndŵr team.

The project is to develop a completely new type of solar module for powering satellites and even space vehicles based on a very high power to weight ratio. This will be achieved through combining the ground breaking CSER thin film PV technology based on the in-line MOCVD (Metal organic chemical vapour deposition) process with the ultra-thin micro-glass manufactured by North Wales company Qioptiq Space Technology. The micro-glass is already a space qualified product, designed to withstand the intense radiation environment in space and is used as a protective cover on solar panels used for powering satellites. In this project we will establish thin film PV devices on this micro-glass and with the assistance of the Surrey team carry out a series of radiation and mechanical tests to establish an ultra-light weight solar cell that can survive the hostile space environment.

The CSER are preparing for the research project to start at the beginning of March. This is a very exciting project with an excellent world class team and we anticipate

that this will eventually lead to new manufacturing opportunities in North Wales.

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Demonstration of CdTe PV Structure on micro-glass

Large Hadron Collider – a life size model of a section of the tunnel visits the Welsh Senate Building in Cardiff

As part of a tour around the UK, the particle physics community visited the Welsh Senate Building from 28th November to 2nd December to report on the hunt for the Higgs boson. PhDs and postdocs studying in Wales and working on the world's largest ever experiment explained their research to AMs and the general public. The life-sized model of a section of the 27km LHC tunnel, located 100m below ground in Geneva demonstrated the project.

This was the biggest installation ever to be hosted by the Senate and the week's events were a great success with some important messages for Welsh businesses and industry.

Presiding Officer, Rosemary Butler MSP, hosted an evening reception which was well attended by the close knit Welsh academic physics community. Guest of honour was Aberavon born Dr. Lyn Evans, who over several decades oversaw the building of the massive machine and switched it on during much media publicity in 2008.



Dr Lyn Evans, LHC Project Manager, with Professor Robin Williams, Swansea University and Professor Sir John Meurig Thomas, Cambridge University.

2012 was a momentous year for the experiment, as researchers announced in July that they had successfully discovered a 'Higgs-like particle' as predicted by the UK's Professor Peter Higgs more than 50 years ago. Dr. Evans was quick to point out that, strictly speaking, it could only be confirmed as the Higgs particle once its spin was verified, which would require some further work. However, Professor Higgs was made a Companion of Honour in the New Years Honours list and it is being widely predicted that he may receive a Nobel Prize in 2013.

Lyn Evans welcomed the interest the discovery had received from the general public. The rise in schoolchildren studying physics to A-Level, was thought to be in part as a direct result.

The LHC outreach activities were supported by the Science and Technology Facilities Council (STFC); the UK Research Council responsible for funding the UK's involvement in CERN, which includes academic research, technology development and industry engagement. CERN has a huge procurement budget and STFC has an in-house team dedicated to supporting UK industry interested in bidding for contracts.

Dr Julie Bellingham, the STFC Industry Liaison Officer for CERN said, "CERN spends in the region of £300M every year on supplies and services and there are great opportunities for UK companies. CERN is obviously involved in cutting edge science, so there are opportunities in cryogenics, vacuum and high precision mechanical engineering, but the opportunities are not limited to high tech sectors. For example, some large contracts last year were in heating and ventilation work, as CERN has many buildings to upkeep. There are also contracts in computing and electrical engineering to name a couple of sectors. CERN's requirements cover a broad spectrum, as you might expect from a site where 14,000

people work. As the UK funds CERN, they are keen for UK companies to win contracts."

Dave Rimmer, Vice Chair North of the Welsh Opto-Electronics Forum who had been invited to the reception said: "the event provided a unique chance to talk to young particle physicists and engineers from Wales working on the LHC. It highlighted both the strong involvement that Wales already has with world-leading projects like this and also the scope for greater interaction. We should do more to promote these opportunities – both within our schools to encourage the next generation of engineers and to flag up the availability of industrial contracts across the supply chain."

Companies who want to find out more about tendering to CERN can contact Dr Julie Bellingham at tenderopportunities@stfc.ac.uk



Dr Lyn Evans, LHC Project Manager; Dr Beth Taylor, Head of Communications, Institute of Physics, Professor John Womersley, CEO STFC; Professor Sir Michael Sterling, Chair, STFC.

Welsh technology firm IQE further expands its global footprint



Cardiff headquartered technology company IQE is firmly established as the global leading supplier of advanced semiconductor wafer products for a wide range of wireless and photonic applications.

The Welsh firm has grown both organically and by merger and acquisition over the last few years, to build an enviable position as a world leader in its field.

The last twelve months have seen a number of potentially transformational deals for the London Stock Exchange, AiM listed company.

In February 2012, the Company announced a strategic investment in Solar Junction. The deal included an exclusive wafer supply agreement with the San Jose based business which holds the world record for CPV cell efficiency at 43.5%.

In June 2012, IQE acquired the in-house Molecular Beam Epitaxy manufacturing unit of North Carolina based RF Micro Devices, securing a seven year wafer supply agreement at the same time. The deal cemented IQE's position as the global leader in compound semiconductor products for RF applications but also provided a unique strategic opportunity to enhance the group's capacity to deliver the CPV solar technology linked with the investment and wafer supply agreement with Solar Junction.

IQE opened 2013 with the announcement of another transformational deal by acquiring US based Kopin's

compound semiconductor division. This transaction provided IQE with additional manufacturing capacity in North America and Taiwan which can be used to enhance the group's capabilities in both wireless and photonic products.

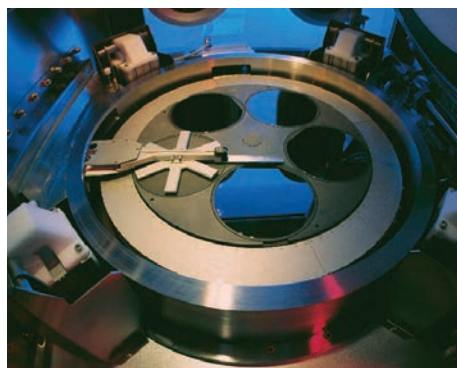
Whilst the company is firmly rooted in semiconductor wafer products for optoelectronic devices, most of the group's growth over the last decade has been in the RF or wireless market sector which accounts for around 75% of the group's production. However, IQE owns a considerable portfolio of intellectual property and manufacturing capability in devices for photonic applications.

IQE believes that the existing core wireless business will continue to grow as consumers demand faster and

"always on" connectivity but also anticipates that the "opto" part of the business offers many opportunities for even higher growth rates, with the exciting prospect that developments in areas such as optoelectronic communications, imaging, sensing and solar (CPV) energy could boost its photonics business to represent a significantly higher proportion of the group's revenues.

With photonics at the heart of a number of European initiatives, IQE is uniquely positioned to provide support and capability across a number of key enabling technologies.

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MOCVD in IQE Cardiff facility



Cleanroom at IQE Cardiff Silicon

ESO E ELT Telescope Prototype Segment Project

The OpTIC Glyndŵr team at St Asaph continue to make significant progress within their contract with the European Southern Observatory to produce prototype segments to the specification required for the proposed E - Extremely Large Telescope that is planned to be built by 2022 at ESO's Atacama Desert site at Cerro Armazones Observatory in Chile.

Probably the largest polished glass artefacts within the UK right now are the prototype segments for the European Southern Observatory's E - Extremely Large Telescope and the associated test tower's master spherical segment (MSS). The first segment has now been polished to an average surface form accuracy of less than 20nm and work is well advanced on the second.

Polishing of the glass is only half of the story. The method being used requires the production of a highly accurate "Error Map" that shows to the polishers the high and low points of the glass surface. The basis of this is through the use of interferometric techniques on the integrated test tower. From this map the software is able to produce a CNC programme that instructs the machine where more (or less) surface material must be removed. It is no mean feat to be able to do this on a large surface as well as one that is off axis, aspheric and has an 84metre radius of curvature.

The work on the 1st segment has established a polishing regime that can produce accurately polished surface form and maintain the specification required at the segment edges. This 1st segment is of Schott's low expansion material Zerodur® which is probably the most popular choice for telescope primary mirrors. The second segment is of Corning's ULE®. Although these materials are different the adaption of the process to these is not the

main focus of this next stage. This challenge is the one of confirming that the process is deterministic and reliable. Once this is confirmed then the work moves on to the speeding up of the process and the understanding of what is required for full scale volume manufacture.

The goal remains of being able to produce a method of producing highly accurate telescope segments to the ESO specification at a rate that will allow the telescope to be built and operational by 2022.

The possibility of producing large optics using the methods and techniques developed in this project will undoubtedly deliver spin off opportunities that will find applications away from large terrestrial telescopes. This would include the possibility of playing a role in Laser Fusion systems.

The project has also brought together other skills apart from the metrology and polishing. There has been a considerable input from mechanical engineers who have designed and built polishing and measuring support systems as well as the crucial optical test tower itself. These skills are already proving of value to other members of the North Wales cluster and the UK optical industry.

The UK Government announced on 6th March, 2013, its long term investment of £88m in the European Extremely Large Telescope. This will ensure UK scientists and engineers are heavily involved in the construction and operation of the telescope and its instruments, set to be the most advanced of its kind. UK industry has already won £9million worth of contracts, and that figure is predicted to increase as much as tenfold before construction is expected to be completed.

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Polishing In Progress

New from OMNISCAN the ZeGage Optical Profiler

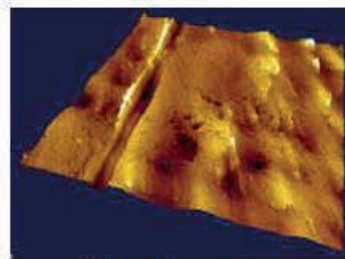
ZeGage is the ideal non-contact optical profiler for quantitative measurements of 3D form and roughness on precision machined surfaces. The industrial design provides fast, accurate metrology in a compact, cost-effective package that can be located directly on the factory floor without the need for vibration isolation or specialized enclosures. And the interactive control software, ZeMaps™, provides easy and detailed visualization to help you control your process. Read more to see how ZeGage Power, Versatility, and Value can benefit you.

The ZeGage optical profiler is now available with programmable stage capabilities. With a motorized, programmable XY stage, ZeGage profiler stitches adjacent measurements into contiguous, high-resolution 3D plots; another benefit of an automated

stage is the ability to either sample sets of parts, or sample different locations on the same part. Made for production metrology, ZeGage features Surescan technology, providing reliable measurements even in vibration-prone environments.

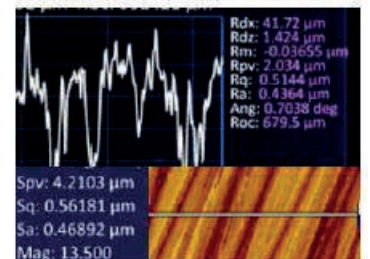
For further information contact Russell Evans at Omniscan on 01978-844155 or e-mail us at info@omniscan.co.uk.

Omniscan Ltd is a supplier of leading edge surface science instrumentation and metrology solutions to industry and academia. We provide instrumentation and consulting for measurement of surface topography (roughness, waviness and shape); layer thickness and optical properties with scales ranging from the sub-nanometer to metres, along with surface modification and laser lithography.



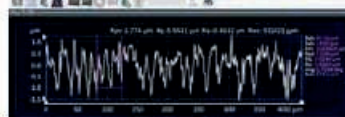
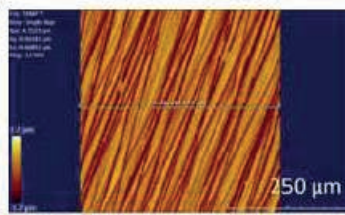
Powerful Visualization

Detailed three dimensional imaging of this prosthetic knee surface shows scratches and surface defects in a rotatable and zoomable model which enables easy investigation and characterization of the manufacturing process.



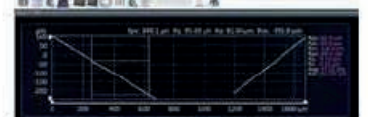
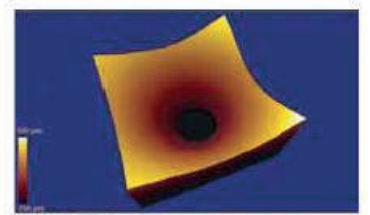
Quantitative Results

Surface results compliant with ISO 25178 and profile slice results are computed instantly for each measurement and can be tracked in real time with run charts and automatic logging features.



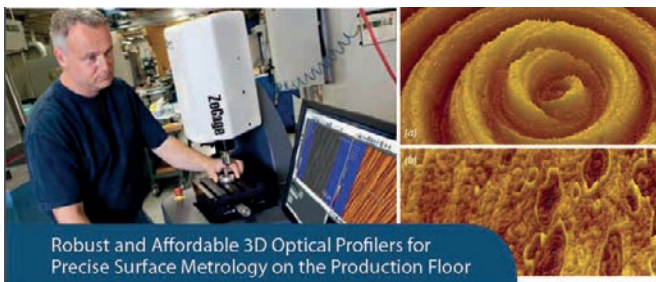
Simultaneous 2D and 3D metrology

Area profiling of this machined surface enables texture measurements independent of sample lay and line profiles can be extracted for correlation to stylus tools.



Interactive tools

Live updating plots enable quick analysis of the angle and texture of this 120° cone from a fuel injector.



Robust and Affordable 3D Optical Profilers for Precise Surface Metrology on the Production Floor

Disruptive Patent Pending Technology in LED Multiplexing



Cymtec Limited is an optoelectronics company based in Caerphilly, who specialise in laser and LED technology. Cymtec Limited was formed in 2007 by Ron Yandle and Professor Nigel Copner with the aim of growing from a start up to a high growth firm by developing LED Multiplexer technology in multiple markets. LED technology is, and will be, impacting our lives for many years to come with an explosion in LED based devices, technology, research, government focus and media coverage. Cymtec is an innovative company within this field and using our patent pending LED Multiplexer technology we are in the process of developing many new products for market.

One of our main projects is to develop LED Multiplexer technology for the three chip digital projection market. The aim is to replace conventional bulb technology with our LED Multiplexer technology. Current bulbs are fraught with problems such as low lumen output, maintenance issues when changing bulbs, low reliability, high cost and less than full potential colour gamut. The advantage of using LEDs is that the projector essentially becomes a sealed for life system due to the lifetime of the LEDs. The lumen output will also far exceed that on the market at the moment producing HD quality images. The markets for this product are numerous and include E-Cinema, D-Cinema, command and control, flight simulation and the 3D market. The LED HD projector market is growing and is set to grow even further in the next few years and as such is one which Cymtec is taking full advantage of.

Another one of our main projects is to develop LED Multiplexer technology for the endoscope market. The aim is to replace conventional bulb technology with our LED Multiplexer technology. Problems with current endoscopes include low colour gamut, inability to fluoresce tissue and expensive maintenance issues. By using LED Multiplexer technology the system will again essentially be sealed for life and provide a higher lumen output than that which is currently provided. The surgeon will have the ability to vary colour temperature, meaning that they will be better able to control what they see. More importantly our system will include UV which will allow the surgeon to fluoresce the tissue. This means that there will be less of a need for invasive biopsies and will allow the surgeon to better discriminate cancerous from healthy tissue. The benefits for the patient could literally be a matter of life and death. Using UV in endoscopes is a relatively unexplored area and no endoscope on the market currently employs this. The market for endoscopes is strong, currently growing and the use of new technology is highly sought after in this field.

The other potential markets which Cymtec could enter with this technology are numerous and are only likely to grow in the years ahead. Cymtec Limited also offer a wide ranging consultancy service which has already been utilised by numerous companies to aid them in their product development. The services we offer include optical design, electronic design, software design, mechanical/thermal management design and six sigma black belt and trainer

HB LED Multiplexer Prototype

Cymtec's new LED multiplexing technology has demonstrated more than 40% more optical light coupling than the current best reported results. This has been achieved with Cymtec's new innovative and

patent pending approach allowing very little loss from coatings, clipping and polarisation while still maintaining commercially relevant costs.

The CTO, Prof Nigel J Copner, said, " We are very excited about this breakthrough in coupling, as it is very cost effective and will have an enormous impact on the overall efficiency of projectors, endoscopes etc. When used in conjunction with Cymtec's earlier phosphor concepts we expect, for the first time, that an effective commercial replacement for the high power Xenon lighting system will be possible".

Cymtec's aim is to take our customers problems and conduct R&D to solve these problems, in order to create totally new products for market resulting in growth for both ourselves and our customers. The need for growth in the current economic climate is paramount and the potential for job creation caused by these projects is high. The number of jobs which have already been created by Cymtec in its start up phase totals eleven and the team spirit and motivation for further growth is evident to all. Our aim is to push the boundaries of LED technology and to be creative in thought, in order to produce products which are groundbreaking and truly innovative. As a result we welcome any discussions with companies or individuals interested in LED multiplexing technology.

Cymtec's core management team comprises of high calibre professionals who have many years of experience in the Optoelectronics industry. Further the team has immense experience in manufacturing process and procedures and as such are able to ensure that suitable process/product quality is maintained (ISO 9001 certification). The key inventions and products

that have been developed by the team include optical switches, dispersionless interleavers, low noise stable blue lasers as well as narrow linewidth metrology lasers. We pride ourselves on the fact that we can work closely with customers and solve their problems with commercially relevant solutions that may or may not lead to intellectual property. We are a team of experienced problem solvers who realise that cost is a key driver alongside quality and delivery reliability. In the main our in-depth experience in optics/lasers/mechanics/electronics/software and manufacturing will enable our customers to move forward efficiently in their respective markets and receive high quality product/services in a timely manner, at the right price.

For more information please visit our website www.cymtec.co.uk our blog <http://cymtec.wordpress.com> or email ron.yandle@cymtec.co.uk



HB LED Multiplexer Prototype

Laser Physics Introduces The New Polarcam From 4D Technology



The new PolarCam micropolariser cameras from 4D Technology simultaneously capture multiple polarised images of each video frame, enabling a range of image

enhancement techniques and polarimetric measurements.

Small, fast and field-proven, these CCD cameras are ideal for polarisation microscopy, industrial monitoring, 3D reconstruction and more. The cameras offer 0.5, 1, 2, and 4MP sensors, up to 260 frames per second frame rate, ensuring the fast capture of rapidly changing scenes without blur.

Proprietary wiregrid polariser technology gives the PolarCam's sensor broad spectral response, angular bandwidth, high extinction and low cross-talk.

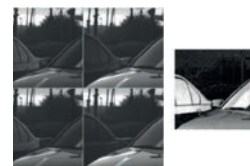
Used for applications in image enhancement, medical imaging, surface mapping amongst others, the PolarCam is available with an optional framegrabber and high speed computer system to maximise your system performance.

For more details on PolarCam please visit www.laserphysics.co.uk

Parsed pixelated camera polarization images are shown above. Below, the contrast of the sky and trees in the background is reduced while the contrast of the two cars in the foreground is dramatically increased.



D Technology Polarcam



Polarcam examples

Optimising CAMPUS Services to Photonics Companies – ASTUTE in action



Under the auspices of the pan-Wales advanced manufacturing project ASTUTE, three WOF universities are offering their services to support industry in Wales. Aberystwyth, Bangor and Glyndŵr Universities will pool their considerable resources in photonics instrumentation and material assessment to support the needs of industry.

The support will be offered as an ASTUTE photonics cluster project entitled: Optics and Photonics Instrumentation and Material Assessment (OPTIMA)

OPTIMA will, over a two year period, engage in multi-lateral collaborative research and development involving three partner HEIs -**Aberystwyth, Bangor and Glyndŵr** - and a range of Wales-based companies whose business can be enhanced by support in the areas of optics and photonics instrumentation and material assessment. OPTIMA will seek further collaborative activities with companies not currently members of WoF.

OPTIMA is a practical realization of the survey of academic capabilities in photonics which was undertaken in 2012 by the Photonics Academy for Wales leading to the publication of the Capability Matrix for Photonics Up-Skilling (CAMPUS). CAMPUS identified university resources in Training, Research, Equipment and Expertise (TREE). OPTIMA will initially make CAMPUS TREEs at Aberystwyth, Bangor and Glyndŵr available to industrial partners and hopes to engage all parts of the CAMPUS network in due course

ASTUTE aims to expand its activities in photonics and OPTIMA will be a first step in that development.

Companies whose business can be enhanced by access to state-of-the-art photonics resources are thus invited to join the OPTIMA project.

For further details please contact Professor Alan Shore, Bangor University, School of Electronic Engineering ; email k.a.shore@bangor.ac.uk



Getting Light to Work : OPUS Opens for Business



The Photonics Academy for Wales @ Bangor (PAWB) offers opportunities for Optics and Photonics Up-Skilling (OPUS) for industry. Under the leadership of Ray Davies, PAWB has developed a novel suite of instructional materials which can be offered at company premises or within PAWB in the School of Electronic Engineering, Bangor University.

The theme of the OPUS offering is Getting Light to Work (GLOW). GLOW has a hands-on approach to learning whereby participants are enabled to immediately put into practice the photonics principles which they acquire. GLOW is highly flexible in providing a menu of activities which can be chosen according to the participants' tastes and requirements. Learning acquired under OPUS is

planned to form the basis for a Foundation Degree in Photonics which, in turn, can lead to higher levels of formal qualifications.

OPUS support is available now and the activity is currently funded until June 2015. However OPUS will respond to demand on a first come first served basis and hence early association with OPUS is strongly recommended

Companies whose business can be enhanced by raising the skills level of their staff are thus warmly invited to participate in the OPUS activity and thereby 'Get Light to Work'.

For further details please contact:

Ray Davies r.davies@bangor.ac.uk Director Photonics Academy of Wales @ Bangor (PAWB) or Professor Alan Shore k.a.shore@bangor.ac.uk Bangor University, School of Electronic Engineering



LIVERPOOL TELESCOPE 2

Astrophysics Research Institute

Liverpool JMU

The Liverpool Telescope (LT) on La Palma is the world's largest fully robotic telescope. Following first light in 2004, the telescope is now at a mature stage in its lifecycle with a strong record of high-impact papers in leading scientific journals. It is the basis for a thriving outreach programme, with over 2000 UK schools having obtained their own data via the National Schools Observatory. The robotic nature of the telescope also means it has a low operating cost, making it excellent value for money when compared to its manned competitors.

Planning is now underway for the development of a successor facility to the telescope ("LT2"), which aims to build on the success of the LT in the field of "time domain astronomy". This wide designation covers observations of any astronomical object which changes in brightness or position over time. These include near-Earth objects like asteroids, cosmic explosions such as supernovae, and extrasolar planets. The autonomous nature of a robotic telescope such as LT means that all of these phenomena can be efficiently monitored on timescales from milliseconds to years.

Another key advantage of a robotic telescope is its ability to react quickly to transient events in the universe, such as Gamma Ray Bursts. These cataclysmic explosions are the brightest electromagnetic events known to occur in the universe. However, they rapidly fade in brightness, and so, following the detection of a new burst from space, the race is on to point the world's telescopes to it as soon as possible. LT has established itself as a leader in this regard, thanks to its unique combination of rapid slew speed, robotic control software, and purpose built instrumentation for GRB followup.

Time domain astronomy is set to massively increase in importance in the next couple of decades. From around 2020 the new US built Large Synoptic Survey Telescope (LSST) will begin a 10 year mission in which the entire southern sky is photographed every few nights. This will identify around a million time variable objects every night. Given this dramatic change, LJMU has begun to investigate the possibility of a replacement telescope facility to come into operation at the same time as LSST and designed to exploit the new scientific opportunities of the coming two decades. A two year project has therefore begun to identify the scientific goals of LT2 as well as

developing the technical requirements for the telescope and a reasonable estimate of the cost to build and operate the facility.

The technical requirements of the new telescope are necessarily driven by its science goals, so the main aim at this stage is to establish the time domain science priorities in 2020 and beyond. Such prognostication is of course challenging, but it is clear that some of the current priority fields of time domain astronomy, such as supernovae, gamma ray burst and extrasolar planets, will remain important, with many unanswered questions which cannot currently be addressed. It is also clear that the detection of electromagnetic counterparts to neutrino, gravitational wave and high energy sources will be a key goal in the coming years. It is important to determine the niche which the LT2 is intended to fill, so that we can be confident that it will make an important contribution in its own right and not duplicate the work of another planned facility. For example, in 2020 the LSST will provide excellent imaging of the southern sky, and so it is likely that imaging will play a reduced role for LT2, compared to LT. Instead, spectroscopy of the newly discovered objects might be the LT2 role - vital observations which LSST will not provide. The LT benefits from a diverse suite of scientific instruments, and it might be wise to make the LT2 similarly versatile. One of the interesting aspects of the new era of time domain astrophysics is that the door will be thrown open on a previously unobserved area of parameter space, so we would expect to detect whole new classes of object, the nature of which cannot be anticipated.

At this early stage, there are many fundamental aspects to the design of this 'Liverpool Telescope 2' (LT2) that are open for discussion. Some are more clear-cut than others; for example it is natural to assume that LT2 will be a robotic facility, given the clear efficiencies in terms of observing and cost which have been demonstrated with the existing facility, and the considerable degree of technical expertise which LJMU has built up in this area. Another extremely important parameter for any telescope is the diameter of the primary mirror. A telescope is essentially a 'light bucket', and with a larger mirror the telescope can capture more light in any given time, and so is more sensitive to fainter targets. This is of course particularly important when the telescope is observing time variable objects, for which shorter exposures are required to properly sample the variations. It is perhaps

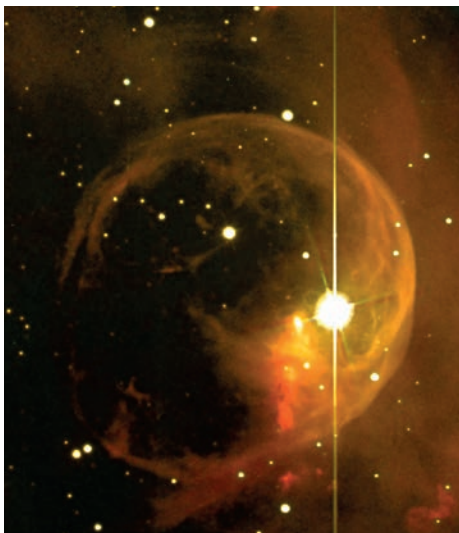


safe to assume that LT2 would feature a larger diameter mirror than the 2 metre LT in order to properly exploit the vast number of fainter objects which will be discovered in the coming decades. However this is not necessarily a given: as discussed earlier one of the core strengths of the LT is the speed with which it can slew to a newly discovered target. A new facility might aim to build on this strength with even more impressive speeds, however such a requirement may conflict with the requirement of a larger mirror. New technology developments in lightweight mirrors and mirror support systems may allow us to break this apparent conflict however, and will be a topic of active exploration during the next two years.

Another item to consider is the wavelength range of the telescope. The existing LT predominantly observes light at visible wavelengths, but upcoming projects like the European Extremely Large Telescope (ELT) and the James Webb Space Telescope (the successor to the Hubble Space Telescope) will observe in the infrared. LT2 might therefore also be optimised for infrared observations, to capitalise on the inevitable shift in emphasis amongst the astronomical community to these longer wavelengths. One other consideration that is of course very important is the site for the new facility. The interest of the astronomical community is also expected to shift more to the southern skies due to the large facilities planned in that hemisphere (such as LSST and the ELT), and so a southern site for LT2 might also be desirable, to maximise the potential synergies between these projects.

In summary, it is clear that an LT2 with a wide-ranging capability will give astronomers at LJMU and beyond the opportunity to continue to play a leading role in the exciting new era of time domain astronomy. There is lots of work to be done in both understanding the science to be done and how we can combine our existing expertise with new technologies to deliver a facility that can deliver the science. We welcome thoughts and input on both of these topics, so if you are interested in contributing to the development of LT2, please get in touch and let us know.

Contact: Dr Chris Copperwheat an LT2 Project Scientist, having recently joined Liverpool JMU from the University of Warwick. c.m.copperwheat@ljamu.ac.uk and Prof Iain Steele who is the Director of the LT, and Professor of Astronomical Technology. ias@astro.ljamu.ac.uk



Bubble Nebula



Eagle Nebula

Bangor University leads a 3 year project on Optical Communications Activities - Increasing Broadband capacity two thousand-fold - for the same price

Bangor University leads a 3 year project on Optical Communications Activities and establishes a spin-off company to commercialise the cutting edge technology 'Optical Orthogonal Frequency Division Multiplexing' (OOFDM)

Could you use a broadband service that is two thousand times faster, but costs you the same? A revolutionary "future-proof" technology known as Optical Orthogonal Frequency Division Multiplexing (OOFDM), first proposed by Bangor University, is the front-runner in satisfying future demand for dramatically increased internet speeds and capacity.

The technology, which would use current optical internet cabling, has proven its ability to increase broadband transmission by up to two thousand times the current speed and capacity. To illustrate, that would mean downloading 20 feature length films in one second. There are, of course, far more practical and wide ranging uses for this capability- uses which the market is increasingly demanding- such as 3D-TV, HDTV, social websites, on-line gaming, video sharing, video on demand and e-health, as well as applications yet to be created. End-user's demand for transmission bandwidth is already increasing by over 70% year on year.

Bangor University pioneers the OOFDM research and development activities worldwide. More importantly, Bangor University is the world-first and world-only organisation that has the capability of experimentally demonstrating a series of ground breaking end-to-end real-time OOFDM transceivers and networks with automatic adaptability to component/system impairments. In addition, the transceivers also have unique and inherent advantages including, for example, fast transmission speed and highest cost-effectiveness compared to all existing technologies, great system flexibility and excellent performance robustness.

However, the existing access networks are just capable of offering less than 100Mb/s per subscriber. This has become the 'bottlenecks' to achieving the ultra-wide bandwidths required in the near future. And the solution lies in the networks and the technology they employ.

Bangor University is leading a three-year project to develop world-first commercially-exploitable smart OOFDM transceivers and network prototypes, using low-cost off-the-shelf components. Making full use of the University's unique technical "know-how" in experimentally demonstrating end-to-end real-time OOFDM transceivers, as well as a total £1M funding from government grant and private investors, a University spin-off company has been established to commercialise the cutting-edge technique.

Compared to today's commercially available broadband connections, the OOFDM transceivers are expected to provide end-users with both downloading and uploading speeds up to 2,000 times faster than current speeds and with a guaranteed quality of services at a price that subscribers are currently paying for their current 20Mb/s services, regardless of subscribers' home location. Obviously, this will revolutionise communication technology. The OOFDM transceivers are also capable of significantly saving the network installation and maintenance cost for both service providers and equipment vendors. This is achieved by using currently installed fibre networks, but its 'intelligent' systems allow greater resistance to imperfect fibre systems and low-quality components. The system allows for the use of cost effective technical strategies; there is a significant reduction in network architectures; and 'central office' bypass and convergence of various networks of different architectures. It also provides a "Green" solution due to the significant reduction in electrical power consumption.

Contact j.tang@bangor.ac.uk

UK Patent Box from HMRC



HMRC has announced that under the new UK Patent Box legislation, companies will be allowed to apply a lower rate of Corporation Tax to profits earned after 1 April 2013 where the profits are attributable to a patented invention or certain other innovations. The tax relief will be phased in from 1 April 2013.

Companies can benefit from the Patent Box if they are liable to Corporation Tax and make a profit from exploiting a patented invention. According to HMRC, the company must own or exclusively license-in the patent(s) and must have undertaken 'qualifying development' of the invention(s). Patents that qualify under the legislation are those granted by the UK Intellectual Property Office, European Patent Office or the patent office of certain European countries.

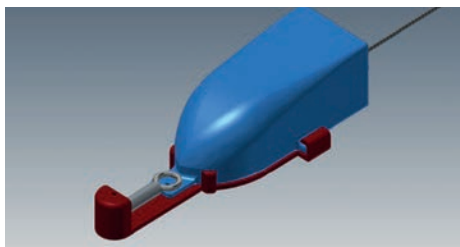
Company profits subject to the lower rate must come from at least one of a list of sources, which include sales of a patented product or product incorporating the patented invention, licensing out of patent rights and use of a patented manufacturing process.

If you are developing or considering developing a new product, tool, process of other potentially patentable invention, the Patent Box legislation provides an additional incentive to secure patent protection for the invention.

The information in this article is based on the information published by HMRC. We recommend employing the services of an accountant and a patent attorney in assessing your eligibility for tax relief under the scheme.

Mark Yeadon, Patent Attorney, Yeadon IP Limited
markyeadon@yeadonip.com

Spring Forward – manufacturing your next profit in style using 3D printing/prototyping



How can we improve support for Welsh businesses? - Swansea University is increasing its efforts to bring academia and industry together and different business orientated projects are collaborating to help deliver more comprehensive support to companies.

Two major ERDF funded projects, SEACAMS and ASTUTE, have been working with the company Wildbyte Technologies Ltd. on a Daily Diary device to track the movements of marine and land animals. This collaboration will be launched by the Deputy Minister for Agriculture, Food, Fisheries and European Programmes Alun Davies AM.

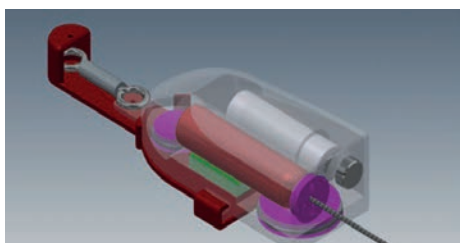
THURSDAY, 18th April 2013, Liberty Stadium, Swansea, SA1 2FA

Registration and Welsh breakfast served at 07:45, event concludes at 10:15, there is an optional tour of the Swansea University facilities from 10:15.

This event is FREE but places are limited, so please register on <http://dailydiary.eventbrite.co.uk>

ASTUTE has been part-funded by the EU's Convergence European Regional Development Fund through the Welsh Government, which aims to boost the competitiveness of the Welsh economy through supporting manufacturers & their supply chains within the Wales Convergence Area, including the Valleys, West and Northwest Wales. The £27million 5 year project targets the aerospace and automotive sectors, as well as other high technology manufacturing companies to create sustainable, higher value goods and services and bring them to a global market. The project is led by Swansea University, in collaboration with the Universities of Aberystwyth, Bangor, Cardiff, Cardiff Metropolitan, Glyndŵr, Swansea Metropolitan University of Wales Trinity St David, and the University of Wales, Newport.

SEACAMS has been part-funded by the European Regional Development Fund through the Welsh Government until 2015 and is delivered by Aberystwyth, Bangor and Swansea Universities. This £24 million project supports economic growth and inward investment of the marine and coastal business sector in the convergence region of Wales.



Capture All Your Digital Microscopy Images Fast



The new compact Tri-colour liquid crystal optical filter from Meadowlark Optics offers 3 user selectable channels from a wavelength range of 420-780nm, such as traditional red, green and blue. Having no moving parts the Tri-colour filter can switch at up to full video speed between filters without causing vibrations in your imaging set up, meaning you can capture images fast.

Meadowlark Optics excels at providing customised filters for a variety of applications.

The Tri-colour filter is factory customisable to achieve different centre wavelengths, wavelength ranges and other specifications, for example, pseudo white state, or continual tuning.



Meadowlark Optics have also updated their Selectable Bandwidth Tuneable Optical Filter, enabling it to be optical cage mounted. Continuously tuneable over 420-730nm with 0.1nm resolution, this filter allows the user a choice of three different bandwidth sizes at each wavelength: narrow, medium and wide, allowing the user to acquire images at thousands of different wavelengths fast in applications including fluorescence, absorption and Raman microscopy.

Meadowlark's Tuneable Optical Filters can also be customised to achieve different bandwidths, wavelength ranges or other performance profile to provide a solution that meets your needs.

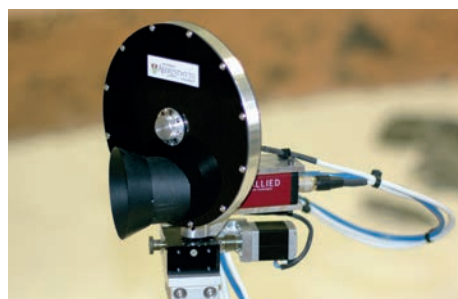
For more information please contact Laser Physics UK or visit us at: www.laserphysics.co.uk

Contact: Siwan Smith siwan@laserphysics.co.uk

Aberystwyth University Technical problems lead to an innovative hyperspectral camera

A 'Blue Ocean' grant has resulted in a joint project between Aberystwyth's Institute of Mathematics & Physics and the department of Computer Science.

A new type of hyperspectral camera has been invented as a result of development work on the Panoramic Camera (PanCam) for the 2018 ESA / Roscosmos ExoMars rover mission. The team at Aberystwyth University, who are Co-investigators for the ExoMars PanCam instrument, have developed an innovative and economical hyperspectral camera whilst investigating a number of technical issues with the PanCam filters. The interference filters used in conventional multispectral cameras show angle dependent transmission wavelength which means that not all regions of an image are taken at the same wavelength. Rather than trying to minimise the effect, researchers in Aberystwyth realised that it could be exploited to yield a cheap and robust hyperspectral camera.



Prototype hyperspectral camera developed at Aberystwyth University.

The camera makes use of a filter wheel mounted at an angle in front of the camera. Each filter disperses a region of the spectrum across the field of view as shown in 1. By scanning the camera across the field of view it is possible to build up a hyperspectral data cube of images. A prototype camera has been built under an Ocean Optics BlueOcean development grant and is being put through its paces. The team hope to develop the camera for future space missions as well as terrestrial applications.

Contact Matt Gunn mmg@aber.ac.uk



A colour image showing how the spectrum is dispersed across the field of view using the Aberystwyth University method.

Qioptiq Innovation is recognised by key customer BAE Systems

The annual BAE Systems Chairman's Awards acknowledge the efforts and achievements of employees, partners and customers in delivering benchmark performance by recognising excellence in the following categories-

- Successful exploitation of innovative ideas,
- Transfer of best practice,
- Delivery of outstanding support to the customer,
- Support of our culture of total performance.

Nominations are adjudicated through a tiered process resulting in awards at three levels - Bronze, Silver and Gold. In total there were approximately 3400 nominations made, with Rochester nominating the LiteHUD- Low Profile Head-Up Display, in the category of innovation.

This nomination recognised the revolutionary optical technologies developed and successfully demonstrated for this product by Qioptiq, enabling an 85% reduction in volume compared to similar existing products.

LiteHUD is a low profile HUD (Head Up Display), designed for fast jet cockpits for large area display applications taking advantage of advances in LED and waveguide technologies to significantly reduce the size of the entire system. It is able to display video and is compatible with night vision goggles and laser protection devices. The optics employed enable a very high resolution to be achieved for symbology display.

The Chairman's Awards were established in 1996 to

"recognise ideas, actions and behaviours that would make BAE Systems a more competitive company.



Image courtesy of BAE shows the LiteHUD (left) next to a conventional HUD (right)

Dyesol news - Tasnee Enters Strategic Investment Agreement with Dyesol

It was announced on 28 February 2013 that Saudi Arabian industrial giant Tasnee, has invested AUD \$4 million in Australian clean energy company, Dyesol Limited (ASX: DYE), by way of a 15 month redeemable loan note, convertible into Dyesol shares at 16.6 cents per share, with a 0% coupon (as is required by Saudi Arabian law). During an initial 6 month exclusivity period, Tasnee and Dyesol will discuss a number of partnership and investment possibilities, focusing on R&D collaboration, large-scale production share, potential demonstration projects in the Middle East and, importantly, further investment up to a total of A\$20 million.

Tasnee is a \$5 billion diversified industrials company listed on the Saudi Arabian Stock Exchange and the world's second largest producer of titanium dioxide. Its subsidiary, Cristal has been working with Dyesol UK since 2009 to develop nano-titania for use in Dyesol's major steel project with Tata Steel Europe in North Wales. Dyesol UK, whose registered office is in OptIC Glyndŵr, St Asaph, look forward to building on the relationship, already established with Cristal, in the future.

Contact Dr Graham Dransfield (gdransfield@dyesol.com).

There are four categories in which nominations are submitted. The Innovation category celebrates the results of behaviour that has stimulated or promoted innovation new to the company or to its field in general.

The Gold Awards ceremony took place in Washington DC on 5 December 2012, culminating with the announcement of the final sixteen Gold Award winners with the LiteHUD winning a Gold Award within its category.

BAE Systems acknowledged and thanked the team at Qioptiq for all their efforts in making LiteHUD a success. Without the significant contribution by Qioptiq the award would not have been achievable.

Contact craig.taylor@uk.qioptiq.com

New Thermography Camera packages, cooled and uncooled MW and LWIR systems



Following their successful launch into mainland Europe, Armstrong Optical Ltd introduces the new VarioCAM HD and ImageIR 9300 thermography camera systems from InfraTec GmbH to an expectant UK market.

These two ranges of cameras include both hand-held and fixed position systems and offer the highest resolution imagery available on the market (3.1Mpixels) and operate across the mid-wave (3-5µm) and long-wave infrared (7-12µm) wavebands.

The VarioCAM HD utilises an uncooled 1,024x768 pixel sensor array (7-12µm) and is packed with customer-



driven features such as a built-in 8Mpixel visible camera, GPS, laser rangefinder, 5.6" colour display and eyepiece. The system is able to record both visible and fully radiometric thermal video sequences

simultaneously and store them on the built-in SDHC-card or transfer them via a choice of interfaces (GigE-Vision, WiFi etc) to a remote computer for subsequent

analysis and reporting using the well-established IRBIS 3 software that is supplied as part of the comprehensive deliverable package.

The ImageIR 9300 operates in the mid-wave (3-5µm) waveband and is based on a cooled 1,280x1,024 pixel sensor running in "snapshot" mode allowing microsecond (µs) scale integration times for fast events. Due to its essentially modular design the ImageIR 9300, like all the systems in the ImageIR range, is easily adaptable to a wide range of applications in the R&D, process monitoring and non-destructive testing sectors.

The flexibility and performance of the VarioCAM HD and ImageIR ranges is further enhanced by a range of exchangeable radiometric precision lenses and accessories. The lens ranges include specialist microscopic lenses that allow features as small as 2µm to be measured right up to telephoto lenses for remote measurement tasks.

The Managing Director and CEO of Armstrong Optical, Ian Routledge, is quoted as saying that "the introduction of these two outstanding camera systems to the UK signals a paradigm shift in the capabilities of professional thermography".

Armstrong Optical Ltd was established 15yrs ago to supply the UK and Irish fine optics markets with

the best test systems available. From an initial representation of a single Swiss company, Armstrong optical now represent two other Swiss-based companies plus several from Germany, Israel and the United States. The prime consideration for Armstrong in their representation of these principle suppliers is not only the quality of their products but also back-up and after-sales service. The product range has grown to include systems for non-contact thickness, roughness, shape and vibration measurement; individual optical elements, optical sub-assemblies and complete optical systems; thermal imaging and thermography cameras; customised industrial measurement systems for production and quality control environments.

Contact Ian Johnstone: ij@armstrongoptical.co.uk



View Holographics Ltd

Holograms can be thought of as three-dimensional photographs. Whilst high quality holograms have been around for many years they have been produced in small volumes at very high cost (several thousand pounds each) using "first generation" analogue technology, and have found demand in price insensitive, niche markets such as works of art or the recording of priceless artefacts.

Just as in conventional photography, we now live in a digital age where an image can be produced using software and electronics. A significant investment of more than £1m has been made by View Holographics Limited over the past 5 years to produce a digital holographic imaging system.

All the digital processing techniques used in digital photography can now be used to manipulate holographic images, and high quality holograms can be produced using computer-generated images. There are very few such holographic imaging systems in the world and the latest, most advanced and sophisticated is the View Holographics imaging system located at OpTIC in St. Asaph.

A special and unique feature of the View Holographics imaging system is the ability to vary the angle of the reference beam. This allows the production of holograms that can be viewed from much wider angles. This is a crucial feature that will be of great benefit in View Holographics' target markets, in particular the advertising market.

View Holographics has succeeded in producing the world's first holographic imaging system capable of printing large, double parallax, full colour digital holograms with a wide field of view. This is the first such imaging system in the world for two reasons;

First is that the design and build of such a device requires optical, mechanical, software and electronics technology skill sets to come together with specialist photosensitive emulsion material expertise, View Holographics has all these skill sets available in one location.

Second is this level of investment could not be justified by financial returns from the small specialist markets mentioned earlier. View Holographics has identified wider markets in advertising and holographic optical elements where there is demand given a unit price in tens or hundreds of pounds rather than thousands.

The key to this second point, of cost effective unit price, is the ability to make copies from the master print output from the imaging system described above. In order to do this View Holographics has designed and built and is now in the final stages of commissioning a copier, and a batch processing facility.

There are currently no other producers of holograms in volume in the world except for security type holograms used on passports and such documents, which is a totally different technology and does not compete with View Holographics.

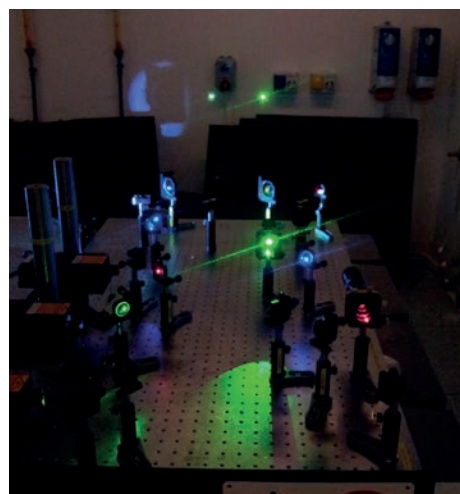
Holographic optical elements control light in new ways. They make much more efficient use of light and have applications in a large number of technology driven markets including defence, medical, energy, instrumentation, automotive, industrial lighting and many others.

What View Holographics has achieved has only been possible by bringing together a unique set of skills embedded in people with vast experience and expertise in the fields of lasers, electronic design, optical design,

software development, emulsion development, mechanical design and industrial experience in working to specifications and timescales. I can't think of anywhere else in Europe that this could have been achieved other than at OpTIC and I am very proud to be associated with it.

Geoff Andrews
Chief Executive

View Holographics Limited based in OpTIC Glyndŵr, St Asaph.



View Holographic printer

Innovation Wales

How Wales can deliver world-class innovation

Earlier this year, the Welsh Government launched a Call for Evidence inviting stakeholders to identify ways to implement an Innovation Strategy for Wales in which innovation could help improve the well-being and economic prospects of the people of Wales. In response to the initial Call for Evidence, the Welsh Optoelectronics Forum and Grounded Innovation made a submission, "A Photonics Enabled Innovation Strategy", in June 2012.



If Wales is to avoid falling into the same trap as others with an innovation strategy, it is prudent to go back to basics and understand what it takes to achieve successful innovation, and how this can be achieved in Wales. The Photonics Enabled Innovation Strategy (PEIS) was based

on this approach, and allied it to the capabilities and needs of Wales as needed for the Innovation Strategy.

The strategy that will realise this opportunity has been the basis of research undertaken by two groups of leading academics in the US, and published in two recent books. The principles of effective innovation are described in these books, and they clearly describe how an effective innovation strategy can be developed for Wales.



"Serial Innovators" (by Griffin, Price, and Vojak) describes the way that innovation occurs within some mature companies. The way this happens is through the activities of certain individuals, and the authors' research has identified how this happens, and what characteristics and activities lead to

success. In the case of Wales, the parallels between a large mature company, and Wales are easy to draw, so the lessons are highly pertinent.

A second book is also very relevant to Innovation Wales. This is called "The Innovator's DNA" (by Dyer, Gregersen, and Christensen). Clayton Christensen has been researching into issues around Innovation for many years, and has published many books that summarise his research. In The Innovator's DNA, the authors studied what makes an effective innovator and what they do to innovate consistently.



Interestingly, many of the characteristics identified by these two research teams have been present in Wales in the past. However, the innovation leadership needed to mobilise these resources has not been consistently available. These two books provide a framework for a national innovation strategy for Wales. Discussion

While innovation might, at times, appear to be "chaotic and non-linear" (as noted in the Welsh Government's Response document), the researchers above show that this apparently chaotic and non-linear activity is only interpreted as such by management who prefer a linear, and incremental, innovation process with well-defined milestones and a Stage Gate process for New Product Development. However successful innovation management has certain characteristics. The first lesson from both books is that innovation requires **leadership and people**. This should be the cornerstone to any Innovation Wales strategy. Without the right team, innovation is highly likely to fail – witness the many innovation initiatives seen around the UK and elsewhere in the past. From the research, there are other activities that emerge as necessary for an Innovation Wales strategy. These can be summarised as follows:

Curiosity. A key factor that drives successful innovation with serial innovators is curiosity and the desire to find an **interesting problem**. Griffin et al identified three criteria that are important for effective innovation:

- There is the potential for significant financial impact if the problem can be solved.
- A solution is feasible.
- The problem and its solution are acceptable to all stakeholders (it solves a problem and fits strategy).

Often this stage is categorised as the "Fuzzy Front End of Innovation", but defining what this means is often ignored. The key activity is the search for an 'interesting problem'. Dyer et al observed that effective innovators keep asking questions (e.g. the 5 Why's). This curiosity and questioning is critical, and can seem "chaotic and non-linear", but is done for a specific purpose.

Inspiration. Finding an 'interesting problem' is not trivial. It requires active engagement with all resources and some exploration. Networking and asking questions are key activities done in this process.

Experiment. With an 'interesting problem' to tackle, the team would explore ways to solve this. Such experimenting work that is key to successful innovation. Within an Innovation Wales team, there would be experience to identify likely approaches to solving 'interesting problems'.

Networking. Networking has been mentioned earlier as an activity for an Innovation Wales team. Such a team needs to engage stakeholders across Wales in a range of 'innovation' activities continually, meeting the needs of all stakeholders impartially and effectively.

Trust. Effective innovation requires a level of trust between parties, and an effective Welsh Innovation Network (eco-system) will require trust as a core element. This is both trust with the Innovation Wales team (which has to be both impartial, transparent, and agnostic to technical and organisational solutions), as well as between other members of the Network.

Exploitation. The route to exploitation of any solution will become clear during the engagement of stakeholders. Exploitation will lead to income, some of which can be re-invested in the Innovation Wales initiative as 'working capital' to maintain the momentum of the innovation eco-system of Wales.

Concern for the 'greater good'. One of the key motivators for successful innovators is not financial reward; it is their own satisfaction in solving a problem that will benefit others significantly. Understanding this philosophy and recognising its motivational power is particularly important for Wales. Any innovation strategy for Wales should be driven in a way that answers the question, "how best will this benefit Wales?" Such motivation, however, is difficult to measure and attempting to put metrics on such ambition will only serve to hinder innovation. The researchers make this very clear in their findings. The Government's response document notes that the process of innovation can appear "chaotic and non-linear". However, as researchers (Griffin et al, and Dyer et al) have shown, although effective innovation is not linear, it is not chaotic and is an ordered process. The activities for effective innovation have been clearly identified by researchers, and they are significantly different from those listed in the Government's Response document. However, they can easily be adopted into a strategy for Wales.

For a complete copy of this article, contact the author, Antony Hurden of Grounded Innovation Ltd, at antony@groundedinnovation.com.

References

"A Photonics Enabled Innovation Strategy for Wales", Welsh Opto-electronics Forum, June 2012. This may be found on the web site www.wof.org.uk

"Serial Innovators" by Griffin, Price, and Vojak (published by Stanford University Press, 2012). The web site: www.abbiegriffin.org has a video trailer discussing the book.

"The Innovator's DNA" by Dyer, Gregersen, and Christensen (published by Harvard Business School Press in 2011). The web site www.innovatorsdna.com covers the principles described in the book.

Welsh Government, "Consultation on the development of an Innovation Strategy for Wales". The Consultation document can be downloaded from this site: <http://wales.gov.uk/consultations/businessandconomy/120430innovation/?lang=en>

Welsh Government, "A Welsh Government Response to the Call for Evidence on an Innovation Strategy for Wales", a request for views to the response. The Response document can be downloaded from this site: <http://wales.gov.uk/topics/businessandconomy/policy/innovationwales/?lang=en>

WOF's new Chair Professor Andy Evans, Institute of Maths and Physics, Aberystwyth on the economic value of photonics, Horizon 2020, importance of innovation, £50m investment to support science, NRNs (National Research Networks) and more



This is my first letter as Chair and it is a privilege (and a challenge!) to take over from Lyndon Jones, and I'm delighted that he will continue as a valued member of the WOF steering committee.

I see WOF's principal role as a collective voice for photonics in Wales and a facilitator for the exchange of information and expertise in this important and growing arena. The economic value of photonics-based technologies is recognized locally and globally, for example in the 2012 Photonics21 report, Photonics Technologies and Markets for a Low Carbon Economy, that states "The European photonics industry is a major contributor to EU industrial output. It had a turnover of €55 billion in 2008 and employed 290,000 people".

The next European framework programme for research

and innovation, Horizon 2020, launches on 1st January 2014 with the first call for projects. Horizon 2020 will be focused on three key priorities: Excellent Science, Industrial Leadership and Societal Challenges. At its core are the Key Enabling Technologies (KET) of micro- and nanoelectronics, photonics, nanotechnology, biotechnology, advanced materials and advanced manufacturing. Regionally, the Welsh European Funding Office in January 2013 opened a public consultation, 'Wales and the EU: Partnership for Jobs and Growth', with the publication of the future Structural Funds 2014–2020 consultation documents for West Wales and the Valleys and East Wales. Innovation is prominent, in particular with the introduction of SMART specialisation that will be the basis for structural fund investment in Research and Innovation. WOF has a key networking role in bringing together consortia with complementary expertise in photonics to ensure that Wales makes the most from these European funding initiatives.

Recognising the importance of innovation, the Welsh Government in April opened a call for consultation on an Innovation Strategy for Wales, following on from the publication of the Science for Wales document in March. WOF was well-placed to contribute fully to this consultation, having developed its Photonics Enabled Innovation Strategy for Wales document that was formally launched in July 2012 at events in North and South Wales.

Photonics has a lower barrier for knowledge transfer from the laboratory to the market place than many sectors, and so it is vital to bridge the gaps between research, innovation and products. Photonics research is widespread across Wales in many university departments and in collaborative partnerships such as ASTUTE (Advanced Sustainable Manufacturing Technologies), CAFMaD (Centre for Advanced Functional Materials and Devices)

and LCRI (Low Carbon Research Institute). In 2012, WOF facilitated a compilation of photonics expertise in Welsh universities within the CAMPUS project that was co-launched with the Innovation strategy in July.

The most exciting development in Welsh science research in 2012 was the announcement of a £50M investment to support the government's Science Strategy. Led by the Chief Scientific Advisor's office, this will fund National Research Networks (NRN) in the three Grand Challenge areas of Advanced Engineering and Materials, Life Sciences and Health and Low Carbon, Energy and Environment. Linked to the networks is the Sêr Cymru programme that will attract top research stars to Wales. Photonics has a presence and relevance in each of these grand challenge areas. The campaign was launched at Aberystwyth University in September 2012 by the Business, Enterprise, Technology and Science Minister, Edwina Hart.

One of WOF's key roles is to bring researchers, innovators and businesses together; it informs the membership in regular bulletins of meetings held across the UK of relevance to photonics in addition to organising regular meetings across Wales. In the past year, for example, WOF has co-ordinated meetings in the North and South such as Materials in the Photovoltaic Supply Chain with CSER, Photonics Enabled Innovation Strategy for Wales, Superfast Broadband – a joint WOF / ICT KTN event. The next event is a Photonics Business Breakfast a joint WOF / ESP KTN event in OptIC this March 2013.

Finally, we need to look even further forward to ensure that the next generation of researchers and innovators are enthused and drawn to careers in photonics. WOF initiated the formation of the Photonics Academy and it is pleasing that this continues to educate and inspire young scientists at schools and colleges by providing hands-on proof that photonics is fruitful and fun.

NEW LASER MANUFACTURING DEVELOPMENTS Laser Micro Machining Ltd

Laser Micromachining Ltd. (LML) is now its eighth year of operation and continues to expand the range of services that it is offering to clients. Following its move into a larger facility on the St. Asaph Business Park in 2010, LML has continued to diversify the range of laser manufacturing options for its broad range of clients and the company now boasts the widest range of precision laser machining tools of any service provider in the UK. These tools include lasers whose wavelengths span the range from the DUV through to the near IR (with nanosecond or femtosecond pulse durations), thereby allowing LML to machine any material with high precision and excellent quality.

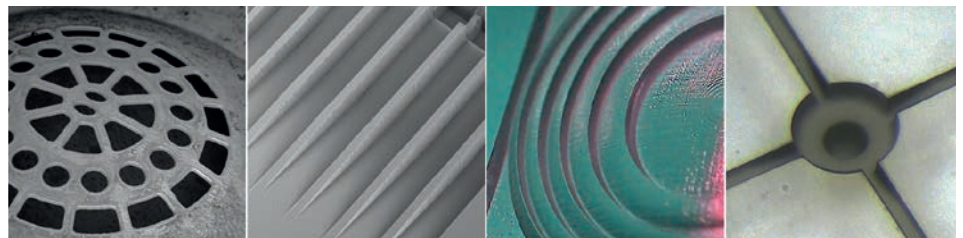
LML is continually developing new processes to help industry gain the maximum benefits from laser-based manufacturing technology. Many process improvements are brought on-stream in an evolutionary way, incrementally improving on existing methods, but LML also identifies major advances which will benefit the business and its customers. One such case has been the 'CALMM' project which is currently halfway through a one-year development program, partly supported by an Industrial Research grant from the Welsh Government. 'CALMM' (Computer Aided Laser Micromachining Manufacturing) is aimed at developing a new set of

software tools which will translate the requirements for a laser-produced part into a practical, time-efficient set of protocols which can then be used to produce the parts on the most appropriate laser equipment. The fundamental driver for this is to reduce the time needed for the complex interventions currently required when a highly-complex part needs to be produced for the first time. CALMM will allow LML to transfer the problem of how to make a component into a set of routines and procedures which should reduce the time needed to make the first-off component and thereby lead to more efficient

development of the necessary manufacturing strategies. The initial results from CALMM, being tested in-house at LML, have been excellent and new ways to produce 2D and 3D microstructures have been evaluated with good results, as shown.

Irrespective of how it is done, the ultimate goal for LML customers is to get their micro-enabled products to market in a timely and economic fashion and LML continues to help a wide range of industries in this regard.

Contact: n.rizvi@lasermicromachining.com



Laser-machined 2D and 3D microstructures produced in metals and polymers



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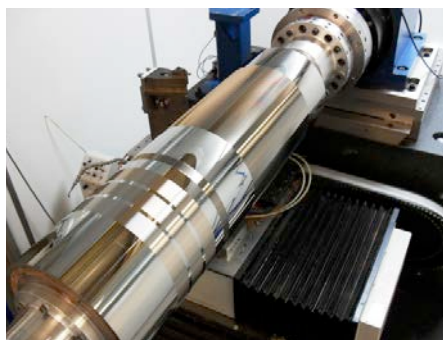
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Ultra Precision Surfaces (UPS2) in OpTIC Glyndŵr supports the EPSRC Centre for Innovative Manufacturing in Ultra-Precision operated by Cranfield and Cambridge Universities

The EPSRC Centre for Innovative Manufacturing in Ultra-Precision, operated by Cranfield and Cambridge Universities is developing a large scale reel-to-reel film manufacturing research platform.

The manufacture of this research platform will be supported by Ultra-Precision Structured Surfaces (UPS2). UPS2 has an Ultra-Precision diamond machining capability which has developed over the last 5 years from Cranfield



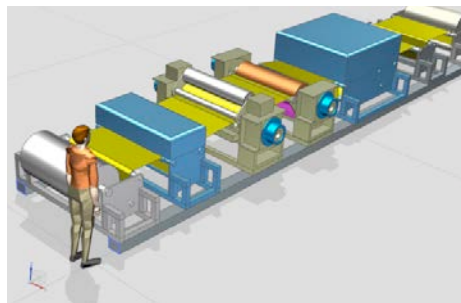
UPS2 Ultra-precision roller after completion of micro-patterning

University diamond turning expertise and successful IKC project development with partners in the Welsh Government and Glyndŵr University.

UPS2 will help develop the Ultra-Precision master rollers for the research platform.

For more information see:

www.ultraprecision.org (website under construction)
www.ups2.co.uk



Large scale reel-to-reel film manufacturing research platform.

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