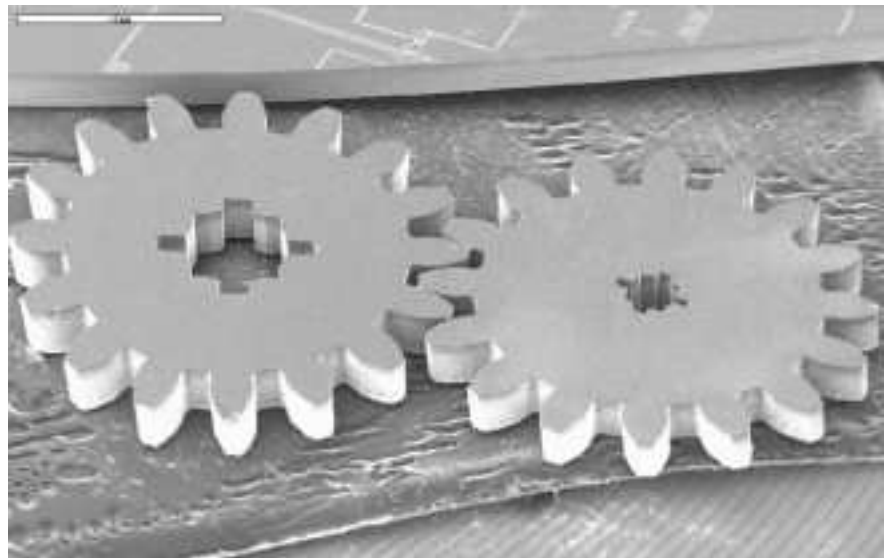


Network for a smaller world

What is the UK's Micro and Nano Technology (MNT) Network set up to do? How is MNT touching UK manufacturing now? Who should be interested? Andrew Allcock finds some answers

Speaking at a Micro and Nano Technology (MNT) Network press presentation last year, Professor Hugh Clare, director of the Network, said that when it was set up in January 2004 (see box item, page 25), a number of key markets in the UK were identified as relevant – Healthcare and biotechnology; Automotive and aerospace; Information and communications technologies; Food and drink; Advanced manufacturing; Advanced materials; Energy; Security; and Environment.

It is important to understand, Professor Clare said, that some of the MNT technology that the aerospace sector, for example, is using actually had its birth in other areas, particularly medical, and in measuring and sensing devices. So infra-red thermography used in aircraft monitoring was first



Micro-fabricated cogs – the scale bar reads 2 mm, so the parts are some 4 mm in diameter. Such parts are features of Micro Electronic Mechanical Systems (MEMS). MEMS have revolutionised the designs of gyroscopes, for example – see page 27

Awareness packs

The MNT Network has published a number of awareness packs. To date these include:

- Wind power
- Marine industry
- Clothes and textiles
- Food & packaging industry
- Aerospace industry
- Speciality chemicals
- Medical devices and products

These can be downloaded from www.mntnetwork.com

developed for application in medicine. “The reason is that, in this case, the medical field can bear the entry costs better than others,” explained the MNT director. So, the message is, even technologies which at first appear in other fields and that have other initial purposes will migrate into other applications.

Professor Clare instanced the aerospace sector specifically because the event saw the launch of the Aerospace MNT Awareness Pack (see box item, left).

CURRENT MNT USES

Dr Ayman El-Fataty of BAE Systems highlighted current uses of MNT in aerospace. These include self-cleaning coatings, abrasion resistance and de-

icing to support improved aerodynamics, lighter and stronger materials to support better fuel efficiency, fuel additives to give longer range and reduce emissions, plus pressure retention in tyres, stronger tyres, easy clean upholstery and improved sealants.

A specific aerospace example he gave was the use of nano-particles within composite materials – many properties were improved in a like-for-like weight situation, he said. And in the area of turbine blades, coatings will allow higher operating temperatures which translates into higher efficiencies and lower emissions.

Dr El-Fataty also leads a NATO working group on MNT for defence and self-cleaning material have particular

uses here, in terms of anti-odour, anti-bacterial and thermodynamic properties. The military sphere is another area which can bear the cost of developing novel technologies, of course.

There is increasing research and development activity in the area of MNT. Indeed, the European Communities' FP7 research programme (started January this year and running for seven years)

What is the Micro and Nano Technology Network?

In July 2003, the then Science and Innovation Minister, Lord Sainsbury, announced £90 million over the next six years to help industry harness the commercial opportunities offered by nanotechnology. Within this, the DTI has allocated £50 million for an applied research programme that will support collaborative research and development projects and technology transfer initiatives, and £40 million for Capital Projects for a UK Micro and Nanotechnology Network.

The MNT Network is supported by the DTI, Regional Development Agencies and devolved administrations in Scotland, Wales and Northern Ireland. It is funding Centres of Excellence throughout the UK with the aim of accelerating the commercialisation of MNT to benefit the UK economy; developing a critical mass of capabilities; providing an open access on equitable commercial terms to microsystems and nanotechnology platforms and associated knowledge.

The Network is a community of UK organisations involved in the creation of value from MNT.

Current Centres of Excellence (capital projects) include:

UK-LMC (Bangor University) – Laser Micromachining

UK Laser Micromachining Centre provides open access, high quality laser micromachining services to industry and research. The main aim of the UK-LMC is to help promote the use of laser microfabrication capabilities by the provision of state-of-the-art services in a flexible, accessible and cost effective manner.

CEMMNT – Characterisation and Metrology Network

CEMMNT will deliver vital measurement solutions and advice built on the knowledge base of NPL, QinetiQ, Taylor Hobson, the SEIC, Coventor and GE Druck, supported by a co-ordinated metrology capability that is commercially focused, and openly accessible.

MetaFAB – Extreme Laser Machining, Microfab Facilities and Centre for Magnetics (Cardiff University)

MetaFAB offers innovative, high level solutions based MicroNanoTechnology convergence. It integrates the resources of diverse research centres and supply chain partners.

MicroBridge (Cardiff University) – Micro-machining and fabrication of non-silicon

MicroBridge's work is aimed at the miniaturisation of components for industry, enabling precision engineers in manufacturing to work to the same microscales as those in electronics. Facilities include focused ion beam milling and laser ablation tools.

Current collaborative research projects funded include:

Development of Microextrusion for the Production of Effusion Cooling Holes – Lead Partner is Rolls-Royce plc, Hucknall, Nottingham. Total project value is £359,504.

Micromachined Diamond Device Initiative (MIDDI) – Lead partner is Element Six, Ascot, Berkshire. Total project value is £1,045,816.

Full list available at www.mntnetwork.com.

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contains a significant increase in funding over FP6, with €32 billion to be spent over the period, including €12.5 billion to be spent on the two themes directly relevant to MNT, according to the *MNT Newsletter*, November 2006. It added that "the UK MNT community should be primed for action". And last month, Cardiff University (see box item, page 25) held a 'Manufacturing in FP7 Conference' to explain the FP7 research programme, to propose research ideas, and to network with industry and researchers in areas of interest. The two-day conference had a focused session on Micro-Nano Manufacturing.

MANUFACTURING PROCESSES

MNT manufacturing processes can be described as bottom up (additive/fabrication), building up from small building blocks, or top down, machining small details starting with a larger piece of material. Both are relevant to metalcutters and manufacturing technology suppliers.

Under FP6, UK Universities and companies are involved in developing MNT manufacturing technology in a metalcutting sense, as *Machinery* highlighted in its July 2006 issue, page 22 (available at www.machinery.co.uk –

search for 'MASMICRO'). The MASMICRO project aims to develop a machine tool capable of attaining 50 nm accuracy with 5 nm repeatability. In addition, it aims to make that machine perhaps one-tenth of the size of anything that has gone before, at one-tenth of the price. It must also remain suitable for mass production of micro components within small and medium enterprises (SMEs) in the manufacturing sector.

The four-year project started in July 2004 and is led by Brunel University. The focus is on developing multi-axis machine tools capable of producing complex 3D geometries to nanoscale tolerances. Two types of machines are being developed – a 5-axis machine (essentially like a conventional machining centre); and a 3-axis test bench (that resembles a turning centre, in principle).

At Cardiff University, Engis UK is involved with micro mould tool developments for the production of non-silicon parts. The techniques which the University project team are using to create the micro-moulds from larger pieces of material include micro-laser, micro-EDM and micro-milling on very high purity mono-crystalline amorphous metal compounds. Atanas Ivanov, manager of the micro-tooling project says that using these methods the team has broken the "10 micron barrier" and is

working on 5 micron inserts and channels. However, the machining techniques can leave debris on the mould surfaces and within the ultra-fine mould cavities, resulting in potentially significant problems with de-moulding – and even the need to scrap the mould if the moulding cannot be ejected. An effective mould cleaning solution that can be used in extremely fine channels without causing any loss of surface finish is necessary and Engis UK offered the project a solution in the form of its Megasonic nozzle.

Just last month, Materials Solutions opened on the University of Birmingham campus and is employing additive manufacturing with an EOSINT M 270 direct metal laser-sintering machine.

The EOS equipment (pictured, left) will be used to develop process experience in additive manufacture of solid, functional components from high temperature alloy powders, particularly nickel – and titanium-based – primarily for aerospace and automotive applications. Prototypes, test parts and training will be offered to manufacturing companies, enabling faster design and shorter time to market for new products.

TOES IN THE WATER

And the online MNT supplier directory also lists a number of engineering technology/service providers familiar to *Machinery* readers who are aligning themselves with MNT activities, so to speak: CMM specialist Carl Zeiss; Deckel Grinders (Kern micro machine tools specialist); mould tool designers Euro Moulds and Euromould; sub-contractor Lasers Are Us; grinding machine maker Loadpoint; high precision grinding/turning machine specialist Cranfield Precision; MCP Tooling Technologies; Newall Measurement Systems; sub-contractor Oxford Engineering; laser source specialist Rofin-Baasel UK; measurement specialist Taylor Hobson Precision; and Unimatic Engineers. They are among the 643 companies, either exclusively or partly, manufacturing or developing products based on micro and nanotechnology or

Disruptive technology

BAE Systems, Plymouth, has some 90 years' experience in the manufacture of gyroscopes. Historically, these have been precision mechanical instruments. Today Micro Electronic Mechanical Systems (MEMS) have revolutionised the technology. MEMS are made by microfabrication methods containing

moving parts linked to electrical components. They can be made cheaply and in vast quantities using silicon chip manufacturing methods. BAE System's Si (silicon) Ring VSG Gyroscope saw proof of principle in 1998 as a 10 mm diameter device. Volume production of a 6 mm ring has been ongoing since 2001 and initial sample production of a new generation 4 mm ring started last year.

Gyros were once expensive, precision electro-mechanical instruments produced in low volumes with cost and volume limiting the technology's usage outside aerospace and defence areas. MEMS technology is transforming this by providing a low cost product for mass markets – 7 million cars have gyros in their breaking systems today.

offering services in this field.

With the UK's MNT Network representing collective facilities, plant and equipment worth £700 million available to UK industry, the Government is clearly serious about this technology area, as is the EU with its increased research funding. As Professor Clare highlights, MNT is a "disruptive

technology" that can "wipe out traditional industries, revolutionise existing industries, and be decisive in allowing small, medium and large firms to compete in the future." Digital cameras rely on MNT and have almost overnight wiped out the traditional camera and film industry, the same in the case of the iPod and other similar

products which are replacing the Walkman, Professor Clare offered.

It may still seem like science fiction to many, but UK industry should pay attention to MNT developments because even if they don't seem relevant today, they may be in the future – either as a threat or as an opportunity, as Professor Clare highlights. □



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