

XGEN CONSORTIUM PARTNERS



From left to right: Mari Arthur, Roger Carline, Nadeem Rizvi, David Barrow, Robert Hoyle, Steve Davies & Neil Sykes

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What is XGEN?

XGEN was established in April 2007, it's raison d'être being to bridge the gap between industry and micronanotechnology

➤ Set up with support from the Welsh Assembly Government, the group is made up of three complementary elements:

MicroBridge Services Ltd (MSL), a company hosted by Cardiff University's Manufacturing Engineering Centre, is an open access facility for micro and nano engineering and micro fabrication of parts and components for a range of materials. MicroBridge offers new technology to industry and is open to anyone wishing to use the facilities on a commercial open-access basis.

UK-LMC (LML) is a company based in St Asaph's OpTIC Technium focussed on helping industry exploit uses of lasers for product development and manufacturing. It provides flexible, responsive and cost effective services and allows customers to access the latest laser micromachining processes to gain a competitive edge. The highly experienced team at UK-LMC works with a variety of sectors including: Medical, Biotechnology, Microelectronics,

Displays, Sensors, Photonics, Energy and Semiconductors.

metaFAB employs engineering tools at the molecular, nano- & micro-scale to enable product differentiation through a paradigm shift in performance. Innovations from invention through technology convergence for industrial microfluidic, instrumentation, biochip, medical, microreactor and photonic products. At Cardiff University, the multi-disciplinary technology transfer team comprise laboratories and expertise for laser microfabrication, molecular imprinting, microfluidics, microreactor synthesis, cytomics and microwave engineering.

Through the XGEN consortium the three centres offer a host of skills, expertise and state-of-the-art equipment. XGEN offers a pioneering service, enabling businesses, to 'tap into' applications as diverse as medicine, diagnostics, industrial automation, optical telecommunications, aerospace and textiles.



The MANUFACTURING
EXCELLENCE Awards

LML WINS QUALITY AWARD



LML has recently been awarded the prestigious MNT Quality Mark by the IMechE. The MNT Quality Mark recognises companies providing exceptional levels of service and quality in micro- technology sectors and is part of a national scheme run by the IMechE.

'This prestigious award recognises the development and implementation of best practice. The award ceremony will be held in June 2008. The XGEN team wish LML every success as they compete with other top UK manufacturing companies!

See full story on page 6 ➤

Introduction

by **Dr Steve Davies**

Technium Director Welsh Assembly Government

➤ The vision of the Welsh Assembly is of a vibrant Welsh economy delivering strong and sustainable economic growth. The approach for realising this vision is built around Wales' core strengths, including, an increasingly skilled, innovative and entrepreneurial workforce and an advanced technology and knowledge base.

It has been recognised both by the WAG and the UK Government the depth of expertise that exists in Wales in MNT (Micronanotechnology). This expertise has recently been highlighted by the D.T.I. funding of 3 open access MNT facilities in

Wales. With only 20 centres throughout the UK it represents a significant resource capability within Wales.

With the help of the WAG the 3 centres are being marketed collectively under the XGEN brand, to help them exploit their expertise and hence become sustainable commercial entities. MNT is recognised as a strategic enabling technology for modern industry.

MNT has the potential to greatly improve productivity manufacturing thereby making companies more competitive. The objective is to capitalise on the commercialisation

DR STEVE DAVIES



of the combined expertise and resources, establishing an international profile for XGEN and to support further inward investment in Wales for related specialised technology-based businesses.

MICROENGINEERING

High-resolution precision microengineering of Fluoropolymers, Fused Silica, Quartz, Sapphire, and PEEK is now possible thanks to unique new service.



➤ The first UK commercial service for Laser Micromachining at 157nm has been launched. This service enables companies, around the world, to fabricate microscale features with a high-resolution (Ra ~2nm) finish in parts made from materials that are traditionally difficult to machine.

These materials include Fluoropolymers (PTFE, Teflon AF), Fused silica, Quartz, Sapphire, PEEK and others. Such materials are used for industrial microfluidic, instrumentation, biochip, medical, micro-reactor and photonic products, where resilient or UV-transmissive materials are needed. The Xtreme Laser Facility service has opened at the metaFAB micro- & nano-engineering innovation and technology transfer enterprise within Cardiff University

School of Engineering. The facility also accommodates high-power, high-resolution equipment for creating miniature and microscale structures in literally any material ranging from biopolymers to diamond.

This new open-access industry facility uses an extremely short-pulse, femtosecond laser which does not cause any significant thermal heating to the materials machined. Features sizes of ~2microns in any material are possible.

Industries as diverse as instrumentation, tooling, MEMS and medical implants are finding that their products can be differentiated by exploiting this new capability. For example, Q Chip Ltd. www.q-chip.com is a leading developer of advanced microsphere based products for life science industries including analytics and drug-delivery vehicles. Q Chip uses microfluidic architectures to create monodispersed, linear micro-emulsions for the synthesis of polymeric microsphere products.

The metaFAB Xtreme Laser Facility enabled Q Chip to use higher-resolution Teflon-based microfluidic manifolds in its production MicroPlant™ for the manufacture of smaller microspheres. Dr. Dan Palmer, Drug-Delivery Programme Manager for Q Chip, commented that

“the flexibility of the metaFAB Laser Facility enabled us to make rapid progress on custom chip fabrication. AutoCAD compatibility, and fast uncomplicated job setup enabled the rapid production of fully functional microfluidic chips through a small number of iterative optimisation steps”.

The facility also accommodates high-power, high-resolution femtosecond laser for creating miniature and microscale structures in literally any material ranging from biopolymers to diamond without thermal damage. Features sizes of ~2microns in any material are possible. Industries as diverse as instrumentation, tooling, MEMS and medical implants are finding that their products can be differentiated by exploiting this new capability.

Miniature gear components from sapphire, silicon, alumina & steel machined using a short-pulse, femtosecond laser.



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MicroBridge Angling for Success

Earlier this year Brecon based company BVG Airflo were faced with a problem, how to meet rapidly rising demand for their new patented Ridge Line® fly fishing line.

➤ The commercial success of the Ridge Line is due to the application of micro technology. The Ridge Line is a unique fishing line, which enables anglers to cast further with greater control, ease and accuracy.

The previously manufactured flyline was well accepted in the angling world but was up against stiff competition from other well known brands. In order to move ahead of the game and penetrate new world markets, BVG Airflo recognised they needed a world-beater fly line.

Given that Flyline manufacture is a complex extrusion process as not only are there three or more different layers in a typical dry-flyline, but the line manufactured by BVG Airflo contains 'slippery' materials in the surface layer to reduce drag as the line passes through the rod rings; the solution needed to be driven by the new technology available.

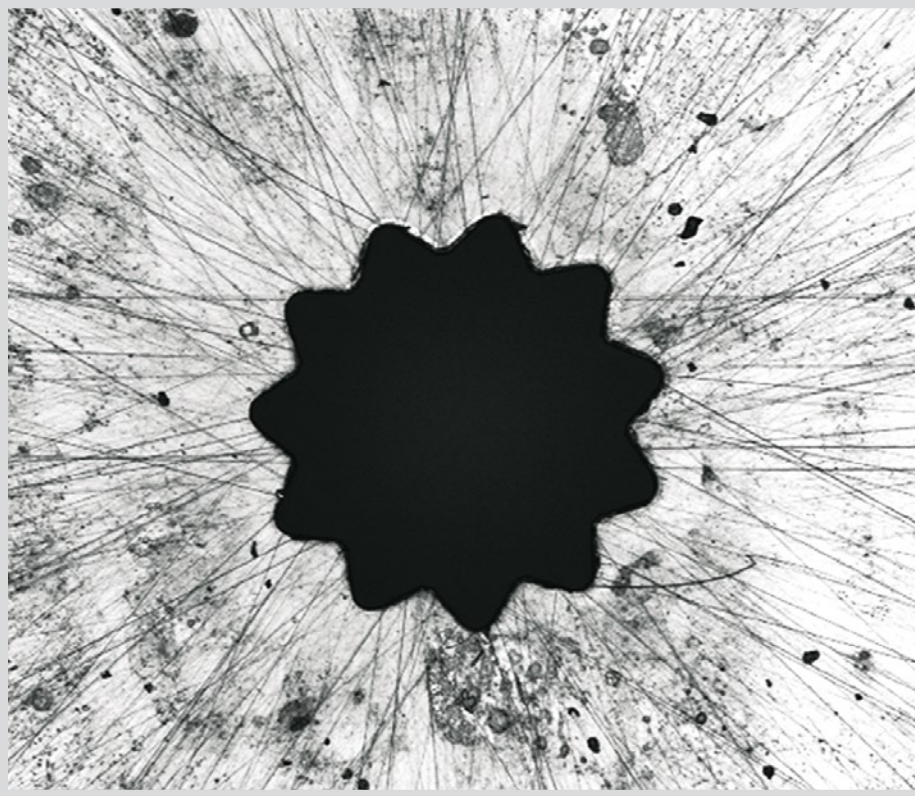
The line is round in cross-section but of different diameter depending on the position along the length of line. This change of diameter is designed to create

tapers so that the middle of the line is usually of bigger diameter than the ends of the line.

A typical extrusion die would be tapered internally with the smallest diameter at the extrusion point, with a diameter anywhere between 0.5mm and 3mm depending on the weight of line. While such precision dies are not easy to manufacture, they are available commercially. The inspiration that gave

Story continued overleaf ➤

FLY LINE DIE



The initial attempt at creating ridges was not successful, “We realised that to manufacture line with such a profile was going to require specially produced extrusion dies”

BVG Airflo a technical advantage over their competitors came from Formula One motor racing.

Typically, wet weather tyres are ridged around the circumference of the tyre and it was this that sparked the idea to create ridges on the surface of the flyline.

The original thought was that the ridges might reduce the friction of the line in the rod rings by reducing the surface contact area. While this might be true, the ridges gave unexpected benefits which set the product apart from other manufacturers' lines.

The initial attempt at creating ridges was not successful, “We realised that to manufacture a line with such a profile was going to require specially produced extrusion dies” said Richard Wothers, Production Director of BVG Airflo “and from our experience of working with MicroBridge Services Ltd on a previous project we knew they had the required expertise and equipment”.

The method used by MicroBridge to machine the extrusion dies was micro wire Electro Discharge Machining (EDM). EDM is a thermal process with the material removal mechanism being by spark erosion and is ideal for metals and certain other

conductive materials. The ridges help the lines glide more efficiently through the air just as dimples on golf balls improve performance. The resulting extruded Ridge Line flyline is seen below, which is a scanning electron microscope (SEM) image of the line.

The diameter of the line in the image is about 1.4mm and the ridges can be clearly seen running down the length of the line. Thrilled with the outcome, Richard Wothers said, “The multiple ridges running the length of the line certainly make a dramatic difference in the way the line casts.

The patent application is now in place to allow us to retain this performance edge. I have been extremely impressed by how MicroBridge have taken the idea and, through their skill and expertise, helped us turn it into a finished product”.

This product has been a huge success for BVG and since its launch a few years ago; sales have grown consistently at 23% per annum. More importantly, the Ridgeline has allowed BVG Airflo to penetrate the Japanese and North American markets which they were previously unable to do as the existing products were not sufficiently well differentiated.

Micro wire EDM machining offers an excellent way of machining micro structures for many different applications from medical devices, drug delivery and diagnostic, micro injection mould tool making and many other applications.

The market for micro and nano structured products is projected to grow hugely in the next decade and companies that are able to grasp the potential of micro engineering and make it happen in their products will gain competitive advantage over their competitors. The challenge for UK product designers and manufactures is to identify where advances can be made using micro before the rest of the world does. MicroBridge is part of the XGEN consortium.

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PAY-AS-YOU-GO

Nikon Microscopy Suite For Small Businesses

➤ A non-contact video measurement microscopy facility has been opened for industry to quality control small engineered parts.

The state-of-the-art Nikon non contact video measurement system (iNEXIV) has been installed at Cardiff University enabling businesses to have direct hands-on access to a new microscope tool that is ideally suited for automated quality control of small engineered parts.

The Nikon-XGEN Microscopy Suite also accommodates several other microscopes, covering a variety of length scales and all fitted with integrated digital image capture capability.

In particular the suite includes a high resolution x-y-z measurement microscope fitted with dark-field, light-field, differential interference contrast, fluorescence, still and movie capture.

The suite serves as a regional customer demonstrator site for Nikon in Wales and enables businesses to use equipment

on a pay-for-use basis. The microscopy suite has been located at the metaFAB micro- & nano-engineering innovation and technology transfer enterprise within Cardiff University School of Engineering. The metrology suite has been specified to improve the metaFAB laser micromachining service to industry, in the fields healthcare, medicine, instrumentation, printing and aeronautics.

metaFAB's, open-access enables smaller businesses to use equipment like the microscopy suite on a pay-for-use basis. The XGEN Microscopy Suite will also act as a regional demonstrator site for Nikon in Wales.

According to David Barrow, Professor of Microsystems Technology at Cardiff University, "We considered video-based measuring systems from several companies before opting for the Nikon product because it combined both the 3D measuring performance we required with the high spec optical system we needed to view our samples and capture digital images.

"We were also impressed by the extended range of measuring and inspection products, put together in a very cost-effective package which allowed us to equip an entire imaging suite.

This will not only help us improve our research, and enable high-tech companies in the region to advance their capabilities but also extends our portfolio of companies locating demonstrator equipment at metaFAB."

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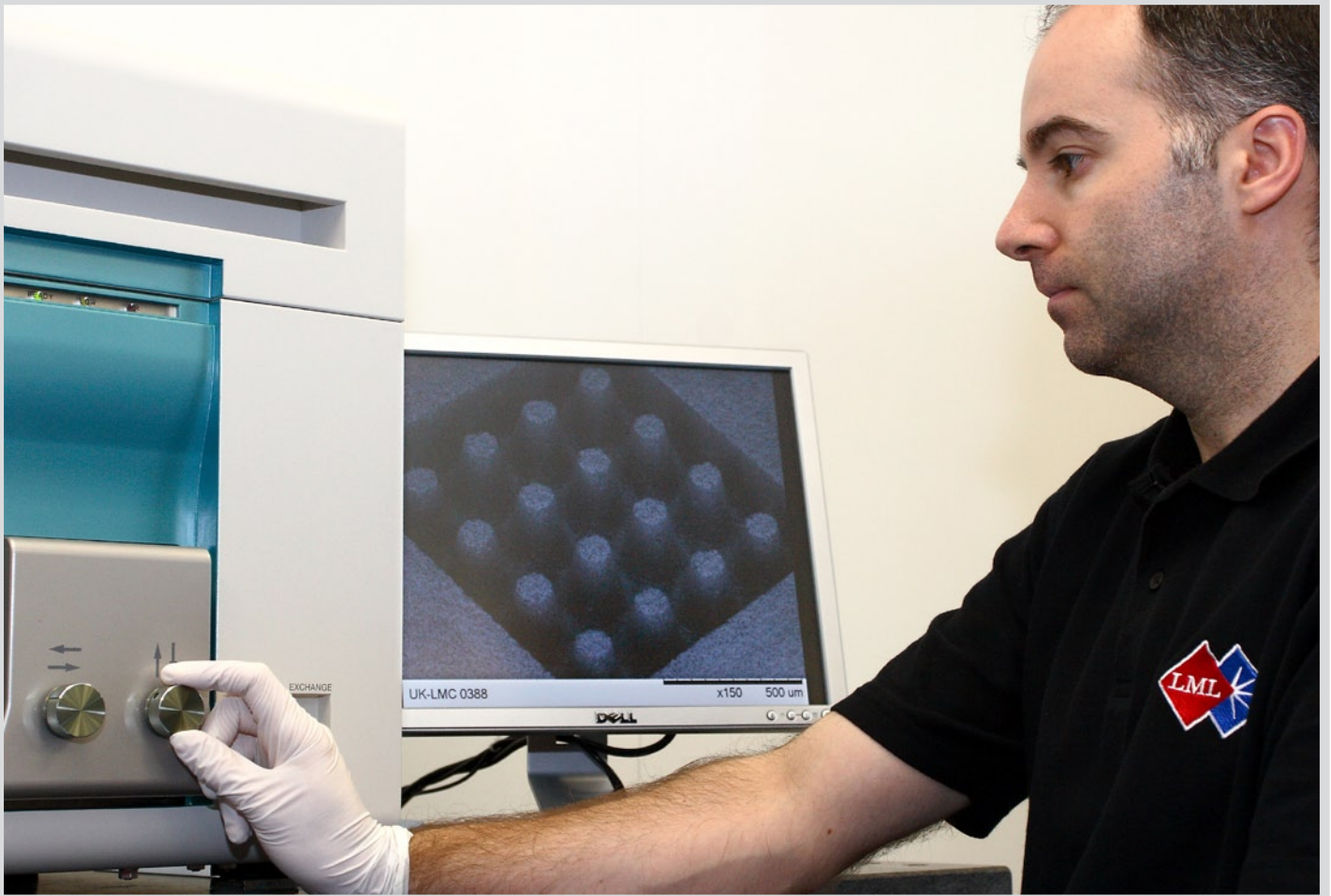
Web: www.metafab.net



Laser Micromachining Limited

A Small Company Perspective

ANALYSING A LASER-PRODUCED MICROSTRUCTURE



“After more than two years of successful operation it is clear that we have done many things right”

➤ **Laser Micromachining Limited (LML)** is a small company which has been providing high quality manufacturing services to industry for over two years. It recently expanded its operations and moved to the impressive OpTIC Technium in St. Asaph, North Wales. LML operates the UK Laser Micromachining Centre (UK-LMC), which is the nationally recognised centre of excellence for laser micromachining in the UK.

The company currently has four employees and a wide range of state-of-the-art laser tools which, together with in-house diagnostic and metrology equipment, allows customers to receive a comprehensive microfabrication service from LML.

Dr. Nadeem Rizvi, General Manager of LML, provides an informal view of the company below.

The original aim of LML was simple: To provide high precision laser manufacturing services to industry in a responsive, flexible and cost-effective manner. This still remains our mission today and such services are more in demand now than they were when we started.

After more than two years of successful operation it is clear that we have done many things right, but as always, there are things which hindsight shows us could have been done differently. However, the

success of the company has been primarily due to two things - hard work and attention to detail. These two things contain the essence of our success in what we set out to achieve and they both continue to be the main elements which drive us forward. Many of the lessons we have learned along the way are quite simple and obvious, but only once they have been recognised.

Often the learning curve can be more difficult than you imagine and even obvious things can be difficult to establish. Our ethos is simple and some of the 'Do's' and 'Don'ts' we try to ensure are:

Do respond quickly and precisely to customers, even if it is only to say 'no'. A good impression is invaluable, even if you can't help them right now.

Do keep up to date with technology. We are, after all, providing a leading-edge service and it is vital to have, and to be aware of, the latest developments.

Do deliver what you promise. If delivery is a problem then inform the customer it is rare that someone will complain after being kept informed, but not being told about delays is guaranteed to cause problems.

Do offer the same attention to detail to all customers, large or small. We approach all jobs in the same way and everybody gets the same attention to detail, irrespective of the size of the company or the size of the job.

Do maintain high standards of quality & service - ensure that each customer feels they are getting real value for money and always check that they are satisfied with what you provide. A happy customer will never refuse to pay.

“By its very nature working in new technologies is unpredictable and that is one point which has to be kept in mind.”

Don't chase what others do, concentrate on your own strengths. This is especially important for a small company like LML because you can't do everything, hence choose carefully what you wish to achieve and concentrate on being the best at that.

Don't lose control: of the finances 'cashflow is king' is still the most important lesson for small businesses. No matter how good your technology or product, you have to survive long enough to make it work.

The above points will be obvious to most readers but it is amazing how many can be overlooked or sidelined in the hectic times we can all have. One of the biggest pressures on small companies is time,

SETTING UP A LASER



with so few people everyone has to pitch in to do most things in the business and this can take a heavy toll on how much time people have (or how hard/long they have to work).

Everyone 'pitching in' has the benefit that all the people are aware of most of the things going on in the company, but the downside is that if this is not effectively managed, then people's time can be taken up by things which are not the highest priority.

Having clearly defined tasks for everyone can have a large beneficial impact when organising how the business runs. The single word which best describes our daily work-life is 'varied'. There is never

a day where something unplanned does not turn up, whether it be in terms of new requests which we receive or where we do something different with one of our laser tools. It may be overstretching the point to say that we deliberately set out to have such a varied existence, but we have definitely learned to embrace the variety and turn it to our best advantage.

One of our USPs is fast turnaround on jobs for industry - typically, jobs for the majority of customers are completed within 1 week and this means that a lot of our work is short (1-2 day) contracts. Hence our success depends a lot on continually turning over lots of jobs quickly and effectively. This has to be factored in to how people's time is organised and R&D and 'blue sky' work (which are also important) have to be fitted in carefully.

Recently we have moved into larger premises as the company has grown and although the new laboratories/offices are much better suited to the company's needs, the transition period has been difficult.

Being a small company has meant that we have had to maintain our customer work while simultaneously moving equipment and re-fitting the new premises. Everyone has had to be even more flexible during this time.

We are mostly over this disruptive phase now, four months after moving in, although it will take another couple of months before all the refit work is completed. After that time, however, our business should be on a far better footing and should allow us to strengthen our offering even more over the next two years. By its very nature working in new technologies is unpredictable and that is one point which has to be kept in

OPTIC TECHNOLOGY CENTRE



mind. We have shown that small companies can make an impact and be successful if this willingness to adapt to unpredictability is combined with sound business methods. The challenge remains of making this business model work for us in the future but the signs are very encouraging:

It appears that demand for micro and nanotechnologies is steadily increasing and LML is well placed to build on its current position. I personally believe that you have to be confident of your own strengths and strive to use them to your best ability without getting distracted by others. There is a very wide playing field out there and there is space for many companies to prosper so you can work together with others for mutual benefit.

After all, the more companies that can succeed, the better for us all in the long-term.

2008 EVENTS



COME AND SEE US

XGEN will be attending many conferences and events in 2008. Recent planned events include:

13-14 February 2008

MedTec // NEC, Birmingham
UK exhibition and conference for Medical Device Manufacturing industry

13 - 15 February 2008

UK@Nanotech
Tokyo Big Sight exhibition centre,
in downtown Tokyo
International Nanotechnology Exhibition
& Conference

www.xgen.org.uk

The Team



WWW.XGEN.ORG.UK

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DR. NADEEM RIZVI



UK-LMC
UK Laser
Micromachining
Centre

➤ **UK-LMC is unique within the UK.** Established in 2005 as part of the UK MNT Network, it's a one-stop resource for any organization's microfabrication requirements.

Based in St Asaph, its role is to work with clients to identify the right manufacturing solution and provide the best and most cost-effective solutions. Its highly experienced staff and state of the art laser micromachining workstations, **UK-LMC** itself offers a complete laser processing service for precision, micro and nano-technology industries.

UK-LMC (LML) is geared directly to the needs of industry – regardless of the size and scope of the project or company. It offers offering rapid turnarounds with ultra-reliability on deadlines. The average job turnaround time is now just four days with 45% of jobs completed in only one working day.

Laser micromachining offers distinct advantages over conventional micro-machining processes and the range of applications are huge and growing as the technology advances and companies look to gain a competitive advantage by refining their products' performance.

UK-LMC offers access to the very latest laser micromachining equipment and expertise for: evaluation trials; applications developments; prototype and small batch production; route to manufacture.

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DR. ROBERT HOYLE



**MicroBridge
Services Ltd**
Between Engineering
And The Future

➤ **MicroBridge Services Ltd** is a company hosted by Cardiff's University's Manufacturing Engineering Centre (MEC), to assist businesses into new miniaturisation processes previously not commercially available for non-silicon materials.

MicroBridge is developing the capability of micro-machining steels and other metals, ceramics, glass, polymers and other exotic materials. This, coupled with polymer microreplication technologies, allows MSL to offer an open-access service to UK industry – a service which is already being used by a wide range of companies, from global down to local SMEs. Clients have already seen product performances enhanced – increasing their sales value and improving profit margins.

MicroBridge is – literally – the connecting bridge between engineering businesses and their future. MSL has one of the best-equipped engineering facilities in the UK, and **MicroBridge** is the door to businesses using these resources.

By tapping into the **MicroBridge** resource, design engineers can look to create levels of functionality, product performance and appearance not previously available. The bottom line for the businesses **MicroBridge** works with is just that: a better bottom line.



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PROF. DAVID BARROW



metaFAB
Convergent
Multidisciplinary
MicroNanoTechnology

➤ **metaFAB** provides the opportunity to participate where disciplines converge as micro- and nano-technology. Based at Cardiff University, direct access is enabled to groundbreaking, industry-facing research undertaken between laboratories in Engineering, Pharmacy, Chemistry and Biology.

One key enabling capability is the industrial Xtreme Laser Facility. This enables, fast microstructured prototyping for industrial microfluidic, instrumentation, biochip, medical, microreactor and photonic products, using its unique 157nm and femtosecond lasers. As a micro- & nano-engineering innovation and technology transfer enterprise, **metaFAB** has close links with many supply chain partners and research organisations around the world, keeping it up to speed on new developments and opportunities – as they happen. **metaFAB** is there to provide industry with: (1) Direct hands-on access to tools for micronanotechnology; (2) Awareness, apprenticeship, and technical training; (3) Commercialisation; (4) Proof of principle hardware demonstrators; (5) Collaborative and contract research; (6) Brainstorming new product introduction activities.

metaFAB acts as a single stop resource, whether you are looking for assistance to design, fabricate or integrate nano- or micro- technology into your products or processes.



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