The FUTURE PHOTONICS Hub

Advancing the manufacturing of next-generation light technologies

Annual Report 2016

A future manufacturing research hub

EPSRC Engineering and Physical Sciences Research Council

UNIVERSITY OF Southampton

The University Of Sheffield.

Contents

Vision

Our vision is to transfer new, practical and commercial process technologies to industry, to accelerate the growth of the UK's £12 billion photonics sector and support the £600 billion of UK manufacturing output that depends on this key enabling technology.

The Future Photonics Hub aims to bridge the gap between academic research and product development, uniting the UK's excellent science base with companies, R&D organisations and national funding agencies to co-invest in developing a pathway to manufacture for the next generation of photonics technologies.

Through our Hub, research will respond to the needs of industry to create new photonics materials, devices and components with ease of integration and production at their core. These transformational technologies will enable the UK to maintain a position of leadership in the high-value global photonics market, driving inward investment through innovation.

"Photonics is a major UK strength. We know from experience the astonishing range of innovative ideas that emerge when scientists and engineers think about manufacturing. The key is to work with industry to understand the opportunity, not only to improve existing manufacturing methods, but to develop entirely new ways of making things." Professor Sir David Payne, Future Photonics Hub Director.

Introduction to the Future Photonics Hub

The Hub is a partnership of two leading UK research institutes: the Optoelectronics Research Centre (ORC) at the University of Southampton and the EPSRC National Centre for III-V Technologies at the University of Sheffield. We work with a network of over 40 companies, representing strategic UK industrial sectors ranging from photonics to photonics-enabled industries, such as telecommunications, healthcare, defence and aerospace. Together, our combined expertise and facilities enables us to pursue integrated photonics manufacturing across an unprecedented range of platform technologies hitherto disconnected: optical fibre, III-V semiconductors, silicon, metamaterials and 2D materials.

The Future Photonics Hub supports the rapid commercialisation of emerging technologies by:

1. Leading research in four core photonics Technology Platforms
2. Tackling the Grand Challenge of Integration
3. Collaborating on specific industry-defined projects
4. Stimulating industry-driven manufacturing research through a regular Innovation Fund call

Executive summary

In 2016 we have made great strides in bringing together the photonics community across the UK and beyond.

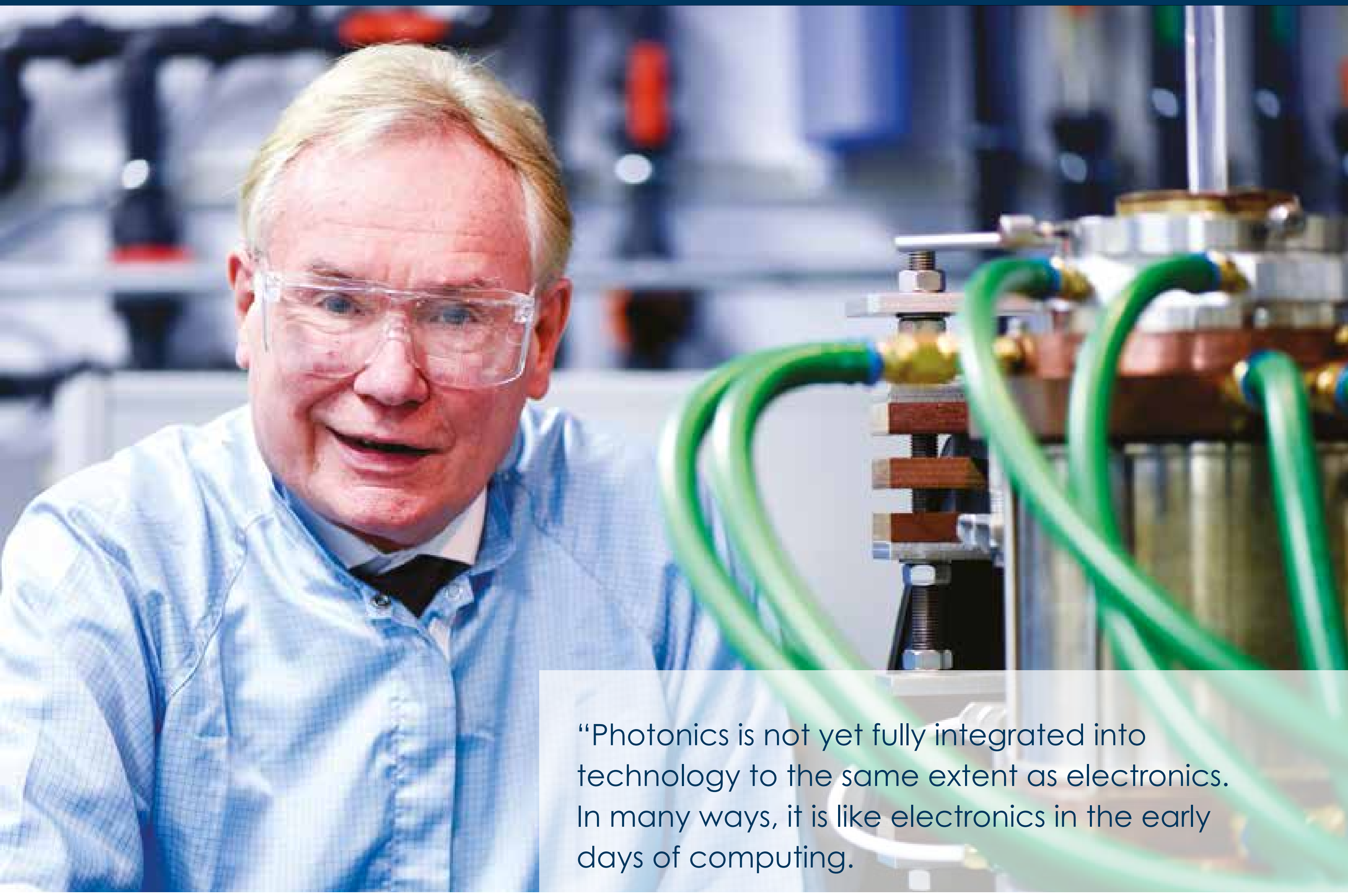
Research across our four Technology Platforms is responding to specific industry needs and we have secured funded projects to a total value of £918k. Since establishing these projects some important outcomes are already beginning to unfold. Examples include:

- A world-first demonstration of guidance at mid-infrared (IR) wavelengths beyond 4 μm for a silica hollow core photonic bandgap fibre and,
- Achieving a five-fold increase in yield for fabricating this high-performance fibre
- Demonstrating a novel Yb-doped fibre optimised for kilowatt (KW) class fibre lasers
- Harnessing conventional fibre manufacturing technologies to fabricate a novel large mode area (LMA) fibre to make high power lasers more efficient
- Fabricating three different types of hollow core fibres for power delivery applications in the near-IR, with world-record low losses
- Developing a breakthrough manufacturing protocol for producing atomically uniform 2D films over an unprecedented wafer-scale area

We have initiated a significant number of collaborations to pursue in 2017, supported by our inaugural Industry Day, held in September with over 125 attendees. £0.25m was also made available to stimulate manufacturing research in the UK academic community through the launch of our Innovation Fund.

Our team has delivered a substantial number of outreach activities, including raising awareness of our capabilities at UK trade shows and exhibitions. These included Farnborough International Airshow 2016 (Hampshire, July) and SPIE Security and Defence Symposium 2016 (Edinburgh, September), as well as sponsoring and participating in a meeting of The Parliamentary and Scientific Committee (PSC) in Westminster (April).

Photonics Hub researchers have also given many oral presentations at major conferences across the world. We are planning to further build our international profile with industry engagement activities at key events including SPIE Photonics West, San Francisco and Laser World of Photonics, Munich.



“Photonics is not yet fully integrated into technology to the same extent as electronics. In many ways, it is like electronics in the early days of computing.

Our next big challenge in photonics is how we make everything smaller, more complex, more functional, and economical.”

Professor Sir David Payne
Director, The Future Photonics Hub
Director, The Optoelectronics
Research Centre, University of Southampton

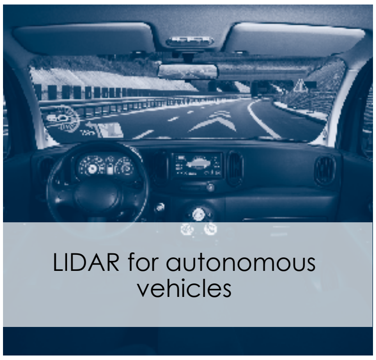
The ultimate enabling technology

Photonics, the science and technology of light, has limitless applications that affect nearly every aspect of our lives. From critical components within our mobile phones, to the physical infrastructure that powers the internet, and industrial lasers used in manufacturing – simply stated, photonics is everywhere.

Enabling key industry sectors

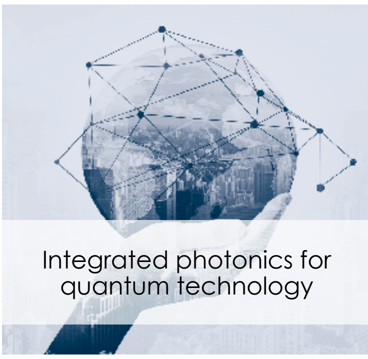
These are just a few examples of the broad applications of photonics technologies:


Harsh environment sensors for oil & gas


LIDAR for autonomous vehicles


Silicon photonics for data centres

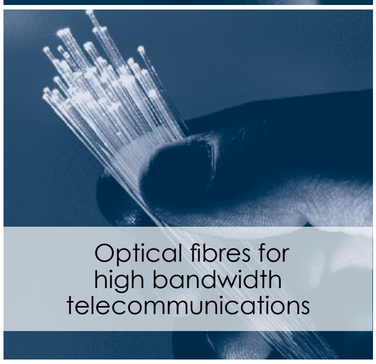

Laser-written diagnostics for healthcare


Integrated photonics for quantum technology


Sensors for security

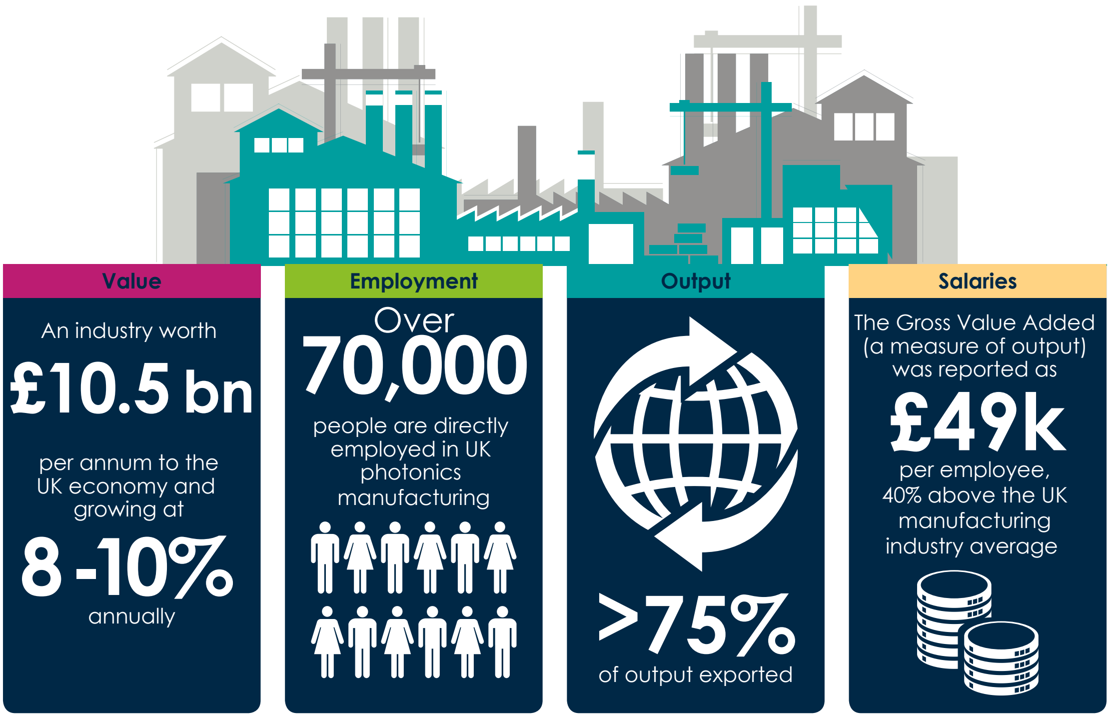

Head-up displays for aviation


High power fibre lasers for manufacturing


Optical fibres for high bandwidth telecommunications

Photonics technologies therefore provide huge potential for growth and innovation. The UK's internationally-renowned research base, spanning all aspects of photonics, has given rise to a globally significant industry which continues to expand at an impressive rate:

UK photonics manufacturing industry



Source: Photonics Leadership Group (PLG), May 2013

With the growth in photonics manufacturing and photonics-enabled industries, now is the time to focus on making next-generation light technologies easier to produce and to embed into products and systems. Our research in photonics manufacturing and integration at this critical stage will enable the UK to secure a significant competitive advantage in what is a £450bn global industry.

Our four core Technology Platforms

Our research targets both new emerging technologies which stand to have the greatest impact on industry, and long-standing challenges in photonics manufacturing which have so far hindered large-scale industrial uptake.

Our aim is to develop the kind of important 'Pervasive Technologies' identified in the UK Foresight report on the future of manufacturing[1], through conducting research in four core Technology Platforms: High-Performance Silica Optical Fibres, Light Generation and Delivery, Silicon Photonics and Large-Scale Manufacture of Metamaterials and 2D Materials.

The key to producing low-cost components and systems is integration. Optical fibres, planar waveguide technologies, metamaterials and III-V semiconductors cannot yet be combined in a cost-efficient integrated manufacturing process. Our direct consultation with over 40 companies, Catapults and Innovative Manufacturing Centres identified a clear business need to reduce the complexity of incorporating next-generation photonics into high-value systems. In response, we have chosen integration as our 'Grand Challenge' and aim to deliver solutions to this industry-wide issue.

Our leading research capabilities

A unique partnership between the Optoelectronics Research Centre (ORC) at the University of Southampton, and the EPSRC National Centre for III-V Technologies at the University of Sheffield, leads the Hub and ensures that photonics innovation is at the core of our work. Some examples of our extensive track record in research and enterprise:

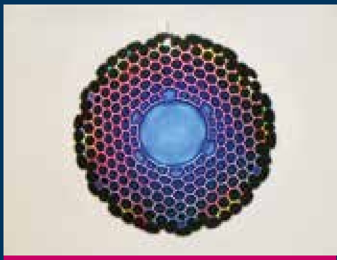
- Our innovations navigate airliners, cut steel, mark iPads, manufacture life-saving medical devices and power the internet
- Our optical fibres, invented and made in Southampton, are on the Moon, Mars and the International Space Station
- Our epitaxial wafers and devices, produced in Sheffield, have enabled world-class semiconductor research in the UK since 1979
- Our combined portfolio of start-ups now exceeds 12 companies
- Our expertise is underpinned by over £200m of state-of-the-art fabrication facilities

1. Foresight (2013). 'The Future of Manufacturing: A new era of opportunity and challenge for the UK Project Report'. Ref: BIS/13/809. The Government Office for Science, London.

Core Technology Platforms

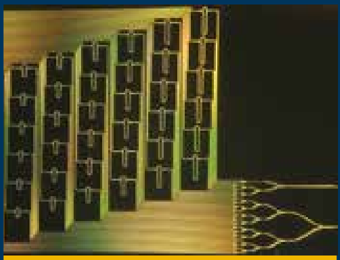
High-Performance Silica Optical Fibres

Optical fibres are essential components in many photonic devices and systems – from the ready transmission and amplification of light to massively-high power levels. The key challenge in fibre manufacture is improving its loss, gain and power handling characteristics.



Light Generation and Delivery

User-driven manufacturing processes will increase integration and the unification of diverse manufacturing platforms in III-V epitaxy, metamaterials, Si-SOI fabrication methods and functional fibre geometries.



Silicon Photonics

Achieving integration with optical fibres, light-sources and key processes of wafer-level manufacturing to enable devices such as low-cost transceivers for data centres and mid-IR sensors.

Large-Scale Manufacture of Metamaterials and 2D Materials

Developing cost-effective, reliable and volume-scalable methods to fabricate these novel materials in order to enable their practical exploitation in applications such as telecommunications, displays and sensors.

Grand Challenge: Integration

Achieving integration is the dominant theme that unites the world's photonics industries. The photonics industry today can be likened to the early days of electronics when individual components were wired together resulting in inevitable cost and scaling implications. Today's photonics components are not yet compatible with a single manufacturing platform and this represents a major industrial challenge.

Platform Performance Report: High-Performance Silica Optical Fibres

Developing an industry-compatible rare earth (RE) doped fibre manufacturing technique

Challenge

Developing a cost-effective and industry-compatible rare earth (RE) doped fibre manufacturing technique, including realising large volumes of doped material with good longitudinal homogeneity.

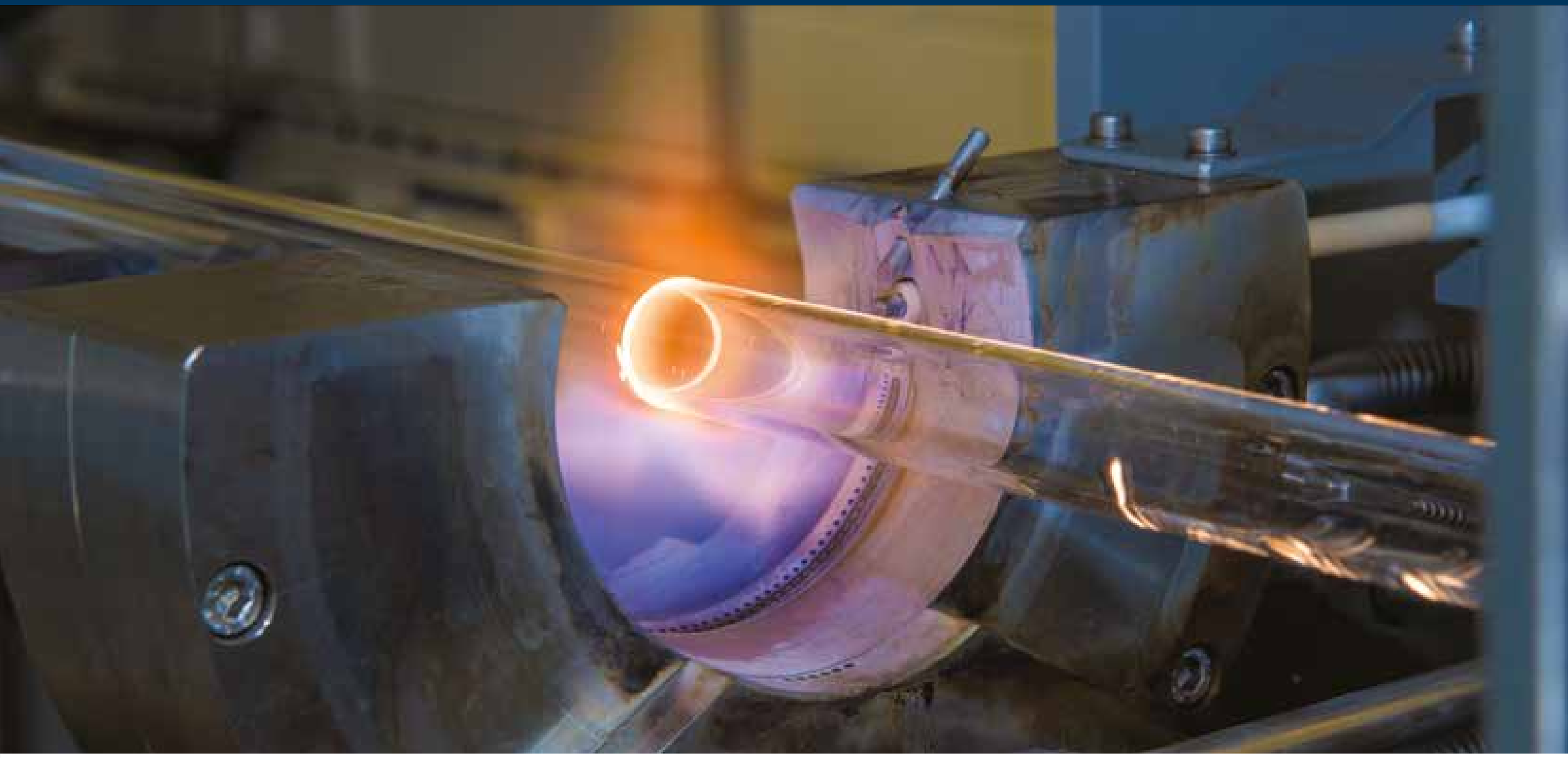
Progress

The focus of our research has been the development of a low-Numerical Aperture (NA) (0.06) ytterbium (Yb)-doped fibre with an optimised glass host for kilowatt-class fibre lasers. Fibre fabrication presents several challenges, which include achieving a low NA with an adequate Yb-concentration, and low photodarkening (PD). Therefore, to meet these requirements, we have targeted a core composition of Yb/Phosphorus (P)/ Aluminium (Al)/Silicon dioxide (SiO2).

Preforms have been realised using a Modified Chemical Vapour Deposition (MCVD) and solution doping technique. We introduced both co-dopants (P and Al) and the Yb through solution doping as opposed to the traditional approach, in which the P is introduced in the silica matrix through gas phase deposition and the Al and Yb through solution doping. Our alternative approach was motivated by increasing the process repeatability, resulting from a more homogeneous distribution of the dopants and achieving fine control of the phosphorous content in the core glass to make it PD.

Using this fabrication technique, we were able to demonstrate several Yb-doped fibres with a low-NA ranging between 0.04 - 0.09 and with different Yb concentrations. In fibres produced to date, we have measured a background loss of 20 - 30 dB/km at 1200 nm. The Yb lifetime of ~ 1.03 ms is consistent with the expectations for this kind of host glass composition. Slope efficiency as high as 81 % has been achieved in Yb-doped alumino-phospho-silicate fibre laser.

We are now pursuing high-yield preform manufacturing based on this host glass and plan to fabricate fibres with dimensions suitable for testing in high power laser applications.



Designing and realising a large-mode area fibre for high-power fibre lasers

Challenge

Design and realise a large mode area (LMA) fibre for improving the performance of high power fibre lasers, including:

- Increasing reliability using low photodarkening fibre (PD)
- Enabling integration and deployment in compact devices through slicing LMA fibres

Progress

Our initial work has focused on Single-Trench-Fibre (STF), a novel LMA fibre design comprising an all-solid fibre structure that can be made using conventional fibre manufacturing technologies. This is a practical approach that we have shown can achieve a large effective area.

The STF design functions were based on the selective loss mechanism of modes for a single-mode operation. The modal properties, including effective mode area of fundamental mode (FM) and the losses of FM and higher order modes (HOMs), have been investigated theoretically by the finite element method.

Experimentally, we have fabricated Er-doped STFs with an ultra-low NA of 0.04 and core diameter up to 60 μm using conventional MCVD and solution doping techniques. Characterisation of these fibres has revealed a remarkable ability on higher-order mode (HOM) suppression. Furthermore, high power tests have shown our 60 μm Er-doped STF to have good laser efficiency (> 45%) at 1.55 μm.

Platform Performance Report:
Light Generation and Delivery

Fabricating HCF for high power laser delivery at 1 μm

Challenge

Fabrication of Hollow Core Fibres (HCF) for high power laser delivery applications in the near-infrared (IR), around 1 μm, the traditional wavelengths used for laser-based manufacturing.

Progress

We have developed three different types of HCFs for power delivery applications in the near-IR, specifically at wavelengths of 1.03/1.064 μm, with a view to carrying out comparative laser power delivery studies.

The fibre types include:
a) Hollow Core Photonic Bandgap Fibres (HC-PBGFs)
b) Kagome fibres
c) Tubular fibres

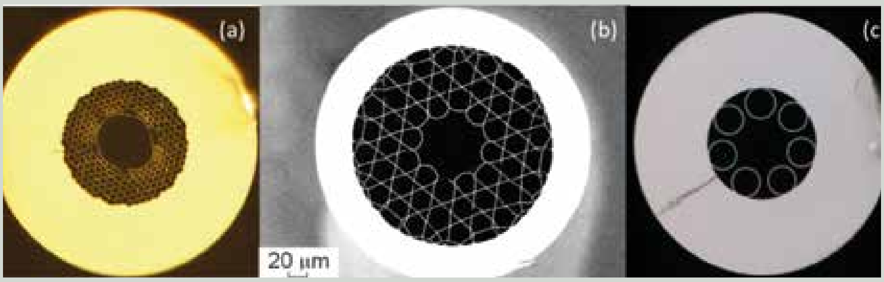


Figure 1: HCF types for near-IR power delivery applications (a) 37-core HC-PBGFs, (b) 19-core Kagome fibre, (c) 7-tube Tubular fibre.

HC-PBGF

We produced a large-core fibre with excellent results, achieving a minimum loss of 12.8dB/km at 1030 nm – a world record in a HC-PBGF for this waveband. The M2 of the output beam was 1.1-1.2 and the fibre was shown to be extremely resilient to macrobending.

Kagome fibre and Tubular fibre

World record loss values were achieved for both fibre types:
- Kagome fibre: 12 dB/km at 1.03 μm
- Tubular fibre: o68 dB/km at 1.03 μm

For both of these fibres, the mode field diameter was approximately twice as large as the HC-PBGF. Due to their larger cores, these fibres were markedly more macrobend-sensitive. We undertook power delivery experiments in all three fibre types, and found that both the Kagome and Tubular fibre were able to deliver the full 500 MW peak power without damage in the fundamental fibre mode.

We demonstrated that by evacuating the fibre and operating with a vacuum core, non-linear effects over longer lengths could be eliminated.

Extending transmission in silica-based HCFs into the mid-IR

Challenge

Achieving robust guidance at these wavelengths, minimising loss, increasing fibre yield and validating the power handling properties of the fibre.

Progress

We developed HC-PBGF and anti-resonant Kagome fibres for the mid-IR, achieving world-leading performance for both fibre types.

HC-PBGFs

The primary challenge in extending HC-PBGFs to the mid-IR was to increase the scale of the structure relative to near-IR fibres whilst simultaneously increasing yield to > 2 km per fibre.

We achieved a 3.6 km draw of fibre that guided at 3.4 μm and a 1.4 km draw of fibre guiding at 4 μm. These results correspond to a five-fold increase in yield relative to previous draws. Further, we reduced loss to as little as 0.4 dB/km at a wavelength of 3.7 μm, 1.4 dB/km at 4 μm and 2.7 dB/km at 4.2 μm.

Kagome fibres

We successfully produced Kagome fibres with losses as low as 10 dB/km at 2.45 μm and 20 dB/km at 3.0 μm and observed transmission all the way out to 4.7 μm, the first ever demonstration of Kagome fibres operating beyond 2 μm.

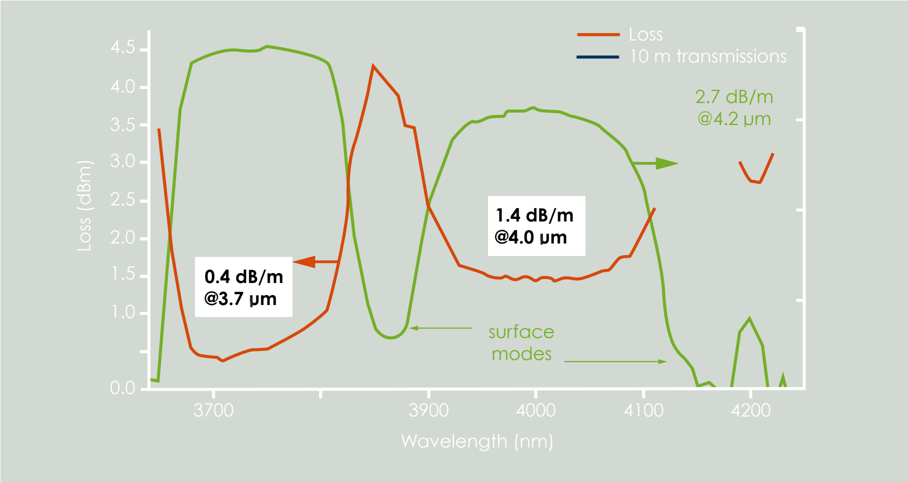


Figure 2: Transmission of Mid-IR HC-PBGF

We are currently exploring potential applications for both HC-PBGF and Kagome fibres in mid-IR gas sensing and will soon be engaging in power delivery experiments, both within the Hub research team and in collaboration with industry partners.

Platform Performance Report: Silicon Photonics

Demonstrating a mid-IR quantum cascade laser (QCL) integrated with Group IV material circuits

Challenge

Demonstrating a mid-IR quantum cascade laser (QCL) integrated with Group-IV material circuits.

Progress

Uniting the University of Sheffield's renowned capabilities in QCL chip fabrication with Southampton's world-leading expertise in mid-IR Group IV photonics has been pivotal to this research.

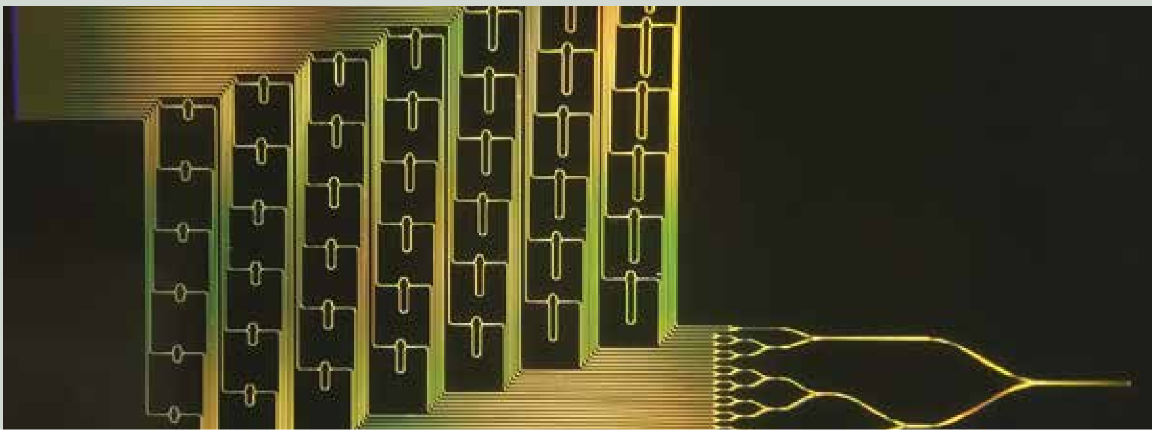
We have designed and simulated Germanium-on-Silicon (GOS) passive devices for transverse magnetic (TM) polarisation at 6 µm, a wavelength selected due to the efficiency and high output powers already demonstrated for existing QCL designs. Single mode waveguides and grating couplers have also been designed, with the grating couplers simulated to have 10% coupling efficiency. In addition, acceptable misalignment losses have been predicted in simulations carried out to design an efficient end-fire coupling structure and to examine its tolerance to misalignment of the QCL chip during bonding, considering the nominal flip-chip bonder tolerance.

To mitigate the risk of working with just one waveguide material platform, we have begun to develop, in parallel, two alternative novel Group IV waveguide material platforms which offer access to wavelengths above 6 µm.

- Suspended silicon - a low risk approach drawing on well-known silicon fabrication processes
- Suspended germanium - expected to be transparent up to 16 µm but requires the development of new fabrication processes

The operating wavelength range of the mid-IR characterisation equipment has been extended accordingly to work at wavelengths > 6 µm, enabling rapid device characterisation and iteration of designs.

Our focus is now to demonstrate and characterise the passive photonic devices separately before integration with the laser.



"Our partnership with the Future Photonics Hub is highly effective and demonstrates the value of relationships between academia and commercial enterprises such as ours. It gives us the ability to combine resources and academic excellence in manufacturing technologies, and focus on the commercial targets of Rockley Photonics."

Dr Andrew Rickman OBE
CEO and Chairman, Rockley Photonics

Case study

Collaboration with Rockley Photonics, a UK start-up company which develops silicon photonics for applications in data-communications.

Aims:
The Future Photonics Hub is supporting two areas of manufacturing-related device research identified by Rockley Photonics as relevant to its commercial targets. Designed to the company's specifications, these include a taper to enable the coupling of light between waveguides, and a coarse wavelength multiplexing component for use in a future application.

Outcomes:
Several waveguide taper design parameters were investigated, and a design produced using a parabolic-shaped taper which met the company's specifications.

By enabling coupling between micron and submicron-sided waveguides, elements with much high-performance in the submicron regime can be integrated into the company's current photonics platform.

A series of designs were produced for a coarse wavelength division multiplexer, using the University of Southampton's patented angled multimode interferometer (MMI) approach which has key advantages for the manufacturing process.

Through the design process, it was established that, achieving all of the company's specifications together using any one platform was unfeasible. Rockley Photonics now has a basis to explore other material platforms.

Platform Performance Report: Large-Scale Manufacture of Metamaterials and 2D Materials

Super-high efficiency, wearable micro-displays utilising Hybrid LED technology

Challenge

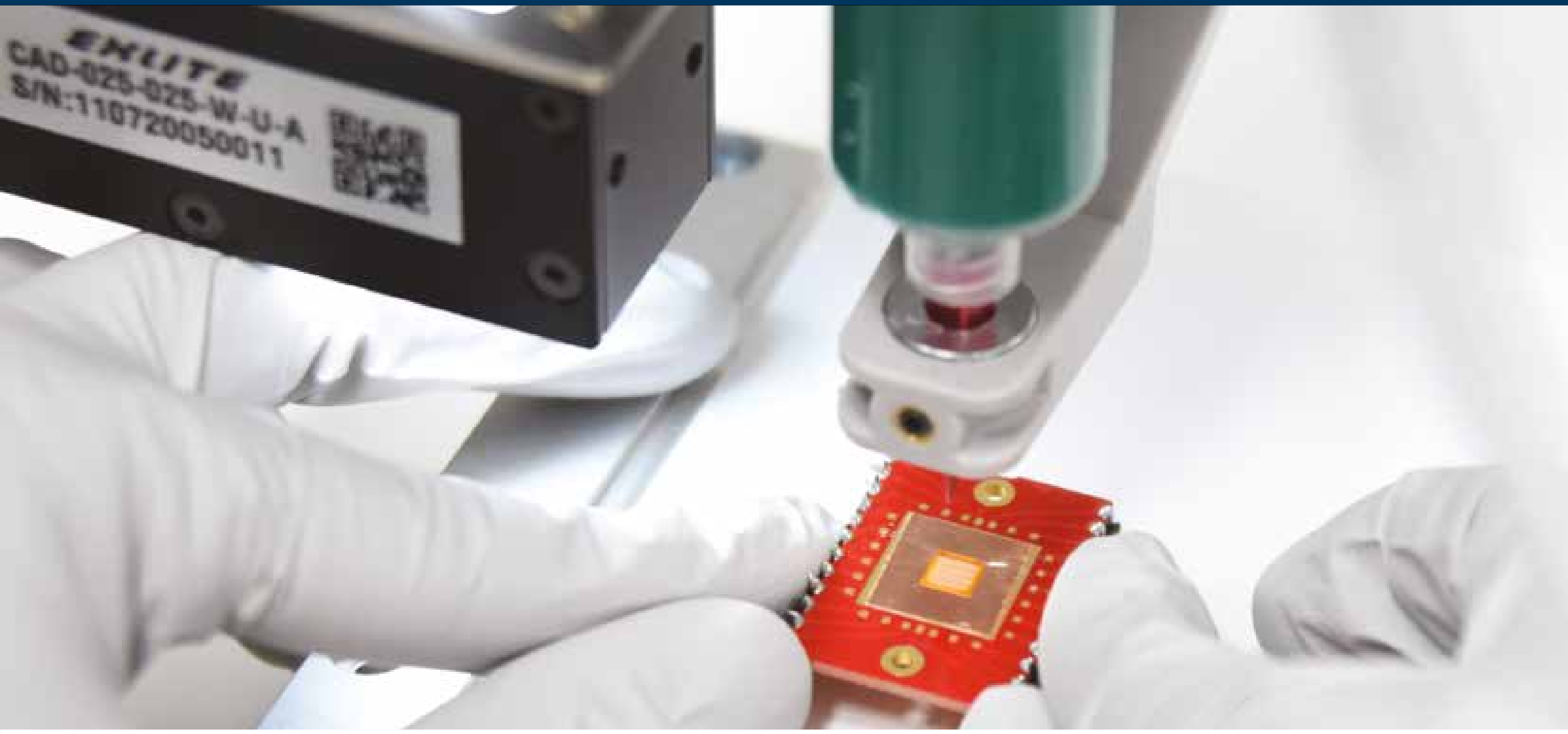
Micro-displays are miniaturised display units, typically smaller than 15mm diagonal with pixels smaller than 5 microns, which have a range of applications in mobile and wearable technologies. For example, micro-displays are being explored by the consumer electronics industry for use in 3D virtual reality systems, wearable head-mounted hands-free information displays as an alternative to smartphone devices, and for aircraft and automotive head-up display units. Current devices rely on organic light-emitting diode (OLED) or conventional liquid-crystal display (LCD) technology and suffer from low efficiency, and poor colour contrast.

Progress

Our research aims to develop a convincing micro-display demonstrator which harnesses our patented, super-efficient Hybrid LED technology, using quantum dots to generate light of any colour from a standard blue LED chip. This technology represents a paradigm shift in efficiency for LEDs, having recorded 123% effective colour conversion efficiency for multi-coloured LEDs [2]. In contrast to a standard LED which uses a simple optical energy transfer mechanism to generate white light, our Hybrid technology employs both optical and electrical energy transfer mechanisms simultaneously and circumvents optical losses, to achieve greater than 100% colour conversion efficiency for a wide range of colours from a single blue LED chip. Devices we have made over the last 12 months are suitable for general lighting applications. The ability to shrink down the size of the LEDs enables us to manufacture high-density arrays of super-high efficiency colour tuneable LEDs and opens up new opportunities in the wearable display market.

During the last year we have bought in £437k investment from a local industry partner to establish a new laboratory for back-end semiconductor processing and printed circuit board (PCB) manufacture. We have already developed wire and ball bonding processes, which have been integrated with manufacturing research being carried out under some of the Hub's other Technology Platforms. Working with partners in the relevant end-user industries, our intention for the next 24 months is to progress the demonstrator system and carry out quality assurance testing including colour quality, lifetime and power consumption, and packaging trials. The development phase will be in close collaboration with our industry partners who will provide custom display driver chips, commercial grade LED materials and access to mass production facilities to complement our own laboratories and cleanrooms.

2. C. Krishnan, M. Brossard, K.-Y. Lee, J.-K. Huang, C.-H. Lin, H.-C. Kuo, M. D. B. Charlton, and P. G. Lagoudakis (2016), 'Hybrid photonic crystal light-emitting diode renders 123% color conversion effective quantum yield', Optica vol. 3 no. 5, pp. 503-509. OSA Publishing. https://doi.org/10.1364/OPTICA.3.000503



Uniform wafer-scale deposition of 2D materials

Challenge

Achieving uniform wafer-scale deposition of 2D materials – a key barrier to large-scale manufacturing.

Progress

Our research has focused on molybdenum disulphide (MoS_2), a new kind of semiconductor and the first material with a 2D geometry to provide the electrical properties of silicon. MoS_2 has exceptional carrier mobility and is widely believed to be a strong contender for the next-generation of electronics, set to supersede the silicon chip as it reaches its fundamental limits. In addition, MoS_2 is an N-type semiconductor, making it suitable for photovoltaics applications.

We have developed a new manufacturing protocol for depositing 2D films of MoS_2 with post-deposition annealing, which has yielded atomically uniform films over a large wafer scale area. This is a world-first for MoS_2, previously only commercially available in small flakes. Furthermore, we have shown our 2D films to have a higher sheet resistance than that measured on flakes. This paves the way for the large-scale manufacture of a wide variety of devices based on this promising new material, including flexible and transparent optoelectronics, gas sensors, memory devices and photovoltaics.

We are currently exploring licensing opportunities with industry and our manufacturing protocol remains unpublished to date as we work on dependent devices for Intellectual Property.

Building capability

We have established a dedicated £1M Innovation Fund to support new avenues of research which arise in response to the evolving demands of industry.

Our dynamic model is achieved through regular thematic calls for proposals which stimulate new industry-focused research partnerships with academia. This ensures that the Hub remains responsive to emerging industrial needs and helps to drive the UK photonics manufacturing ecosystem.

Our first Innovation Fund call was launched in September 2016, seeking proposals to increase the depth and breadth of our existing capabilities within the four Technology Platforms and Grand Challenge of Integration. From 18 applications, four projects were funded to a total value of £225k*:

- Parallel micro-assembly of quantum cascade lasers on germanium, University of Strathclyde
- Manufacturing process of laser fibre depolariser, University of Southampton
- 3D interconnect technologies, Heriot-Watt University
- All-dielectric surface wave devices for light generation with 2D material, University of Bristol

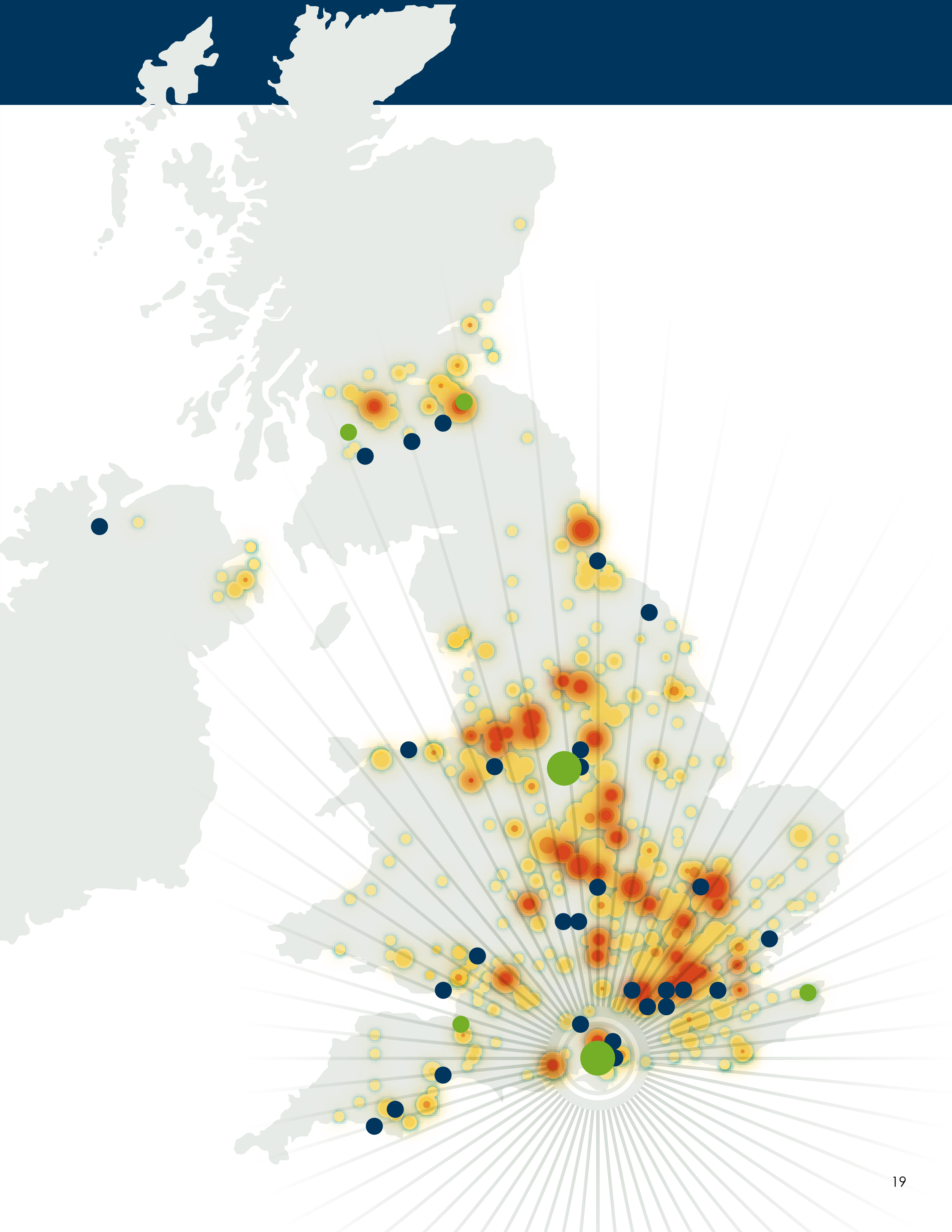
**Grants funded at 80% FEC*

Hub
University of Southampton
University of Sheffield

Innovation Fund partners
Heriot-Watt University
University of Strathclyde
University of Southampton + Phoenix Photonics Ltd
University of Bristol

Industry partners
Our founding UK industry partners

Distribution of UK photonics industry activity



Working with industry

Our first year of operation has focused on delivering both the core research underpinning our four Technology Platforms and also targeting specific applied research projects with industry. These have included collaborations with companies in the photonics supply chain and photonics-enabled sectors such as materials processing, data storage and oil and gas.

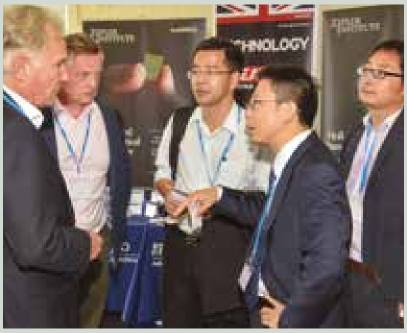
Future Photonics Hub Industry Day

Our first Industry Day held in September 2016 was attended by more than 125 delegates. The day featured a keynote speech by Dr Andrew Rickman OBE, CEO and Chairman of Rockley Photonics, speed networking with the Hub's lead academics and business development team, cleanroom tours and an exhibition attracting over 35 photonics companies.

Our team has also represented the Hub at over 20 conferences, trade shows and network meetings across the UK and six international countries, across four continents.

Events and exhibitions are a key part of our ongoing industrial engagement programme which uses a range of mechanisms, from articles in trade press to bilateral meetings, to connect with companies and prospective partners.



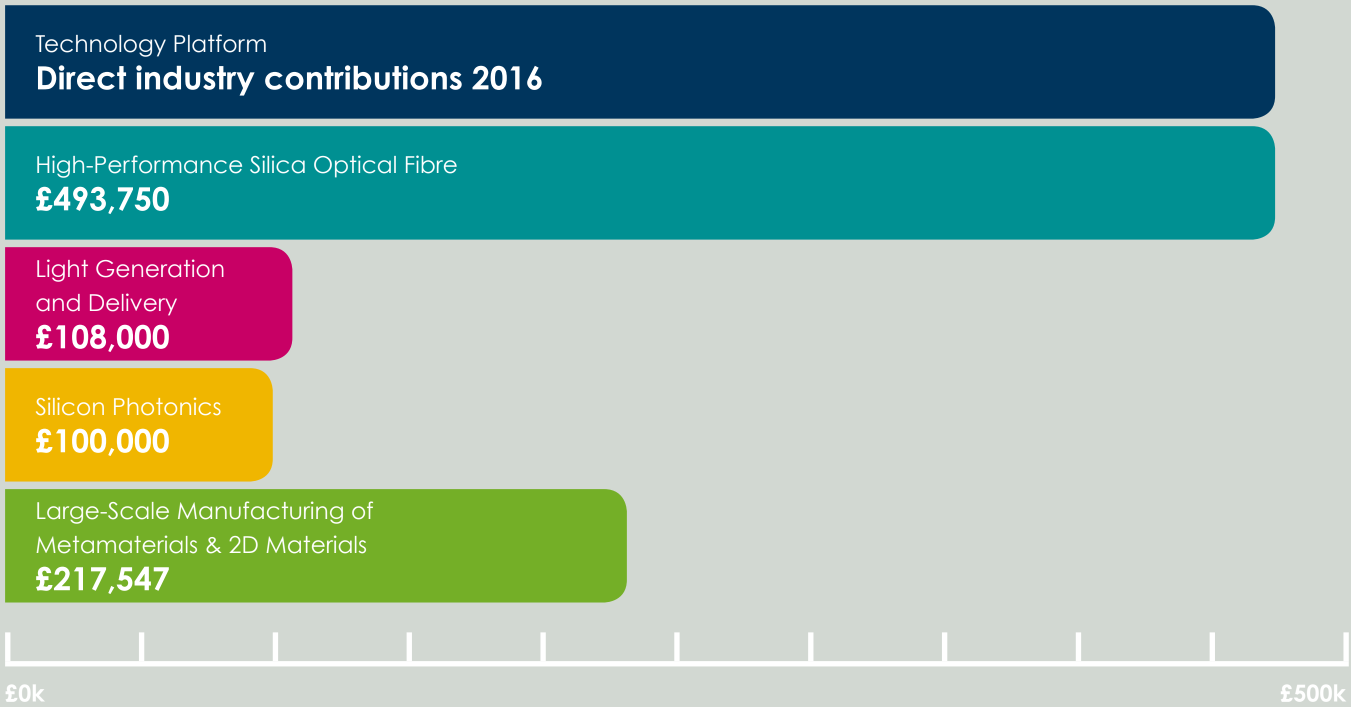



Industry collaborations

We have secured funding in each of our four Technology Platforms in 2016, with industry showing the greatest demand for research collaborations in High-Performance Silica Optical Fibre.

Other collaborative projects have ranged from supplying bespoke materials to industry, through to large-scale research programmes. Such programmes include developing nanophotonic materials for smart data storage applications based on Heat-Assisted Magnetic Recording (HAMR) technology.

Industrial engagement 2016



£900k

new industry collaborations

17

projects over four Technology Platforms

5

industry sectors: sensing, defence, photonics, data comms and storage, and advanced materials

Based on signed contracts from industrial collaborations

Promoting photonics

Communications

We produced an iconic poster promoting UK photonics manufacturing capability as part of the UK Government's GREAT Britain campaign. This campaign showcases the best of the nation and encourages people to visit, do business, invest and study in the UK. It is the government's most ambitious international campaign ever.

Our poster, produced under the GREAT Technology banner, depicted a high power fibre laser cutting the outline of the UK from 5mm stainless steel. The photograph was shot at the Southampton base of SPI Lasers, one of our industry partners and a world-leading manufacturer of fibre lasers, both designed and made in the UK. The photo became the iconic image of the campaign – placing the UK firmly at the centre of photonics manufacturing and was featured across major events and social channels around the world.

We also created our own distinctive brand identity to unify all Hub communications channels and marketing materials. Collateral included a website, printed literature and an exhibition kit for use at trade shows.

All-Party Parliamentary Group on Photonics

Our Industrial Liaison Manager, Dr John Lincoln, was instrumental in the formation of the All-Party Parliamentary Group (APPG) on Photonics. Established in October 2016, the APPG Photonics provides a forum for parliamentarians and industry representatives to discuss the impact of photonics technologies on the UK economy and future economic growth.

Chaired by Carol Monaghan MP, the APPG has a broad scope, spanning the full range of photonics technologies, from lasers and fibres to cameras and lighting. The Group aims to raise awareness of the vital role that photonics plays in key areas such as manufacturing productivity, efficient healthcare delivery and keeping the UK digitally connected and secure.

Image courtesy of SPI Lasers

Photonics for the next generation

Reaching out to the public is an important part of our role in fostering a vibrant, sustainable UK photonics community. Our Outreach and Public Engagement Programme provides the wider context to our work with industrial partners and business, raising awareness of the impact of photonics in shaping the world and our everyday lives, and helping to encourage future generations of UK photonics researchers, technical specialists and industry leaders.

We offer a suite of activities to schools, colleges and members of the general public including providing teaching resources, bringing our interactive 'Lightwave Roadshow' to classrooms, community group meetings and national events and even opening up the doors to our own state-of-the-art cleanrooms as part of the annual British Science Week festival. The programme is delivered by a mix of both our PhD students and academic staff who are experienced in tailoring their specialist knowledge to help different target audiences engage with new concepts.

In 2016 alone, we reached over 5,100 students, teachers and members of the public at over 30 events. Post-event evaluation has shown the positive impact of the programme on participants' knowledge, attitudes and behaviours towards photonics, and four journal papers have been published in the field of education and outreach discussing our work and models of best practice.

It inspired me to learn about my future.

Year 11 student

I enjoyed the practical demonstrations and learning about light reflecting in water and the pros and cons of Morse Code.

Lauren, Year 9 student

The Future Photonics Hub team


Deputy Director and Manager: Professor Gilberto Brambilla, University of Southampton


Business Development Manager: Tom Carr, University of Southampton


Co-Investigator: Professor Martin Charlton, University of Southampton


Coordinator: Ruth Churchill, University of Southampton


Deputy Director: Professor Jon Heffernan, University of Sheffield


Co-Investigator: Professor Dan Hewak, University of Southampton


Public Engagement Leader: Pearl John, University of Southampton


Industrial Liaison Manager: Dr John Lincoln

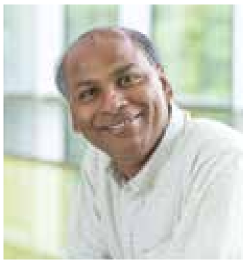

Co-Investigator: Professor Goran Mashanovich, University of Southampton


Principle Investigator and Director: Professor Sir David Payne, University of Southampton

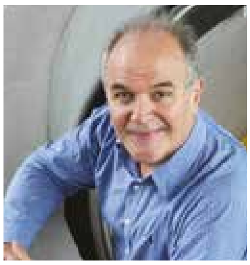

Co-Investigator: Professor Francesco Poletti, University of Southampton


Co-Investigator: Professor Graham Reed, University of Southampton


Co-Investigator: Professor David Richardson, University of Southampton


Co-Investigator: Professor Jayanta Sahu, University of Southampton


Marketing Manager: Rebecca Whitehead, University of Southampton


Co-Investigator: Professor Michalis Zervas, University of Southampton


Co-Investigator: Professor Nikolay Zheludev, University of Southampton

Founding industry partners

- AFE
- AWE
- BAE Systems
- Centre for Process Innovation
- CIP Technologies
- Coherent Scotland
- Dstl
- Electronics and Photonics Centre (EPIC), Torbay
- European Photonics Industry Consortium (EPIC)
- EW simulation Technology
- Fianium
- Fibercore
- Fraunhofer UK
- Gas Analysis and Sensing Group (GASG)
- GE Oil and Gas Sonder Wireline
- Gooch and Housego
- Glass Technology Services
- Han's Laser Technology Industry Group
- Heraeus Quartzglas GmbH & Co. KG
- High-Value Manufacturing Catapult
- II-VI Photonics
- IQE
- IS-Instruments
- Knowledge Transfer Network
- LAND Instruments International
- Lynton Lasers
- M Squared Lasers
- National Physical Laboratory (NPL)
- Oclaro Technologies
- OpTek Systems
- Optocap
- Oxford Instruments Plasma Technology
- Phoenix Photonics
- Plessey Semiconductors
- QinetiQ
- Qiotiq
- Renishaw
- Seagate
- Selex ES
- SG Controls
- Sharp Laboratories of Europe
- SPI Lasers UK
- VLC Photonics
- Xmark Media

Connect

If you are interested in learning more about the Future Photonics Hub, or finding out how we can work with you, please contact us:

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