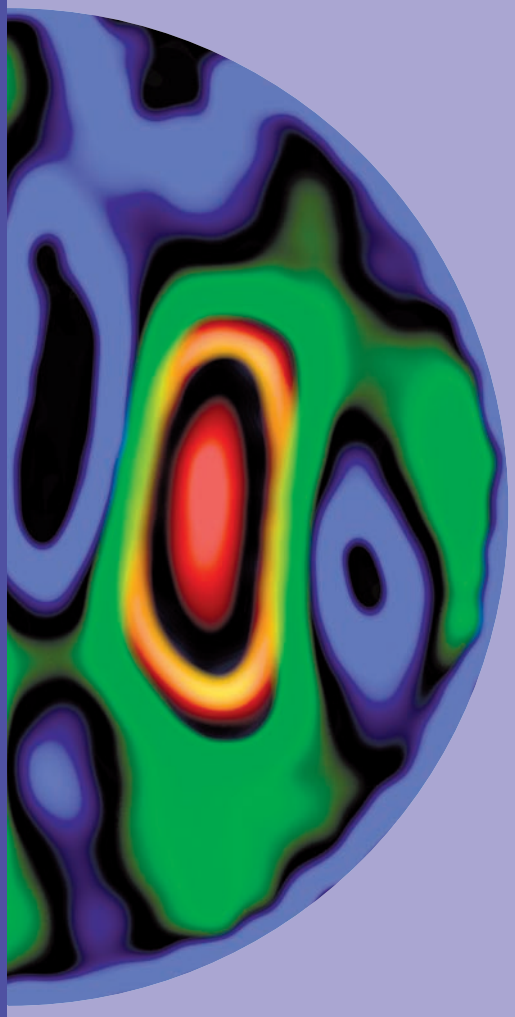
INDUSTRY TECHNOLOGY PROGRAMME

Photon08

The UK's premier conference in optics and photonics



→ **26–29 August 2008**
Edinburgh Conference Centre,
Heriot-Watt University, UK

→ **www.photon.org.uk**

Industry Technology Programme

- Funding and Commercialisation
- Future Technologies
- AILU Medical Group meeting

UKCPO UK Consortium for Photonics and Optics | IOP Institute of Physics | the association of AILU laser users

ITP sponsor

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Introduction

Welcome to the Industry Technology Programme, the commercial sessions for this year's Photon conference. Here we will review some current growing photonic markets and their upcoming technologies which will help to sustain and grow this exciting and innovative sector.

This year we have four distinctive sessions over three days covering a variety of established and growth areas.

- On **Tuesday** we will start with routes to **funding and commercialisation**; discussing how to turn the UK's long celebrated technical expertise into thriving business opportunities. There will be presentations on how to secure funding for your business and projects as well as the various ways to translate your technology into profit. There will also be some successful case studies to show that it can be done and that it can be done well.
- **Wednesday** is a bumper day with two sessions running in parallel. The first is a session discussing the future of the resurging UK market of displays and the new but rapidly increasing market of **photovoltaics**. Along with presentations on the current technologies and possible future direction from industry leaders there will be discussions on industry roadmaps including a presentation on the various roadmaps currently available.
- The second session on Wednesday, running in parallel, has been organised by **AILU's Medical Group** and concentrates on the use of **lasers in medicine and biophotonics**. They will present and discuss the ways that lasers have transformed these areas. They will show that lasers are not just tools and components of instruments which can provide innovative treatments, but also some of the ways they can be used to manufacture medical devices themselves.
- **Thursday** will deliver presentations on some more established technologies, focusing on the **communications and laser industries**. Communications has graduated from a recovering industry to be a steadily growing business with many promising opportunities now available. We will also look at the way fibre lasers are adding to the long established laser industry and discuss their place in this ever evolving technological area. Between these technical sessions we will have presentations discussing how photonics companies can benefit from working for and with the defence agencies and companies.

IOP Institute of Physics

The Business and Innovation team at the **Institute of Physics** plays a pivotal role in creating an essential link between the Institute and business. The Institute is active in representing the views of its business members and of physics-based industries to government agencies and other funding bodies. We produce reports on the health of physics-based industry and host events attracting high-profile speakers addressing issues relevant to the physics-based business community.

The Institute of Physics has strong links with organisations of all sectors and all sizes that engage with physics or employ physics trained staff. An important element of the linkage is the **Corporate Affiliates Network**, which has over fifty members, including both exciting spin-out ventures and commercial global institutions. The network bridges the gap between science and industry and supports professional physicists in business, giving a unique insight into the world of work and the roles that scientists and engineers can play. Corporate affiliates support the professional development of their young physicists, providing them with the technical and business awareness needed to build a successful career at the frontiers of industry.

The Institute of Physics works closely with the Photonics Knowledge Transfer Network, interacting with them and their stakeholders to emphasise and promote the essential role of physics in innovation.

To find out more, contact Govind Kharbanda (govind.kharbanda@iop.org) or visit www.iop.org/activity/business.

the association of AILU laser users

The **Association of Laser Users (AILU)** was established in 1995 as an independent, non-profit making organisation run by and for laser users involved in activities such as manufacturing, healthcare, academic and industrial research; as well as suppliers of laser-related products and services.

The aims and objectives of the association are set out in its Memorandum and Articles of Association available from the AILU website (www.ailu.org.uk). They include the fostering of co-operation and collaboration and the dissemination of information, experience and expertise relating to industrial laser technology, laser materials processing; its applications and related technologies.

AILU is a partner in the Photonics KTN. Contact Anna O'Neil (anna@ailu.org.uk) for more information about AILU.

The **UK Consortium for Photonics and Optics (UKCPO)** is the leading association for organisations that serve the Photonics community in the UK. It provides a focus and a voice for academic institutions, trade associations and regional networking bodies. It aims to stimulate the innovative use of photonics technology in the UK, by providing opportunities for networking and the collection and dissemination of information. The ultimate target is to create an environment conducive to the identification and realisation of new wealth creation opportunities based on photonics enabling technology.

Flagship activities include the organisation, in conjunction with the Institute of Physics (IOP), of the biennial Photon Conference and Exhibition; and the Photonics Knowledge Transfer Network (PKTN), in which it is the Lead Partner. Both activities are designed to bring together the best from academia, industry and finance in the furtherance of photonics excellence in the UK.

The IOP is a member of the UKCPO council, along with IET, EPSRC, FIA, AILU, UKIVA and regionally based bodies NWPA, PCUK, SEPNET, SOA and WOF. For more information on UKCPO please visit www.UKCPO.org.

If you are involved in academic research into any area of Photonics, the design and development of products or equipment enabled by Photonics technology, the provision of finance for investment in businesses based on Photonics, or the manufacturing, marketing and sales of Photonics based goods, join in the activities of the UKCPO. Registration on the PKTN web-site is free, and there will be a UKCPO member organising networking events near you.

Photonics

Knowledge Transfer Network

The **Photonics KTN**, which is funded by the Technology Strategy Board, was established to facilitate the transfer of knowledge from the UK's research base in photonics to business. The KTN taps into the wealth of knowledge in UK universities and other government-funded research centres, interacts with organisations of all sizes and across all sectors, and identifies technology partnering opportunities to meet the requirements of the industry.

From signposting photonics training courses at every level, to helping its members identify and secure funding, and supporting photonics conferences, exhibitions and workshops, the Photonics KTN draws together the UK's world-class capabilities in photonics and ensures that the UK makes a significant technical and commercial impact on a global scale. The Photonics KTN will be leading a mission to China in September 2008, which is fully supported by UK Trade and Investment.

If you have not yet joined the Photonics KTN we invite you to do so via our web portal at www.photonicsktn.org. Contact info@photonicsktn.org for more information about the PKTN.

The UKCPO and AILU are partners in the Photonics KTN, along with the Centre for Integrated Photonics, Photonics Cluster UK, TWI, UCL and the UK Astronomy Technology Centre.

We hope that many of these sessions will be of interest to existing and future entrepreneurs and look forward to seeing you there.

Lynne Morton SOA	Govind Kharbanda Institute of Physics	Anna O'Neil AILU	Ian Tooley UKCPO

Programme summary

Tuesday 26 August 2008

Wednesday 27 August 2008

Thursday 28 August 2008

Tuesday 26 August 2008
Funding and Commercialisation
Wardlaw Room

10:45 Acquiring Funding: How to fund your business to the next level

Chair: Bill Bryan, Entrepreneur Business School Ltd

10:45 Show me the Money – Photonics/Electronics KTN funding roadmap
Ashley Evans, Electronics KTN and Alastair Wilson, Photonics KTN

It is well known that there is a plethora of government initiatives to help businesses, particularly SMEs, grow and develop. The problem is finding the most appropriate scheme that will meet the business's needs.

To assist companies with this problem, the Photonics and Electronics KTNs jointly commissioned a roadmap to help companies find their way through the maze of funding schemes that are currently available in the UK. The features of the roadmap will be outlined and an explanation given of how to use the roadmap to efficiently find the scheme that best suits your business.

11:15 Where is the money going?
Jonathan Harris, Young Company Finance

This talk will look at the various sources of finance available to early stage high growth technology companies, and their various pros and cons. It will then analyse recent patterns of investment and identify discernible trends.

On the assumption that ventures seeking investment are more likely to succeed if they take note of these trends, some suggestions will be given for entrepreneurs proposing to start upon the process of raising funds.

11:45 Investing in University IP
Rob Rule, IP Group plc

Rob Rule is the Managing Director of Techtran, the commercialisation and investment partner for the University of Leeds. Techtran is a subsidiary of IP Group, which also has partnerships with 9 other universities across the UK and is the country's leading company for the commercialisation of University IP.

Rob joined Techtran in 2007 from Liverpool Ventures Ltd, a subsidiary of the Merseyside Special Investment Fund and an investor in early-stage technology businesses. Prior to that, Rob was Commercial Director of Micap PLC and played an integral role in the successful flotation of the company on AIM in 2003. Rob also had extensive blue chip experience with ICI and DuPont, encompassing various roles in business management, sales, marketing and R&D. Some background information on IP Group will be provided along with some examples of spin-outs from the company's

portfolio at Leeds University. In addition, the process for creating and investing in successful spin-outs will be examined.

12:15 Panel Led Discussion
Bill Bryan, Ashley Evans, Alastair Wilson, Jonathan Harris and Rob Rule

An opportunity to question the chair and speakers collectively on their experiences in the industry and to share their views on the challenges of raising finance in the current economic climate.

12:30 Break for Lunch

13:45 Technology Transfer: From concept to profit

Chair: Clive Reeves, Scottish Enterprise

13:45 Routes to Commercialising Heriot-Watt University Inventions
Mike Cox, Heriot-Watt University

Knowledge and technology can be transferred from academia to industry through a number of different routes. Transferring technology (commercialisation) typically involves the formation of spin-out companies or licensing. However, both of these approaches have drawbacks as well as advantages.

The third option of technology transfer through collaborative research projects with industry addresses a number of these disadvantages, and a range of collaborative methods exist. Heriot-Watt University's approach to these three routes to commercialisation is presented with appropriate case studies and the advantages and disadvantages of each highlighted. A selection of preferred collaborative options is outlined.

14:15 Innovation and how we can effectively manage it
Peter Dobson, Oxford University Begbroke Science Park

In this talk I will define invention and innovation and show how there are cultural and time gaps that restrict our way to effective commercialisation. In Oxford we borrowed ideas from the Scottish Enterprise Fellowship model and we believe that there are very effective ways of training young scientists and engineers to be innovative. It is also important to create the right environment for innovation to take place and it is becoming apparent that simply locating small companies in "Science Parks" is not sufficient.

We are experimenting with providing what can best be described as "well defined after-care" service on a Science park that has academic activities

and buildings, meeting rooms for courses and seminars alongside restaurant facilities that encourage networking and sharing of experience.

14:45 Tending the Flame; Supporting Welsh Innovation in Photonics
Nia Roberts, Department for the Economy and Transport for the Welsh Assembly Government

Successful development and commercialisation of innovation is encouraged in Wales by a wide range of support from the Welsh Assembly Government. This support includes funding packages such as the Single Investment Fund and other mechanisms such as dedicated IP support funding. Innovative companies can take advantage of the pan-Wales Technium® network of high-tech business incubators, including the award-winning OpTIC Technium® which focuses on the opto-electronics sector and offers incubation units and a well-equipped Technology Centre. The Welsh Assembly Government also offers access to a network of technologically qualified and IP-accredited Innovation Managers together with a raft of other business support measures. This has led to some significant success stories.

15:15 Break

15:45 Company Case Studies: Covering a range of business maturity

Chair: Peter J Dobson, Oxford University Begbroke Science Park

15:45 Revolutionising Digital X-ray Detection
Max Robinson, Kromek

The presentation will outline the evolution of Kromek, formerly Durham Scientific crystals, from being a spin out from Durham University to being a Company poised for IPO.

The company specialises in producing single crystal semiconductor materials within the cadmium telluride family. These materials have significant applications as detectors of x-rays and gamma rays, notably in medical imaging, security screening, industrial inspection and space exploration. In addition to its range of semiconductor materials, detector packages and non imaging detection systems Kromek also produces x-ray imaging packages with multi-view capabilities. These x-ray display platforms provide real 3D x-ray imaging for the first time without specialist viewing equipment.

16:15 Commercialising Adaptive Optics
Andrew Zadrozny, Starpoint Adaptive Optics

Starpoint Adaptive Optics started as a spin-out company from Durham University's astronomical instrumentation group. This talk charts the company's evolution since then.

16:45 Patenting Activity in Photonics and Commercialisation
Maureen Kinsler, Marks & Clerk

Intellectual property and patents in particular are increasingly important for protecting investment and ensuring commercial returns. Many companies are using their IP to generate revenue, and with the transfer of much manufacturing to the Far East, this is a trend that is likely to continue.

The presentation will look at a number of different IP commercialisation strategies.

17:15 Finish

Wednesday 27 August 2008
Future Technologies 1
Wardlaw Room

11:15 Roadmaps: Availability and how they can help your business
Chair: Steve Welch: The PKTN

11:15 Photonics Roadmaps: A Review
Sandi Wilson, UK Astronomy Technology Centre

There are many documents available about many photonics-related subjects all calling themselves roadmaps and yet the only thing they seem to have in common is the title! The Photonics Knowledge Transfer Network has collected and reviewed the information from many of these sources and the results are now available for the community to use.

This presentation will cover the wide variety of sources and will explain the challenges encountered when trying to synthesise the data. It will explain the different types of "roadmaps" encountered and the value of the data to different users. Finally, a simple web-based interface will be presented which allows Photonics people to navigate successfully through the roadmaps and get at the data they really need: a Streetfinder for the Photonics Roadmap.

11:45 Opportunities for European Industry in Emerging Nanophotonics Technologies
Tom Pearsall, European Photonics Industry Consortium

Through the European project MONA, we have been able to study the impact of photonics on emerging nanotechnology markets. The results give an advance look at where the most significant business opportunities lie for photonics industries in Europe. Market opportunities can be rated by euro-volume, growth-rate, and added-value contributed by nanophotonics-based components or technologies.

The largest application markets are in photovoltaics where the European market grew by 60% in 2007 and flat-panel displays where European industries already play an important role in almost every part of the value chain except the final assembly. In other highly-innovative areas like biosensors, there is potential for strong growth, but the overall market volume remains significantly lower.

12:15 Break for Lunch

13:45 Displays: A European roadmap and where the UK is putting its money
Chair: Ian Underwood, MicroEmissive Displays Ltd

13:45 A European Displays Roadmap
Chris Gracie, ADRIA

The Adria Roadmap was compiled from meetings held throughout Europe attended by over 300 display professionals. This talk will summarise the report and finally touch on Europe's Microdisplay industry.

14:15 Plastic Electronics – the disruptive technology of the future
Chris Williams, Director, Displays & Lighting KTN

Where we are today, where we will get to tomorrow, and how we will get there.

14:45 Flexible Displays – A Case Study
Bill MacDonald, DuPont Teijin Films

TSB/DTI funding was instrumental in bringing together a small and focused consortium of parties, in this case DuPont Teijin Films, Plastic Logic and University of the West of Scotland, targeting flexible displays. This programme was extremely successful and largely underpinned the product development that has led to Plastic Logics proposed commercial offering. The benefits the external funding brought to the product development programme will be discussed.

15:15 Break

15:45 PhotoVoltaics: How to make a profit whilst saving the planet
Chair: Ian Maxwell, WOF

15:45 PhotoVoltaics Roadmap
Stuart Irvine, Welsh Optoelectronics Forum

If PV is to fulfil its considerable potential as a vital part of a low-carbon energy strategy, then it must be understood in terms of the whole chain of supply, from fundamental research and development, through manufacture and distribution to adoption and installation.

In June 2006, the Welsh Opto-electronics Forum (WOF) PV Group took this whole-sector approach in producing its "PV Solar Energy Road Map for Wales", a document which was used to inform the Welsh Assembly Government during their consultation on the "Microgeneration Action Plan for Wales" (MGAP).

Prof. Stuart Irvine will review the production of the Welsh PV Road Map, together with recent steps taken to ensure the document remains up-to-date. He will also look at options for generating similar regional Road Maps and for extending this to a wider context such as the UK as a whole.

16:15 PV in the UK – Here and now
Ben Robinson, Dulas

The UK PV industry is still in its infancy as mainland Europe ploughs ahead with thousands more installations, thanks to strong market conditions and government incentives.

Dulas have been instrumental in proving the viability of PV in the UK and have worked hard to be major players with no external investment.

Now acting as framework suppliers to deliver Phase 2 of the government's Low Carbon Building Programme, Director Ben Robinson will explain how they found themselves in such a privileged position.

Hear how a small worker owned company based in mid-Wales has not only seized the opportunities for PV in the UK but for all renewable energy technologies across many countries.

16:45 The SUPERGEN PV-21 Project
Ken Durose, Durham Centre for Renewable Energy

'Photovoltaics for the 21st Century' (PV-21) is a collaborative research programme funded under the UK EPSRC Sustainable Power Generation and Supply (SUPERGEN) framework. PV-21 is an intense collaboration between the universities of Bath, Cranfield, Durham, Edinburgh, Imperial College, London South Bank, Northumbria, Southampton and North East Wales Institute of Higher Education.

Key elements of the programme are:

i) focus on thin film PV and routes to reducing cost and improving sustainability;

ii) extension of fundamental understanding of the factors controlling thin film PV performance;

iii) evolution and upscaling of technology platforms to incorporate new ideas and processes;

iv) development and integration of advanced approaches to light harvesting and management;

v) identification/development of emerging/new materials to address concerns about materials sustainability;

vi) consideration of economic factors influencing progress towards large scale deployment of low cost PV;

vii) integration of 'Plus' projects in selected areas to enhance progress;

viii) training activities.

Building integration of PV in the UK has the potential to generate over 20% of our energy needs from the ultimate clean renewable energy source. For this vision to become reality, PV energy conversion efficiencies must be improved and fabrication costs reduced. Although thin film PV holds the promise of for low cost production, AM1.5 conversion module efficiencies are currently 10% or less, so there is scope for substantial improvement. By contrast, efficiencies for inherently more expensive monocrystalline silicon modules are approaching 20%, but here the potential for cost reduction is lower. For this reason, the PV-21 Consortium will focus effort on the three polycrystalline thin film platforms of silicon, cadmium telluride and the copper indium diselenide (CIS) class of alloys, while encouraging pursuit of the relatively mature wafer silicon technology activity in Loughborough outside the Consortium.

The three basic platforms will be used to test innovative materials and design concepts — for example new absorber materials, transparent conducting oxides (TCOs) or light capture strategies — some of which may also be relevant to the Excitonic Solar Cells Consortium. The Consortium's structured approach will be enhanced by integration of 'Plus' projects that will inject new ideas and open new pathways towards the ultimate goals of PV21.

The Consortium is increasingly aware of the important role played by economic factors in determining the timescale for widespread adoption of thin film PV, and the inclusion of a new package focussing on economic issues will ensure that the planning and management of PV21 will be based on informed choices regarding sustainability, producibility and long term economic viability. This contextualisation of the PV21 research platform will also improve the quality of the Consortium's training programme and aid dissemination to a wider industrial and public audience. At the same time, the expansion of the university/industry interface resulting from the addition of new industrial partners will help to ensure the continued relevance and impact of our research effort, which is ultimately guided by our mission *to make a major contribution towards achieving competitive solar PV.*

17:15 Finish

Wednesday 27 August 2008
Medical Group Meeting: Lasers in medicine and biophotonics
Bruce Room

10:45 Laser-based medical procedures
Chair: Duncan Hand, Heriot-Watt University

10:45 Refractive Surgery of the Eye with Ultrashort Laser Pulses
Holger Lubatschowski, Laser Zentrum Hannover

Ultrashort laser pulses have become a promising tool for micromachining and extremely precise ablation of all kinds of materials. Due to the low energy threshold, thermal and mechanical side effects are limited to the micrometer or even sub micrometer range This precision enables the use of ultrashort laser pulses in a broad field of medical applications. Especially, the interaction process based on nonlinear absorption offers the opportunity to process transparent tissue not only on top of a surface but three dimensionally inside the bulk.

This mechanism is used in refractive eye surgery, where fs pulses create flaps into the corneal tissue to remodel the curvature of the eye and to improve visual acuity. Moreover, fs pulses could be used to influence the biomechanics of the crystalline lens of the eye and improve accommodation on eyes who suffer from presbyopia.

The talk will give an insight into the basic mechanisms on refractive eye surgery as well as an overview in current state of the art of the used laser technology.

11:15 Lasers and Light Sources in Aesthetic Dermatology
Jon Exley, Lynton

Lasers are commonly used to treat a variety of cosmetic and dermatological skin conditions such as unwanted hair growth, tattoo removal, and even the reduction of wrinkles. More recently Intense Pulsed Light (IPL) sources have been developed as an alternative modality in such applications with great success. However, in all application of Lasers and IPL in aesthetic dermatology it is critical to understand the nature of the skin condition and then choose the appropriate wavelength, pulse duration and energy density to achieve a safe and effective treatment. This presentation will consider a variety of conditions and the appropriate light characteristics to achieve a successful treatment including the most advanced techniques using fractional technology.

11:45 Dentistry and Light
John Colles, Denfotex

Lasers and state of the art LED devices find increasing applications in the treatment and repair of teeth and the surrounding soft tissue in the oral cavity. In this talk whilst illustrating most of these applications I will concentrate principally on the more controversial 'cosmetic' process of tooth whitening, the relatively new process of photo-activated disinfection and continuing attempts to provide a really useable optical drill.

12:15 Break for Lunch

13:45 Laser-based manufacturing for medical applications
Chair: Duncan Hand, Heriot-Watt University

13:45 Laser Machining of Zirconia Ceramic for Manufacture of Dental Restorations
Jon Parry, Heriot-Watt University & Nick Jones, Renishaw Plc

As the life sciences communities continue to embrace laser scanning microscopy techniques, the growing range of applications places greater demands on laser technology. The need to visualise cellular and sub-cellular structures within deep tissues and to capture dynamic cellular and intracellular processes has undoubtedly created new research paths in laser source development. In particular, the ability to control the temporal, spectral and spatial properties of robust, simple to use and (ideally) inexpensive laser sources is crucial for successful and efficient imaging.

Nonlinear optics offers a potential solution in the creation of novel photonics systems for bio-imaging, providing the ability to tailor pulse durations and precisely control excitation parameters. I will present an overview of current photonics research at the Centre for Biophotonics aimed towards improving sources for various imaging optical techniques including confocal imaging, multi-photon flash photolysis and coherent anti-Stokes Raman scattering microscopy. This will incorporate a synopsis of conventional, commercial laser sources available for linear and nonlinear optical microscopy and the improvements in bio-imaging that can be achieved by employing nonlinear optical methods such as pulse compression and white-light supercontinuum generation.

14:15 Harnessing the power of light – the fibre laser revolution
Dave Richardson, University of Southampton

Over recent years the power that can be achieved from fibre lasers has grown rapidly due to parallel advances in high power diodes, diode-to-fibre coupling schemes and doped fibre design and fabrication.

From a technological perspective the headline results have generally related to the possibilities of scaling continuous-wave fibre lasers, with >5kW now possible from an effectively single-mode core. However, advances in many aspects of pulsed laser performance have been just as spectacular. Using the fibre MOPA approach it is now possible to realise fs and ps pulsed fibre systems operating at the multi-100W level with pulse energies now up at the 1 mJ level. In the nanosecond regime multi-100W systems have also been achieved with single mode pulse energies as high as 10mJ, and by relaxing the mode quality pulse energies approaching 100mJ are now possible.

On a more practical level, fibre lasers are alignment free, extremely compact, robust and power efficient — greatly reducing the cost of ownership. These advantages derive from the waveguide nature of fibre and the fact that large surface area to volume ratio of the fibre geometry means that heat generated in the lasing process is readily removed and does not compromise laser performance.

Within this talk I shall review the state-of-the-art in both CW and pulsed fibre laser systems, outline some of the issues limiting further power and energy scaling, describe various applications now being targeted, and speculate as to likely future developments.

14:45 Fabrication of micro-fluidic channels with Nd:YVO_4 and CO_2 laser systems

Dermot Brabazon, Dublin City University

Two new laser micromachining processes developed for the production of channels and voxels with highly repeatable micrometer level resolution will be presented.

Devices fabricated with this developed technology can be used for applications such as microfluidic lab on a chip, strain measurement, sub-micrometer cooling systems and various photonic guiding systems.

These systems include automated 3D Nd:YVO_4 and CO_2 lasers for microprocessing. In order to achieve the precise control, CAD processing, laser firing, 3D sample movement and thermal field modelling software were developed. Additionally, for the characterisation and optimisation of these processes an automated channel and voxel profiler was developed and built in-house. Details of the system and the high efficiency achieved from these processes, will be presented.

15:15 Break

15:45 Laser-enabled bio-research
Chair: Duncan Hand, Heriot-Watt University

15:45 Getting a Grip on the Micro-world
Jonathan Leach, Glasgow University

We have developed a real time interface for holographic optical tweezers where the operator's fingertips are mapped to the positions of silica beads captured in optical traps. The beads act as the fingertips of a microhand which can be used to manipulate objects that otherwise do not lend themselves to tweezers control, e.g. objects that are strongly scattering or highly light sensitive. Following from this, we show how a similar system can be used to position multiple cells in complex 2 and 3D arrangements. We are currently investigating how high-speed video microscopy can be used to measure the sub-thermal forces between interacting cells and particles. By using either a bespoke imaging camera with integrated particle tracking or commercial CMOS cameras we can measure the residual Brownian motion of many objects simultaneously. This data gives positional information at the nanometre level a corresponding force sensitivity of 10 femtonewtons. The extreme sensitivity of these measurements, suggests the basis of a new sensor used to measure the stiffness of different biological material.

16:15 Cellular Nano-Surgery (Enhanced techniques for optical transfection by the control of femtosecond lasers)
Tom Brown, University of St Andrews

The transfection of cellular materials, in which a membrane impermeable DNA plasmid is injected into a cell and a protein subsequently expressed, is an important technique for Life Science applications and is an active area of research. Currently several different methods exist for implementing this functionality including electroporation, gene guns, viral vectors, ultrasound (sonoporation) and chemical based techniques.

In this presentation, we will outline the techniques that we have developed for the use of femtosecond (fs) lasers to target and transfect individual cells with high efficiency. The use of lasers to transfect cells offers several advantages including selected targeting, sterility, and the ability to combine with other optical techniques including micromanipulation and spectroscopic analysis. This technique was first described by Tirlapur et al in 2002 [1] and makes use of a fs-Ti:Sapphire laser source operating around 800nm. In our work, we have demonstrated that average transfection efficiencies >50% may be obtained using this technique for large numbers of cells (n=4000) under optimised operating conditions. By moving from a Gaussian beam to a pseudo-Bessel beam, we have shown that the critical alignment condition of the beam focus and the cell membrane can be greatly reduced allowing the development of a near alignment free optical transfection system, which when implemented using

a spatial light modulator allows a point-and-click transfection system to be developed. The use of fibre delivery of the laser radiation to the cell under study has also been investigated and we will show that optical transfection can be achieved using such methodology. We will also show that when the temporal behaviour of the laser is controlled, we can obtain multiple functionality from the same laser and microscope system, using the laser operating in a CW mode to optically tweeze a cell to a particular reagent of interest followed by obtaining photoporation when the laser is operated in fs mode before switching the laser back to CW to optically tweeze the cell to another area of interest.

In conclusion, we have shown that high efficiency transfection can be obtained using fs-lasers and that careful control of the laser output in both spatial and temporal domains can lead to further enhancements of this technique.

[1] U.K. Tirlapur and K. Konig, Nature, 418, pp. 290-291 (2002)

16:45 Lasers for single-photon and multi-photon excitation microscopy

Gail McConnell, Centre for Biophotonics, University of Strathclyde

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17:15 Finish

Thursday 28 August 2008
Future Technologies 2
Bruce Room

10:45 Communications: A high speed future with the next generation network
Chair: Andy McLaughlin, Scottish Enterprise

10:45 Towards Next Generation Access Networks in the UK
Michael Robertson, Centre for Integrated Photonics

In this talk, I will describe the issues surrounding the deployment of Next Generation Access Networks in the UK. The issues can be grouped under the headings technical, economic and political. While technical solutions are well understood, customers' expectations of the price of broadband bandwidth are at odds with the costs of rolling out a next generation access network in the UK. At the same time, the benefits of improved access infrastructure are expected to have a significant positive impact on the health of the UK economy, and also lead to reduced carbon emissions through reduced need for travel. Given that it may take 10 years to roll out such a network, there is an urgent need to develop a business model that supports such a network so that the economic benefits to individuals and competitiveness of UK business offered by the use of this network can be exploited as soon as possible.

11:15 Next Decade Optical Communications Trends
Bob Musk, Optoelectronics Industry Development Association (OIDA)

In this talk I will present the latest updates from the OIDA communications roadmap. I will discuss the implications for carriers as well as systems, components and materials manufacturers and distributors.

11:45 Optical Transport Network Evolution — market drivers and technology challenges
Richard Dorward, Ericsson

The evolution of the optical transport network is being driven by changing user requirements, the rapid growth in IP and Ethernet services, and a dramatic increase in the capacity demanded. The network is being transformed by new technology and equipment types to address these requirements, both in the electronic and the photonic domains, but they face major challenges to meet the projected ongoing growth in capacity. Key areas are the transmission rates and bandwidths, the cost of opto-electronic conversion and the scalability of switching solutions.

12:15 Break for Lunch

13:45 Defence: Photonics, defending the UK at a profit
Chair: TBC

13:45 Photonics in the Defence Industry
Iain Clark, Defence Technology Centre

The requirements for photonic components and devices in the defence arena are driven by a diverse set of challenges. Requirements for persistent surveillance of diverse operational scenarios are currently being met through the exploitation of a wide range of military sensors and systems. These include advanced RF systems that can address wide areas at long range, but which can also track individual targets via GMTI radar and their attendant processors. For increased resolution, it is necessary to turn to optical imaging techniques, exploiting active laser imaging if necessary to enhance the accuracy of the identification process. In the guided missile arena, optical seekers play an important role in ensuring the terminal accuracy of hypersonic payloads. With the evolution of strategies in network-centric warfare, system designers are evaluating the potential of optical communication techniques as a way of overcome limitations in bandwidth and security imposed by RF approaches. The Electromagnetic Remote Sensing Defence Technology Centre (EMRS DTC) supports projects in most of these areas, with activity in EO systems, novel laser sources, microwave photonics, THz technology and embedded processors.

This presentation will present a summary of aspects of its work, setting it within the context of the requirements of the Defence Technology Strategy.

14:15 Opportunities for UK Academia and Industry to Engage with Defence Science and Technology
John Perry, MOD

Science innovation technology is the part of the MOD responsible for commissioning research worth around £500m a year. The research programme is no longer delivered exclusively by in house laboratories. The MOD wants to capture innovation from anywhere in the UK science and technology community to protect UK Armed Forces and help them deliver their mission more effectively.

The talk will describe the many new initiatives such as the Grand Challenge and the Centre for Defence Enterprise as well as a new community of interest magazine, CODEX. More details are at www.science.mod.uk. This is an opportunity to assist UK Armed Forces by also enter the £16bn a year business of supplying those Forces.

14:45 Working with the MOD
TBC

Abstract not available

15:15 Break

15:45 Fibre Lasers: What next for these high power flexible lasers?
Chair: Anna O'Neil, AILU

15:45 Photonics in Healthcare Roadmap
Andrew Whitaker & Helen Goddin, TWI

The global medical device market is growing rapidly, with annual growth rates of between 5% and 12% depending on the sector. It is important that the UK establishes itself a strong presence in this growing sector, to continue to compete with companies in Europe and USA. To this end, the Photonics Knowledge Transfer Network has commissioned a roadmap, to focus specifically on the Photonics in Healthcare sector. This presentation will give preliminary market data on the medical sector, and introduce the work that is planned for the roadmap. As part of the sector analysis, the Photonics KTN invites participation from the attendees, as the basis of early discussions on the future of Photonics in Healthcare in the UK.

16:15 Fibre Lasers for Industrial Applications
Jack Gabzdyl, SPI Lasers

Fiber laser technology is relatively new to the industrial materials processing arena with the first production examples being recorded only 5 years ago. However, in a short space of time fiber lasers have created a substantial market position accounting for >10% of the total industrial laser market. In some applications fiber lasers are having significant impact and have already gained market share in the range of 30-50%. The benefits of fiber laser technology in terms of high beam quality and low cost of ownership are making them a natural choice for some applications. A number of examples in micro and marking markets are examined to highlight the benefits of the fiber laser source.

16:45 The Talisker Laser
Chris Dorman, Coherent

Many industries currently use lasers for drilling, cutting, scribing and contouring materials as diverse as silicon, metals and plastics, with features as small as a few tens of microns. Traditionally, this precision micromachining has been powered by DPSS or excimer lasers with nanosecond pulse durations, but there is a growing need for even higher

precision and resolution. While shorter pulsewidths can yield higher resolution, superior edge quality, and eliminate peripheral thermal effects, drawbacks in existing ultrafast laser technology have limited its use to a few specialty applications.

In this article we describe a new type of laser that delivers picosecond output, and combines the simplicity of a fiber laser with the high pulse energy characteristics of a free-space laser. We then discuss applications that can benefit from the unique output, including semicon and photovoltaic manufacturing.

17:15 Finish

Selected Speaker Biographies

Iain Clark
DTC

Iain Clark has worked as a Systems Engineer in Electro-Optic design for some twenty years. As part of the UK defence industry, he has been involved in the design of designation and active illumination lasers and thermal imaging cameras for targeting pods and missile seekers. He has also worked on the attendant image processing algorithms for detection, tracking and automatic target recognition. His current role includes acting as Electro-Optics Theme Leader for the UK MoD Electromagnetic Remote Sensing Defence Technology Centre (EMRS DTC).

Mike Cox
Heriot-Watt University

Mike Cox graduated from Manchester University in 1975 with a First Class Honours BSc in Chemistry and then obtained a PhD in Physical Chemistry in 1978 from Manchester University. He joined the Plastics Division of ICI in 1978 as a research scientist. On its formation in 1983, Dr Cox joined the Advanced Materials Group of ICI. During that period he managed the development and launch of a range of engineering thermoplastics including ICI's liquid crystal polymer and new grades of polyether sulphone and poly ether ether ketone. In 1989 he took a secondment to ICI Japan as research manager of the Materials Technology Group. In 1991 Dr Cox returned to the UK as research manager of the Biopolymers Group, developing the biodegradable polymer Biopol, which became part of Zeneca on the demerger of ICI. He was the technical member of team that sold the Biopol business to Monsanto. Dr Cox joined W L Gore & Associates in 1997 as UK, and then European, Technology Leader of the Industrial Products Division. He identified new opportunities for expanded PTFE and managed the development and launch of new products in medical, coating, and fluid transport sectors. Dr Cox joined Heriot Watt University in 2003 as Technology Transfer Manager. He currently manages the commercial exploitation of all Heriot Watt University inventions through spin-out company formation, joint ventures/collaborations, and licensing.

Peter Dobson, BSc, MA (Oxon), PhD, CPhys, FInst P, Member of the ACS.
Academic Director, Oxford University Begbroke Science Park

After a career as a lecturer in Physics at Imperial College and Senior Principal Scientist at Philips Research laboratories he was appointed to a University Lectureship and College Fellowship at the Queen's College Oxford in 1988 and a Professorship in 1996. At Oxford, he assisted with setting up much of a new joint course of Engineering and Materials Science and his research moved into the areas of nanoparticles,

nanostructures, optoelectronics and biosensors. In 1999 he spun off a company, now called Oxonica plc, that specialises in making nanoparticles for a wide range of applications, ranging from sunscreens to fuel additive catalysts and bio-labels. In 2000, with colleagues in Chemistry and Engineering, he spun off Oxford Biosensors Ltd that makes a hand-held device based on enzyme-functionalised microelectrode arrays. He was appointed to his present position in August 2002 and has the responsibility of setting up new research institutes that will combine University activities with company R&D, and leading a team that facilitates the rapid transfer of technology and knowledge. This has led to him being in demand internationally to advise on Knowledge Transfer. He consults widely and advises several corporate and national organisations on nanotechnology. His research interests are very broad, covering most aspects of nanotechnology, and embracing biotechnology, environmental technology, materials science, especially the applications of polymeric materials, renewable energy and the whole innovation/exploitation process.

Chris Dorman
Coherent

Chris Dorman is a General Manager at Coherent Inc., a global leader in lasers and photonics components. He is responsible for Coherent Scotland, Coherent's facility in Glasgow. He joined Coherent in 2002 as a Product Line Manager and has held various Business Management positions. He has an MA in Physics from Oxford University and a PhD in Lasers and Quantum Physics from Imperial College, London.

Richard Dorward
Ericsson

Richard Dorward holds a Masters degree in Physics from Cambridge University and a post-graduate business diploma from Coventry University. He is a chartered engineer and a Fellow of the Institution of Engineering and Technology. His experience covers over 40 years in the development of digital transmission systems, from 2 Mbit/s PCM systems on twisted pair cable, through systems on coaxial cable, radio and optical fibre, to today's multi-terabit DWDM systems. This has included research, engineering development, system and network design, and the technical management of major contracts, as well as his current role of Photonics Product Strategy Director in Ericsson Broadband Networks.

Helen Goddin, PhD
Photonics KTN

Helen Goddin completed her PhD in electronics packaging at Cambridge University in the Materials Science and Metallurgy department. She now works within the Microtechnology Section at TWI, which is a Hub Partner of the UK Photonics KTN. Helen has special interests in microjoining, reliability and thermal management in electronic and photonic systems.

She is currently contributing to several major photonic and electronic packaging projects, including roadmapping of technologies and products in the photonics field.

Jonathan Harris
Young Company Finance

Jonathan Harris is the publisher and editor of Young Company Finance (YCF), a monthly review of early stage high growth companies in Scotland which focuses particularly on the issues of how to fund growth.

After graduating from Cambridge with a degree in Modern Languages, Jonathan joined Scottish shipping group The Ben Line as a management trainee. After couple of years in the Edinburgh head office and four years in Japan, he joined the offshore drilling division Atlantic Drilling Company Ltd, which managed eight offshore drilling rigs in many locations worldwide, and where he ultimately spent 15 years as director and general manager. During this time he served as chairman of the International Association of Drilling Contractors' North Sea chapter, and on the Industry Advisory Board appointed by the then Minister for Energy.

During the prolonged recession in the offshore industry in the early 1990s, Jonathan left the Ben Line Group and started working with young companies, in various roles including adviser and interim chief executive. He acquired YCF from its founder Gavin Don in November 2000 and now all his activities come under the YCF umbrella. Jonathan has subsequently expanded the business to encompass special reports on specific market sectors (to date Life Sciences, and Digital Entertainment), a very successful annual conference now in its sixth year, and in 2006 a new edition of YCF tracking young companies in the North of England.

Maureen Kinsler
Marks & Clerk

Maureen is a qualified UK and European Patent Attorney with experience of many areas of patent practice, including oppositions before the European Patent Office. She deals with a variety of subject matter, but specialises in telecommunications, computer related inventions and semiconductors. Maureen has direct experience of nano-electronics, MEMs, photonics devices and semiconductor processing, including e-beam lithography, plasma etching and metal deposition.

Maureen has an honours degree in physics and a PhD in semiconductor devices from Glasgow University, and a masters degree in Intellectual Property Law from Queen Mary and Westfield College, University of London.

Bill MacDonald
DuPont Teijin Films

After graduating BSc and PhD in chemistry from the University of St Andrew, Bill Macdonald joined ICI Plastics Division in 1980. He was initially involved in research into advanced materials, primarily liquid crystal polymers, and moved into the Polyester Films Business in the early 1990's. The Films Business was sold to DuPont and Bill MacDonald is currently a Business Research Associate in DuPont Teijin Films (DTF), a 50:50 joint venture between DuPont and Teijin. He is currently actively involved in developing substrates for flexible electronic and PV applications and in understanding the material requirements required for this emerging industry. He has coauthored ca 40 papers, several book chapters and regularly presents on the flexible electronic conference "circuit". He is a Visiting Professor in the Department of Pure and Applied Chemistry, University of Strathclyde.

Nia Roberts
Department for the Economy & Transport for the Welsh Assembly Government

Nia originates from Anglesey, North Wales and studied Physics at the Victoria University of Manchester. After graduating, she joined the European Patent Office in the Netherlands as a Patent Examiner and upon her return to the UK she trained in the Intellectual Property Department of a scientific instrument manufacturer the North West of England, where she qualified as a UK and European Patent Attorney.

In 2004 she joined the Technology and Innovation team of what is now the Welsh Assembly Government as part of a Wales-wide team advising SMEs on Innovation and Intellectual Property issues; assessing technology needs and facilitating solutions and grant support. She is currently concentrating on a project to further develop IP support in Wales.

Nia is a Fellow of the Chartered Institute of Patent Agents (CIPA), a Member of the Institute of Physics and a Chartered Physicist.

Michael Robertson
Centre for Integrated Photonics

Michael Robertson has over 20 years experience in photonic devices for telecommunications. Following a PhD at Durham on cadmium sulphide solar cells, he joined BT Labs working on laser reliability for optical telecommunications. After this, he led a team that developed a high reliability planar PIN photodiode for submarine optical communications and he successfully transferred this to manufacturing at BT&D (later part of Agilent). During this time, he was part of the team at BT that won the Queen's Award for Technology in 1993 for its work on optoelectronic materials and devices.

Since then he has managed research on components for optical fibre systems including expanded mode lasers, semiconductor optical amplifiers, electroabsorption modulators and optical switches. He is currently VP Research programmes within CIP Technologies.

Professor Max Robinson, BSc, MSc, PhD, CEng, FIET.
Kromek

Max Robinson has received degrees in Electronics, Solid State Electronics and Materials Science. He has had industrial experience with English Electric and Ferranti and he has also served as a commissioned officer in the Royal Navy. In 1973 he joined Nottingham Trent University where he formed the Three-dimensional Imaging Research Group. The results of his work have been shown to be of significant commercial potential.

As well as producing a steady stream of academic papers and PhD students, Max is also the author of 12 awarded patents with a further 6 still pending.

In April 2002 a company he founded was floated on the AIM of the London Stock Exchange. He has since acted as a Business Angel to a spin-out venture from the University of Durham's Physics Department. This Company, Kromek, formerly known as Durham Scientific Crystals Ltd, produces semiconductor crystals by a revolutionary new process which has applications in medical imaging, security screening and space exploration. The Company was recently awarded prizes for the NE Technology Company of the year and Innovation Company of the year, by the Journal newspaper. This company is also scheduled to float within the near future.

He was until recently the Enterprise Education Director at Durham University where in 2004 he initiated the first "Blueprint" North East Universities Business Plan Competition.

He is currently a director and consultant for Kromek and he is also an Entrepreneur in Residence at the Universities of Newcastle and Aberdeen

Rob Rule
IP Group plc

As Managing Director of Techtran, Rob is responsible for the day to day running of the Leeds-based business. IP Group bought Techtran, a company set up to commercialise university intellectual property under a long term contract with the University of Leeds, in 2005. Rob joined IP Group from Liverpool Ventures Ltd, an investor in early-stage technology, where he was Business Director. Prior to that, Rob was Group Commercial Director of Micap plc and he also has extensive international blue-chip experience with ICI and DuPont. Rob has a first class degree in Chemical Physics from the University of Bristol, a PhD in Materials Structure from the University of Liverpool and a Business Masters degree from the University of Warwick.

Andrew Whitaker
TWI

Andy Whitaker is Section Manager for Microtechnology at TWI, which is a Hub Partner of the UK Photonics KTN. Andy took a Degree in Metallurgy and Material Science at Oxford University, and subsequently worked in commercial research and development on materials based projects in many market sectors. He has 20yrs experience in the design and manufacture of electronic and photonic products, especially for high reliability applications.

Alastair Wilson
PKTN

Alastair has been involved in UK photonics for over 30 years, operating in both the private and public sectors. He started his career in Barr and Stroud Ltd, Glasgow as a laser physicist and subsequently held positions in project management and marketing.

In 1989 he joined Scottish Enterprise, Scotland's principal economic development agency, and was Head of Optoelectronics for several years. During this time he founded the Scottish Optoelectronics Association and was involved in establishing the Institute of Photonics at the University of Strathclyde. In 2001 he was appointed as Business Development Manager of Compound Semiconductor Technologies Ltd, a foundry for compound semiconductor devices and was a key figure in growing the company's global customer base.

In December 2006, Alastair was appointed to his current position as Director of the Photonics Knowledge Transfer Network.

Sandi Wilson, UK Astronomy Technology Centre

After completing a first degree in Physics at Heriot Watt University, Sandi obtained her MSc in Optoelectronics and Communication Systems from Northumbria University at Newcastle. She worked briefly for Philips Laser Magnetic Storage in the UK before moving to Eindhoven in the Netherlands in 1997 to continue work at the Philips Optical Disc Technology Centre. For the first 4 years she worked on the development and standardisation of the DVD+RW disc and system, gaining expertise in optical recording, test and verification, injection moulding and sputtered thin films. This expertise was put to good use in the following period when she was technically responsible for the DVD+RW pilot production line in Eindhoven and for the transfer of the technology to licensees in other parts of the world. After a time leading the Philips project team responsible for development of the novel, inverse-stack production process for DVD+RW Double Layer she moved sideways into the Masters and Stampers Unit and took on responsibility for the development of robust production processes for the new BluRay Disc stampers, gaining experience with Deep UV mastering

and galvanics processes as well as consolidating her project and people management skills.

Sandi returned to the UK in 2007 to take up a post at the UK Astronomy Technology Centre in Edinburgh where she splits her time between finding new avenues to exploit the technology developed in-house at the UK ATC and working with the Photonics Knowledge Transfer Network on a variety of projects.

Andrew Zadrozny, Starpoint Adaptive Optics

After obtaining a doctorate in infrared astronomy from Imperial College, Andrew Zadrozny worked at several European academic institutions in the general area of high resolution imaging for astronomy. He then moved to Durham University, where he was heavily involved in the development of the adaptive optics systems for the UK's telescopes in the Canary Islands. With initial financial support from a PPARC/Royal Society of Edinburgh Enterprise Fellowship and a DTI SMART award, he started the company Starpoint Adaptive Optics Limited to go after the wide range of opportunities springing up for adaptive optics technologies.