focus

Knowledge Transfer Network

Materials

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NEW RESOURCES FOR PRODUCT INNOVATION

Showcasing UK talent

During the UKTI-Materials UK event - organised by the Materials KTN, Materials Technologies for Energy Applications, UK and overseas delegates heard what the country can offer to investors.

The Materials Technologies for Energy Applications conference, held in Manchester from 2-3 March, set out the UK strategy for energy and showcased UK excellence. Several priorities are set out in the Government's strategy regarding clean energy and security of supply. There is a role for knowledge transfer and inward investment.

Support is provided by Research Councils and the Technology Strategy Board (TSB), with competitions for funding. The UK aims to provide solutions to specific customer needs resulting in innovative solutions which can be exported. Examples of this innovation were seen in the exhibition and innovation expo.

Dr Derek Allen, Materials UK, introduced the organisation and its unique partnership between UK industry, academic and government with the role of advising UK Government on strategy and priorities on behalf of the materials community. Allen explained how materials underpin the entire energy infrastructure and can help reduce CO_2, secure an energy supply and provide affordable electricity.

The UK has a target of reducing CO_2 emissions by 34% by 2020 and 80% compared to 1990 levels by 2050. Materials will play a key role. Allen gave a view on what 2010 might look like –

- Over 1.2m people will work in 'green' jobs.
- Seven million homes will have had a green makeover and 1.5m will generate their own energy.
- Around 40% of electricity will be from low carbon sources.
- The UK will be less dependent on imported fuels.
- Low carbon vehicles will be on every garage forecourt.

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Inside

Foreword

by Dr Robert Quarshie, Director, Materials KTN

Welcome once again to the readership of Focus, the quarterly newsletter from the Materials KTN. This issue reports on a number of key technology developments and high impact events. One such event was held over the first week in March (last month). Billed as a showcase of UK excellence in materials technologies for energy applications, the event lived up to and even exceeded expectations. Both UKTI and Materials UK who were the main partners for the event were delighted with the outcomes and so were the 180 plus delegates who attended the two-day international conference. Forty of the delegates attended the conference as part of a UKTI mission from 15 countries. I am grateful to Narec, Sharp Manufacturing Company, the Centre for Solar Research - OpticTecnium, TWI at the Advanced Manufacturing Park in Sheffield and Sheffield Forge Masters for opening their doors to UK and overseas delegates to showcase the excellent work they are doing. The articles about the event, featured in this issue, show how Materials technology is playing a key role in the development of advanced power generation technologies, the development of cleaner energy supplies that are secure, reliable and competitive and underpins energy savings and efficient usage. The UK is in good shape to deliver value to a global market.

This issue of Focus also features how materials solutions are helping to extend the operational life of electronic devices, power plants and moulds used in casting steel slabs. There is a catching development by the University of East Anglia where smart materials are used to verify the freshness of food. Anyone who has read with awe the huge cost of food waste (£8 billion in 2007), will be asking when this technology will be commercialised.

Commercialisation of technology is the topic for a featured article by Thomas Morgan of Morgan Linley. Advanced materials have been hailed as the third wave of revolutionary innovation after IT and Biotech but have been poorly positioned with private equity providers. In his article, Thomas provides a few tips for commercial success.

The importance of maintaining a strong science and technology base for the advancement of materials was recognised in TSB's Advanced Materials Strategy for 2008-2011. It is, therefore, good to learn of the academic research groups in Manchester combining knowledge and expertise to support industrial partners in achieving lightweight transport solutions in a low carbon economy.

I would like to acknowledge the new partnership between Glasgow University and the Materials KTN to offer a new generation of SPARK Awards to SMEs commercialising nanotechnology. Through the successful exploitation of a previous Materials KTN SPARK Award, Nicky Stanley – a UK Landscaper – has turned her idea of developing a pick up patio into reality and has secured an appearance on BBC2's Dragon Den.

People continue to be important assets to the Materials KTN knowledge transfer activity and the KTN is pleased to engage with its members. That is why it is important for each and every member to register on the new TSB web platform, _Connect, to stay engaged and continue interacting with the Materials KTN.

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POWER GENERATION

Power generation is responsible for 40% of the UK's CO_2 emissions which provides great opportunities for materials. New nuclear power plants will be commissioned, requiring high temperature materials, composites and coatings. Transport and the modern built environment also provide business opportunities.

The UK is the leader in offshore wind technologies and wave and tidal power. There is a resurgence in nuclear technology and it is a world leader in R&D of high temperature materials, coatings, photovoltaics, fuel cells and hydrogen materials. To compliment the Materials UK Strategic Research Agenda for energy materials, KTN released a new Materials UK report on nuclear R&D.

STEAM PLANT – TURBINES AND BOILERS

Steve Osgerby, from international company Alstom Power, outlined the materials challenges for steam turbines and boilers. He introduced the typical materials used, which range from austenitic steels to nickel-based alloys, depending on the operating temperature. In steam turbines, the rotors tend to be large martensitic steel forgings. Valve internals tend to be a martensitic steel substrate with a Stellite hard facing.

There is a need for increased efficiency for commercial advantage, CO_2 capture, plant availability and longevity. Efficiency gains could be achieved with higher steam temperatures which will require materials with enhanced properties. For more efficient low pressure turbines, it is necessary to optimise the aerodynamic design and increase the exhaust area. This requires materials of high strength and steels capable of operating at up to 650°C. Where nickel alloys are to be introduced, long-term life testing is required.

Welded properties, joining of dissimilar metals, inspectability and surface engineering are important. These challenges will be met by identifying the UK R&D capacity, suppliers and processers. The UK has the required skills and a proven track record in materials development.

GAS TURBINES

In a turbine, there are 360 single crystal components, precision cast parts, and nickel, iron and titanium alloys, as well as metallic and ceramic coatings. It is estimated that there are US$137bn of business opportunities in the gas turbine market. Demand is driven by the US and Europe – hence there are high overseas market opportunities.

The technical challenges are those of increasing temperatures, extending life, oxidation, corrosion (this effects reliability) and whole life costs. Research tends to be incremental and is dependant on aerospace derived technology which leads to affordability issues. Research is usually company specific with little collaboration. The urgent issues to be addressed are –

- Validation of new alloys in full-scale testing.
- Integrating all aspects of the process and adopting a systems solution approach.

It is expected that in 10 year's time, new materials will be developed based on existing knowledge, process knowledge and a total system approach will be the focus. Another 10 years following, there will be a step change in the development of materials systems not based on existing technology. The UK has a strong academic network, a robust supply chain and support from funding agencies.

CARBON CAPTURE AND ADVANCED TECHNOLOGIES

Professor John Oakey, Cranfield University, presented on the UK strategy for advanced biomass co-firing and CO_2 capture. Biomass fuel for co-firing is variable and can include energy crops such as willow, agricultural waste and world traded plants such as palm. The fuel can contain contaminants which cause corrosion and fouling, but co-firing reduces these risks. Most UK coal plants have co-firing capability and there has been extensive research in the area.

There are three main approaches to CO_2 capture – post-combustion, pre-combustion and oxy-fuel. The most common post-combustion technology is amine scrubbing. This is widely used in the gas industry and can be retrofitted. It operates at low temperatures and pressures. However, there is a relatively high energy penalty and solvents have to be dealt with. The system reliability for the materials need to match the rest of the plant. The UK has pilot-scale facilities which are being operated by the industry.

Pre-combustion technologies include integrated gasification combined cycle power stations. There are few of these worldwide. The system produces a synthetic gas which has a low heating value. It produces a smaller volume of gas for treatment but involves complex fuel processing. In oxy-fuel firing, there is a need to recycle the flue gas and O_2 must be generated. Corrosion is also an issue but extensive materials research into protective coatings has been conducted.

NUCLEAR FISSION

Professor Andrew Sherry, The University of Manchester, spoke about the nuclear renaissance and opportunities for UK businesses. The UK has internationally

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recognised R&D in NDE, structural integrity, fabrication, materials degradation, decontamination, and decommissioning and modelling. The technical challenges are –

- Plant life extension – Graphite properties, creep and oxidation resistance, high temperature materials and corrosion behaviour.
- Reactors for near-term deployments – Design approval, fabrication technology, supply chain alignment, materials ageing, fatigue and corrosion.
- Safeguards and non-proliferation – Fuel cycle assessment, separation techniques, radiochemical cleanup and detection.
- New reactor systems – System design, fuels and materials technologies.

The UK has a mature supply chain with well integrated links to academia across all technology readiness levels. It is investing in nuclear fission, and the Nuclear Advanced Manufacturing Research Centre, a joint venture between the Universities of Sheffield and Manchester, has been launched. The UK has a world-class skills base and a track record of collaboration with significant public and private investment.

NUCLEAR DECOMMISSIONING AND WASTE

Professor Bill Lee, Imperial College London, explained that the UK has been slow to address the issue of clean up. In 2004 the Committee on Radioactive Waste Management (CoRWM) was formed and two years later the Nuclear Decommissioning Agency (NDA) was initiated. CoRWM advises the Government and NDA, while the NDA is responsible for implementing geological disposal – seen as the end point with robust storage in the interim period.

Nuclear waste is classified by the level of activity, ie low, intermediate and high. Low level waste tends to be encapsulated in cement and high level waste vitrified in glass. Storage facilities must last at least 100 years and the waste form needs to be stable. A toolbox of cement matrices is needed and metal interaction with the alkaline cement system is an issue.

The skills needs are being addressed in the areas of nuclear science, mining, hydrogeology and geology. There are significant opportunities for universities and state-of-the-art laboratory facilities, and potential for technology transfer from military and nanotechnology sectors.

OPPORTUNITIES FOR INTERNATIONAL COLLABORATION

Knut Hachmann of Voith Engineering Services GMBH, introduced the international Voith group. In the energy sector, activities include composite propellers for ships, train engine composite parts, and hydro and tidal turbines. Voith has a UK presence on the Bristol Airbus site. Potential areas for joint ventures include manufacturing partners for carbon fibre-reinforced polymers.

The Russian Research Centre 'Kurchatov Institute' was founded during World War II to develop nuclear weapons. Activities now focus on nanotechnology, energy generation and energy efficiency. The centre offers a full range of research from fundamental science to pilot-scale facilities. Another area of research is plasma melting technology for the gasification of coal and solid and liquid hydrocarbons and wastes. The centre does not have any large demonstrator projects and is interested in speaking to potential UK collaborators.

Subhabrata Mukherjee, UK Trade and Investment (in India), gave an overview of the energy sector and advanced engineering in India. The Indian economy is expected to grow by 7.2% in 2009/10 with the manufacturing sector doubling. The engineering industry is diverse and is the main growth driver for the future. India is rich in raw materials and has a low cost structure with a large proportion of the population of working age.

There is a high demand for infrastructure, automotive, power and aerospace. In materials, the focus is on composites, nanotechnology, special alloys and tool steels, glass and carbon fibre and high end aluminium and titanium alloys. India and the UK have signed an understanding in the nuclear sector. The UKTI promotes inward investment and assists overseas companies to do business in the UK.

The energy related funding bodies in the UK include the Energy Technology Institute (ETI), the Carbon Trust and the Research Councils. A number of Research Councils are funding energy research in conjunction with ETI and have established doctoral training centres.

As part of the second day of international presentations, Liang Zhan, Sany Electric, spoke about the Japanese company, which operates in the heavy machinery sector in China. The company has three overseas R&D centres and a manufacturing site in Brazil is planned. It has invested $100m in wind energy. Their first 1.5MW prototype was produced in 2008. 3MW and 5MW turbines are under development. The company continues to look for potential R&D centres overseas.

Rusnano in Russia invests in high technology products to establish an innovation economy structure and provide state policy in nanotechnology. Finance is given to projects in fabrication, scientific forecasting, roadmaps, standards, certification, safety, education and popularisation of nanotechnology. Priority areas are in composite materials, opto-electronics, solar energy, medicine and pharmaceuticals. Opportunities for funding are listed on the Rusnano website (www.rosnano.ru). Overseas projects can be funded if there is a Russian partner.

There are opportunities for collaboration with 3M. The UK-based science company defines itself on a number of technology platforms and is active in wind and solar energy.

UK STRATEGY SETTING

Heidi Lovelock, Head of Innovation Platforms, TSB, gave an overview of the company. £1bn of funding has been allocated over three years, a third of which is from Research Councils and RDAs. The TSB works across all sectors but focuses on the innovation climate and challenge led or technologically inspired innovation. It operates through collaborative R&D, feasibility studies, contracted work, KTNs, the Small Business Research Initiative, and Knowledge Transfer Partnerships.

The TSB has key technology areas including advanced materials, electronics and photonics, high value manufacturing and nanotechnology. Its application areas include energy generation and supply, the creative industries, transport, the built environment and sustainability. The current grant level in advanced materials is £61m. The TSB also has a number of structured programmes with associated resources which address a challenge.

ENERGY USAGE AND EFFICIENCY

BUILDING INSULATION

The trend in modern architecture towards glass and lightweight construction to give bright, open spaces and maximise space can lead to lower thermal mass and reduced insulation, said Kevin Tinkham of Corus. To achieve a level 4 or better in the Code for Sustainable Homes, funding will be required. Today's housing stock will still be in place in 2020 but new materials and technologies can help achieve environmental targets.

Insulating paints such as vacuum filled microspheres act as mini thermos flasks. The microspheres can be mixed with conventional paints by the consumer. In phase change materials, energy is stored when the material changes from a solid to liquid and this energy is released when the change is reversed. The most common phase change material is paraffin wax. A number of technologies are emerging in the market place which can be used in new build and to retrofit buildings to help the construction sector reduce CO_2 levels.

LOW ENERGY PROCESSING

Alex Hewitt of Aeroform Ltd spoke about low energy processing. Aeroform is a UK company producing equipment for the composites industry The autoclave process is energy intensive and can have extremely low energy efficiency. In sectors where composites are used, there are different drivers, such as productivity, efficiency and aesthetics. In the motorsport industry aesthetics is extremely important and efficiency can be as low as one per cent.

In aerospace, the next generation of composite airframes will be produced predominantly by autoclave. Computational fluid dynamics modelling is being used to optimise the performance and design of autoclaves. This equates to an annual saving of around 1,000GJ.

DESIGN FOR EFFICIENCY

Edward Elias, University of Bath, presented on efficiency design for consumer kitchen products. He explained how eco-design addresses all of the environmental impacts of a product while maintaining design criteria. Design for efficiency includes how the product is made and used. For example, 72% of the power used by a washing machine is in its use cycle compared to 90% for a fridge.

New technology, materials or processes create opportunities for product innovation. In fridges, there has been a 60-70% improvement in energy efficiency since 1980 but energy losses in use have become more significant. Awareness campaigns have been ineffective in changing behaviour and so this must be locked into the product design by studying user behaviour.

TRANSMISSION

The world economy is dependent on energy and there is increasing risks of blackouts. The requirements of the energy transmission system is delivery on demand but it is constrained by an ageing system. A national programme to address this is needed. Superconducting materials have zero resistance, a high current density and low impedance, enabling transmission level power at distribution voltages. Dwindling resources of copper are driving their use. Superconducting materials can allow a 10x size reduction for the same power compared to copper. Full-scale projects are in operation in the USA and are starting in Europe. These materials will be key to the development of fusion power.

THERMAL MANAGEMENT

Energy conserving coatings have been developed by Pilkington. These need to be different depending on whether they are used in a hot or cold climate. In a cold climate the coating needs to let the heat of the sun in but not out. In a hot climate, the coating needs to stop the heat getting in. The framing system is also critical. Spacer and seal technology present huge materials challenges.

Generating electricity using windows may be a possibility, and switchable glazing is being developed. Energy savings can be enhanced using higher transmission glass coatings, gas and vacuum glazing and triple glazing. Other technologies include weather resistance, fire resistance, anti-condensation, electrical interference and low reflectance. Materials challenges include raw materials, energy of manufacture, coatings, laminates and recycling.

SOLID STATE LIGHTING

The final presenter was Majd Zoorob of Photonstar LED Ltd who focus on illumination grade lighting. The company undertakes lighting design and a complete turnkey service. Payback for these lighting systems tends to be 1-5 years. LEDs give no UV or radiated heat, are dimmable, and are 85% more efficient that incandescent bulbs. Design is key in terms of colour quality and that light should be where it is needed.

Conference website:
www.energymaterialsuk.biz
More detailed coverage of the event can be found on the new Materials KTN website:
www.materialsktn.net

Keeping it fresh

The sight of perishing food on supermarket shelves could become a thing of the past thanks to discrete smart packaging that verifies freshness.

The University of East Anglia (UEA), a Materials KTN organisation, has developed smart packaging that could detect food's freshness throughout the supply chain. This would reduce the risks of food poisoning and customer dissatisfaction while addressing the problem of food waste.

Professor Thomas Nann, a chemist and nanoscience expert at UEA, has developed a technology which enables staff throughout the meat and seafood supply chain to verify freshness at any time without outward indication to concern customers.

It detects biogenic amines (produced by the bacterial decay of meat and fish) using a luminescence-based system suitable for abattoirs, fresh food transporters, restaurants, supermarkets and retail outlets. Current methods show obvious, visible colour change in response to certain indicators of decay. Market research indicates supermarkets and food retailers prefer a controlled testing process that displays no evidence of deterioration to customers.

It is desirable to remove deteriorating products from display before any indication of loss of freshness occurs. 'Sell by' and 'use by' dates are indicative of time since processing but cannot validate the condition of produce at any point in time and tests such as smell require undesirable opening of sealed packaging.

The freshness sensor is based on nanoparticle technology which can be incorporated into packaging. It allows suppliers and retailers to control the testing process by shining a readily-available UV light, such as a barcode scanner, onto the packaging. A luminescent colour clearly reveals the state of freshness or decay of the product so that unsatisfactory products can be discarded before they reach customers, and before any colour change or smell becomes apparent. The technique is patent pending.

The University of East Anglia is seeking partners interested in licensing this technology or collaborating to develop packaging solutions. Contact Nick Goodwin, tel: 01603 591560, e-mail: **n.goodwin@uea.ac.uk.**

Surface engineering helps power up

A white paper produced by the Materials KTN explains how surface engineering can provide advanced solutions for the next generation of fossil-fuelled power plants.

The powders sector of the Materials KTN has issued a white paper on the crucial role of surface engineering solutions in enabling the development of fossil-fuelled power generation plant.

Several authoritative sources have emphasised that fossil-fuelled generation will continue to dominate both the power generation mix up to at least 2030 and the projected installation of new capacity up to that date. The paper covers the period up to this date, and considers future needs and potential developments from two perspectives –

- Opportunities for UK companies in the power generation supply chain to gain competitive advantage exploiting the growth in global markets up to 2030.
- Securing a viable UK power generation/supply capability over this same period.

The report analyses predictions for developments in power generation capacity/requirements, globally and specifically in the UK. It defines the implications for increased performance demands on fossil fuel power generation plant components and describes the established and recently developed surface engineering solutions that can satisfy performance demands in power plant components. It also highlights the areas where new solutions are needed to satisfy future performance demands.

This focus on fossil-fuel generation does not signify that surface engineering will not also make significant (and vital) contributions to renewable energy source installations. These issues will be addressed in a separate white paper.

For a copy of the paper and to discuss any of the issues raised, contact David Whittaker, tel: 01902 338498, e-mail: **david.whittaker@materialsktn.net**

A weighty issue for transport

An EPSRC grant is helping KTN member companies develop new materials for lighter vehicles.

Funding of nearly £6m is helping a consortium to develop new super-light materials solutions for greener cars and aircraft. The five and a half year venture, led by The University of Manchester, aims to significantly reduce the environmental impact of transport by improving the design of high performance light alloys.

The LATEST2 (Light Alloys Towards Environmentally Sustainable Transport 2nd Generation) Project is being funded by a Programme Grant from the EPSRC. These grants help world-leading research groups address major research challenges. They are intended to support a suite of related research activities focusing on one strategic research challenge.

A team of eight multi-disciplinary academics at the university will investigate techniques for forming complex component architectures, joining advanced alloys and dissimilar materials, and engineering surfaces for low environmental impact, while ensuring low cost and recyclability. They will also investigate self-healing coatings and new approaches to process modelling and simulation.

George Thompson, Professor of Corrosion Science and Engineering at Manchester, said, 'This important grant provides us with secure funding over several years to develop the scientific understanding to meet the challenge of building lighter vehicles and aircraft with lower carbon emissions and better fuel economy.' The project team also hopes to 'promote awareness of the importance of engineering and physical sciences – and materials in particular – to the fabric of everyday life', added Thompson.

The Programme Grant builds on the success of the original LATEST Portfolio Partnership. Website: **www.materials.manchester.ac.uk/research/portfolio/latest/**.
The project will be officially launched in June 2010.

For more information contact Alex Waddington, tel: 0161 275 8387.

MATERIALS KTN MEMBERS INVOLVED IN THE LATEST2 PROJECT

AIRBUS UK

Alcan Engineered Products

Alcoa Europe Flat Rolled Products

CSIRO

Innoval Technology Ltd

Jaguar and Land Rover

Keronite International Ltd

NAMTEC

Norton Aluminium Ltd

Novelis Global Technology Centre

Rolls-Royce plc

TWI Ltd

Pick up a patio

Support from the Materials KTN will lead to a UK landscape designer appearing on BBC2's Dragons' Den.

The Materials KTN is supporting UK landscaper designer Nicky Stanley in her endeavor to design a simple and quick method for laying a patio.

She came up with the concept in the summer of 2006 when installing a stone patio at the rear of a terraced property. During the tiring and frustrating process of moving the materials through the property, she came up with an easier and lighter way of doing it. Her idea uses existing technology of rigid plastic ground grids to substitute for sand and cement. The Eureka moment came two years later when she thought of using a flexible cover with a decorative design to mimic stone, wood or other finishes.

Nicky contacted the Materials KTN who assisted her in material choices. The contacts she received enabled her to produce samples for the cover which has led to interest from major DIY retailers such as B&Q. Nicky said of the KTN, 'The advice and assistance over the last two years in my pursuit for a suitable patio cover material has been invaluable, not only in the contacts, but also the encouragement through difficult times'.

A prototype rubber patio has been produced and Nicky is working with a UK moulder to find a process capable of making full sized production patio. She is pursuing investment and will appear on BBC2's Dragons' Den programme, where entrepreneurs pitch for funding, later this spring.

Designer Nicky Stanley in her Hampshire garden with her prototype flexible patio cover

For more information, visit: **www.bbc.co.uk/dragonsden/pitches/nickystanley.shtml**

How to make a commercial success

Thomas Morgan of Morgan Linley, a technology commercialisation specialist based in Sheffield, offers advice on how to bring ideas to market.

Successful commercialisation is achieved when work generates a profit stream. The two critical factors are identifying and understanding who wants what you have, and having someone who can make the deal happen.

So you want to see your research, work or invention put to use, and maybe make some money too? At this stage, how your work, innovation, research, technology, product or process – your 'idea' – does what it does is not important. Neither is the societal impact of the idea – how it will save the world, change peoples lives' or be the next big thing.

The first question must be 'Who wants your idea?', which must translate into a real intent and not polite or convenient interest. This is the market opportunity. The next step is to work back from this to determine if and how this intent can be converted into orders and profit (see far right).

If you do not have data and finance information at this stage aim for the 'ball park' and move on from there as this is just the first rough cut. It will set out your intentions and provides some initial credibility, giving market qualification. This is the basis for intellectual property (IP) protection strategy (because there is only value in IP if someone else wants it). You then have to consider whether it is appropriate to file a patent application and what the application needs to look like to secure the best value. [For more on IP protection, see *Focus 14, p5*].

Market qualification is the basis for a commercialisation strategy. It could be a joint venture development. If so, consider who would be appropriate partners and whether it is a licence sale. What is the value of the deal and the target customers? Alternatively, it may be a new company is the way forward.

If the strategy is for a new company then the market qualification is also the basis for deciding who can make this happen. What your idea does, and why it is wanted needs to be locked down to allow the market qualification to be of value. How to tweak, improve or develop the idea needs to be put on hold. Someone needs to focus on resolving issues about –

- Production – raw material supply, processing and relevant equipment, volumes and rates, etc.
- Interface – if the idea is a product, this will be user interface design and cosmetics. If this is a component, treatment or process then consider the interface between the idea and the other components in the system. The idea or established components may need to be modified, and interface technology added.
- Maintenance – how is the idea going to be used, or misused.

You may need to bring someone else onboard if you are going to work on developments, iterations or related ideas. Alongside the physical mechanisms for getting an idea to market, the commercial arrangements need to be seen to. The new company probably needs investment. This needs a business plan and a strategy for turning intent into orders, to deliver the details behind the market qualification. You probably require an additional person to fulfil this role, someone who knows and understands the way business works in the appropriate sector. They need to know how to balance volumes, price and delivery, negotiate deals and contracts, and manage money and the right legals. You need, and you should want, a Commercial Champion to drive the business opportunity and get the best return.

If your idea can deliver to someone something they want at a price they are prepared to pay, then you have the basis for commercialising your idea. A Commercial Champion who can make the deal a reality makes for a successful commercialisation.

Public sector organisations and academic institutions should channel some of their innovation budgets to help people secure effective market qualification. Too many good ideas are not commercialised because their market opportunity has not been understood. Also, good ideas people (academics, inventors and scientists) do not necessarily make good businessmen. They are needed to generate the ideas in the first place.

There are plenty of 'latent entrepreneurs' with sound commercial skills working in large companies and other organisations. They are primed Commercial Champions who need to be matched with the market qualified ideas in order to deliver successful commercialisation.

CONSIDERATIONS FOR COMMERCIALISING IDEAS

- How much do people want your idea? – Your market price.
- What is it replacing or displacing? – Market inertia.
- What will happen to existing suppliers and supply chains? – Barriers to market entry.
- How will it be made and by who? – Supply chain.
- Quality, cost and delivery – The ability to supply and volume capacity.
- How will they get it – direct or through intermediaries (if the latter, with how many intermediaries and what is in it for them)? – Route to market.
- How much will it cost to supply? – Breakeven point.

Thomas Morgan has a background in commercial roles for both large corporates and start-ups. He has experienced two start-up failures and has shelved a number of 'really good ideas that were going to change the world' because market qualification revealed commercialisation was not viable. He set up Morgan Linley to deliver independent market qualification and recruit commercial champions. E-mail: **thomas@morganlinley.co.uk**

Natural composites

With 2009 designated The Year of Natural Fibres, how has the use of these materials moved on? Stella Job, a Materials KTN Technology Expert, reports

How far have we come with natural fibres? Are they a viable alternative for high value structural applications, and to what extent can bio-derived polymers provide an engineering solution?

Following biocomposite demonstrators such as the Lotus EcoElise and, more recently, the WorldFirst Racecar, along with the Eden surfboard which uses a linseed oil-based resin, we are starting to see bio-derived composites compete for mass production industrial applications.

UK-French company EcoTechnilin is producing natural fibre products on a commercial scale. Its non-woven mats of comingled flax with various binder blends are being used in high volume production for the Citroën C4 door panels, and Opel Insignia boot trim panels. It has recently introduced two new products for the automotive and construction industry – Fibriboard, a board using 100% flax mat impregnated with bio-resin, and Fibricork, which sandwiches a granulated waste cork core between two sheets of bio-resin-impregnated flax mat.

Chesterfield company Composites Evolution markets the Biotex range of more structural woven flax fabrics for those seeking an all-natural product (see *Focus 14, p7*). It also weaves flax fabrics for resin transfer moulding/vacuum infusion with thermoset resins.

Polylactic acid (PLA) is a thermoplastic derived from corn starch or sugars. It is finding acceptance in a range of products, produced by companies such as USA-based Natureworks. Development work in Brazil could bring bio-derived thermoplastics into a much wider market. Brazilian chemical giant Braskem expects to have a major polyethylene production facility commissioned before the end of 2010, using ethanol from sugar-cane waste as the primary feedstock. Renewable polypropylene production is past pilot stage and should be up and running within a few years. Braskem's recent acquisition of Sunoco's US polypropylene plants gives it a substantial global market share which could be replaced with bio-derived polypropylene.

Thermoset composite resins are also forging a path to market. Canadian boat maker Campion Marine recently announced plans to use Envirez, a predominantly bio-derived resin produced by US company Ashland for all its boats. Envirez uses a substantial amount of soybean oil and corn-derived ethanol.

Furan is a thermoset resin derived mainly from sugar cane waste, supplied in Europe by Belgian company TransFuran Chemicals. It is reported to have fire resistance properties comparable to phenolic resins and is beginning to find substantial market applications. Resins derived from various natural products are working their way up the technology readiness level scale, and work is ongoing in several UK universities to this end.

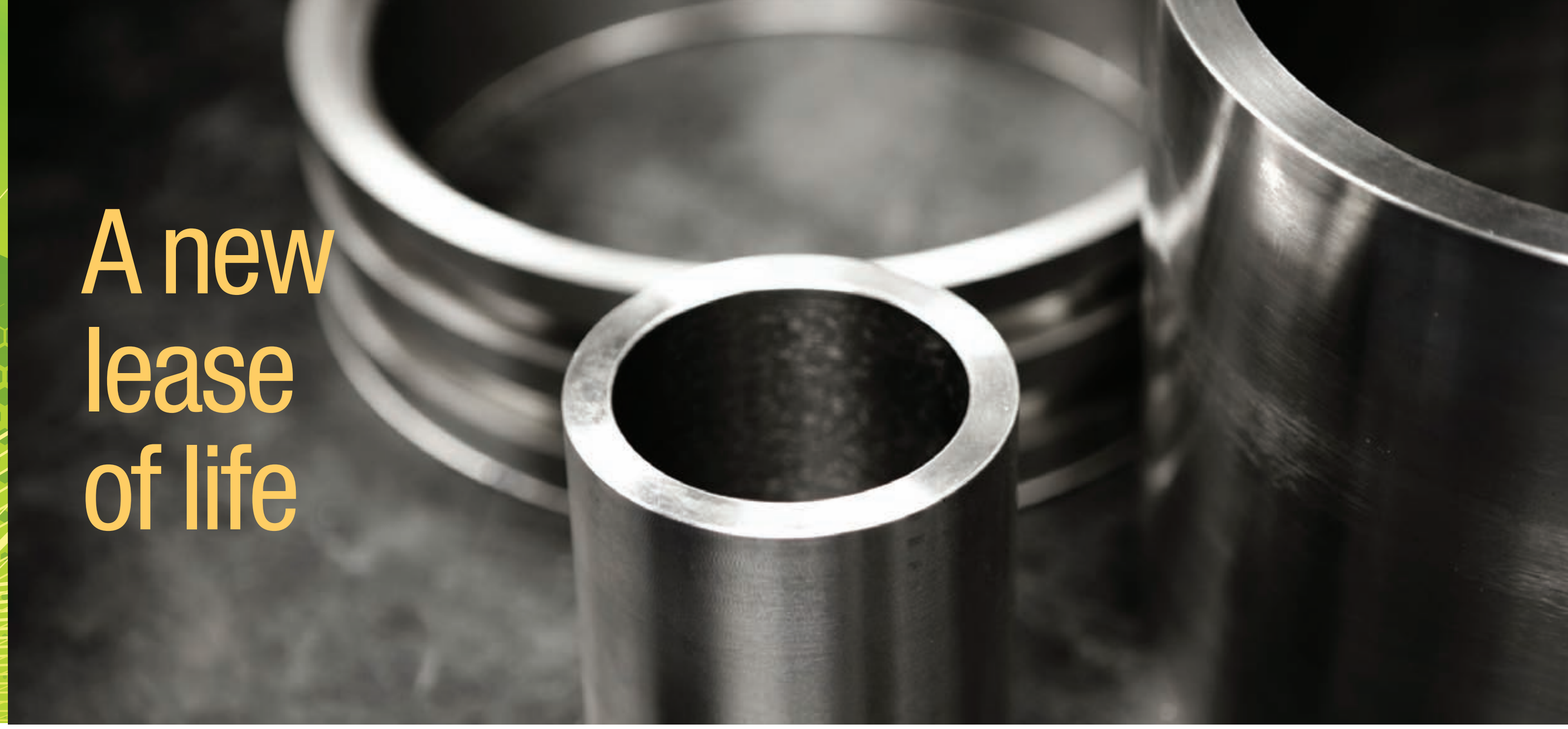
Some of this is not new. Tree resins have been used for rubber and as adhesives for centuries. More recently, in the automotive sector natural fibres have been used for decades and many cars now contain natural fibres in their seat structures and parcel shelves. In 1940 car manufacturer Henry Ford used to swing an axe onto his soybean-based plastic trunk lid to demonstrate its strength. The plastic car he developed never made it to mass production because of the Second World War, but the modern-day low carbon revolution is forcing us to use and protect nature far more effectively than we did in the past.

Part of this involves developing a consistent, growing supply of the relevant plant resources without compromising the parallel need for increasing the supply of food. Some of the resources for natural resins and polymers can be derived from agricultural waste. Many of the natural fibres can be grown in poor soil, but market drivers for these materials should not displace essential food supplies or incentivise the destruction of rainforests.

- In conjunction with the National Non-foods Crop Centre and NetComposites, the Materials KTN launched a bio-composites working group last December. It enables much-needed knowledge sharing across this emerging industry and seeks to identify how best to move forward. At a London event on 31 March a roadmap for the future of natural composites was developed.

If you would like to get involved, contact the Materials KTN Composites Sector Leader, Nigel Keen, e-mail: nigel.keen@materialsktn.net.

The Materials KTN has produced a *Best Practice Guide for Natural Composites*, available for £50. This valuable resource summarises what can be achieved, with comparative material properties and processing information. E-mail: **info@materialsktn.net.**



A new lease of life

Funding from the Materials KTN has helped improve spray coating technology for the steel industry.

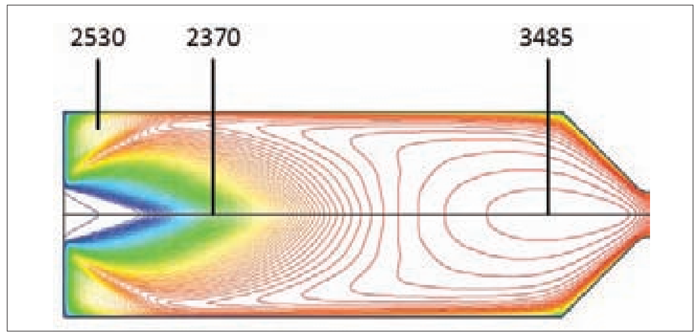
Castcoat is a patented coating system that provides severe environment protection of flat plate moulds during continuous casting of steel slab products. It was developed by Monitor Coating Ltd, North Shields, in collaboration with Corus, based in London. A Materials KTN SPARK Award funded the collaborative project with Southampton University.

The thermal spray coating system can increase the service life of components by up to a factor of six. If transferred to billet mould applications with a similar service life extension in continuous billet casting of steel, it would save Corus £1M/year on production costs.

The bores of billet moulds, however, typically have a profile of 200mm, either as tubular or square profile moulds. The preferred, high performance high velocity oxygen fuel spraying (HVOF) technology has problems depositing coatings in such a confined space. To apply HVOF coatings in a narrow space, a small gun was needed. A collaborative project was therefore set up with to develop a gun of the required size.

The Southampton group, led by Dr Sai Gu, has applied state-of-the-art Computational Fluid Dynamics modelling techniques to optimising the best-in-class HVOF gun. As a result, a size reduction of up to 70% has been achieved by redesigning the combustion chamber, nozzle, fuel atomiser and powder injection.

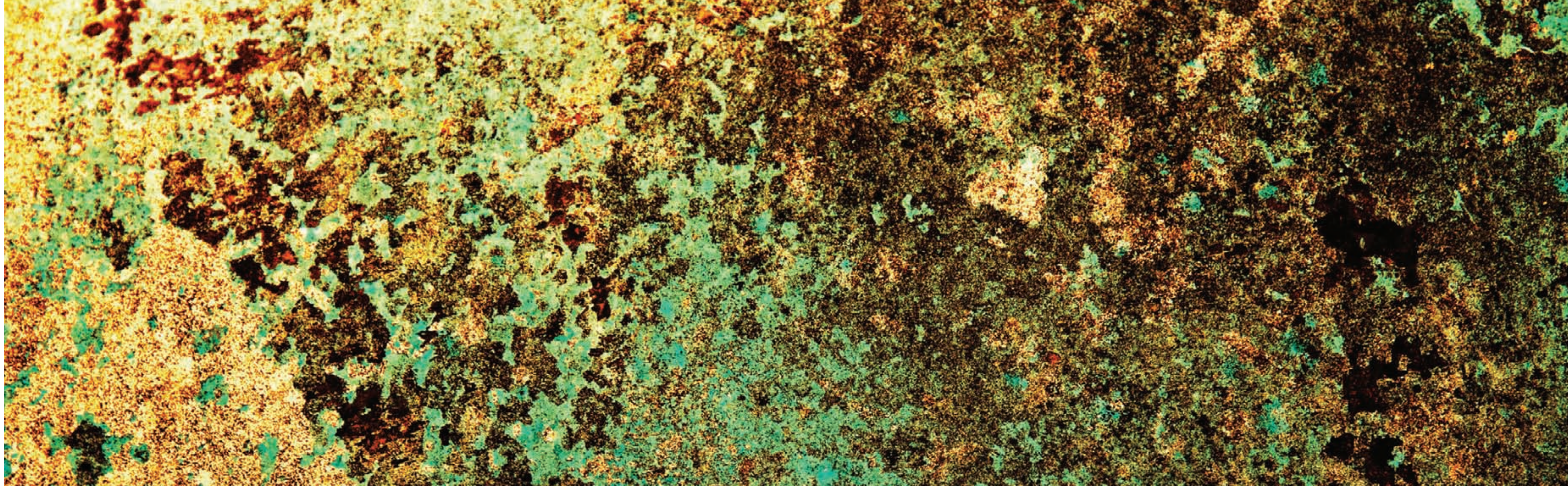
Armed with this compact HVOF technology, Monitor Coatings projects a doubling of its UK market share in three years and a saving of £650,000/year in consumables, lost raw material and redundancy of spare parts.



Combustion chamber temperature contours illustrating the flame shape.
Image courtesy of Monitor Coatings Ltd and Southampton University

Cooling down

Porous copper is being used in thermal management devices to provide a more cost-effective solution.



Electronic devices and systems incorporating microprocessors and integrated circuits are becoming ever smaller, breaking the barriers of Moore's Law. These new devices have to dissipate large amounts of heat to prevent electronic devices from failure. Applying the principles of thermal management, using heatsinks, heatpipes or active cooling devices, removes excessive heat. Current thermal management devices, however, are either inefficient or too expensive. Consequently, there is a demand for them to be more efficient and cost-effective.

A multidisciplinary consortium has been carrying out a £630k project, supported by the Technology Strategy Board, over the past two years to develop thermal management products from Lost Carbonate Sintering (LCS) porous copper. The consortium is led by C-Tech Innovations Ltd in Chester and composed of the University of Liverpool, Ashington-based Thermacore Europe Ltd, Vacua-Therm Sales Ltd in Hamilton, and Ecka Granules (UK) in Birmingham.

'The world market for thermal management products approaches US$6.7bln a year,' says John Collins of C-Tech Innovation. 'Lost Carbonate Sintering is a world-leading technology for manufacturing open-cell micro-porous metals. It offers significant advantages over competing technologies, combining low production cost and accurate control over the pore structure... It will reduce product weights for better heat transfer performance and reduce the production time and energy consumption.'

MIXING IT UP

Porous metals are currently produced using a range of techniques – melt-gas injection, melt foaming or infiltration, powder foaming, investment casting, metal deposition, metal gas eutectic method and sintering hollow metal spheres. They all have disadvantages, says Dr Yuyuan Zhao of the University of Liverpool's Department of Engineering.

'Some produce only closed cell materials,' he says, while others involve expensive materials or are only suitable for metals with low melting points. Techniques that can be used with a wider range of metals and their alloys are generally more expensive. 'There are relatively low-cost methods, but they offer poor control over the size and distribution of the pores, or the porosity range obtainable is very narrow. Investment casting produces the highest quality metal foams and offers more controllability, but it's extremely expensive.' While researching metallic powder production technologies, Zhao combined non-metal particles with metal particles and removed the former to create porous metal solids where the pore size and shape were tightly controlled.

'We mixed metal particles with soluble non-metal particles… for instance, salt crystals and powdered aluminium, potassium carbonate and powdered copper, and compacted the resulting mix,' Zhao recalls. 'We then sintered it – heating it enough to make the metal particles in the mix adhere to each other without melting. Finally, we cooled the mix and dissolved the non-metal particles in water.'

The university has patented Zhao's LCS process, which works particularly well for copper. 'In principle, it will work with any metal or metal alloy,' he says.

'Ideally the diameter of the metal particles should be between five and 500 microns but if a pore size greater than this was appropriate for a particular application, you could use particles up to 1.5mm in diameter. They can be any shape, but spherical particles are compacted and sintered more readily.' The porosity of the resulting materials is 50-85%. The regularity and quality of the foams can be seen in the images right, top and bottom.

ADDING AND SUBTRACTING

The removable additive can be one or more of a range of widely available and cheap carbonates like calcium, magnesium, potassium or sodium carbonate. 'The precise choice will be influenced by the melting point, the size of the particles and their solubility in liquids,' explains Zhao. The decision regarding the shape of the particulates is influenced by the end application and the functionality required.

Potassium carbonate works particularly well as a removable agent. It has a relatively high melting point (891°C) and is highly soluble in water, thus it can be removed rapidly. When it melts it decomposes into a gas and an ash. This opens up another route for its removal. The dissolution route retains the perfect shapes of the porous copper components, but can be slow. The decomposition route is faster and cleaner with a slight compromise in geometry. Depending on the specifications of the final products, one or both of these routes will guarantee efficient production of high quality products.

HEAT EXCHANGE

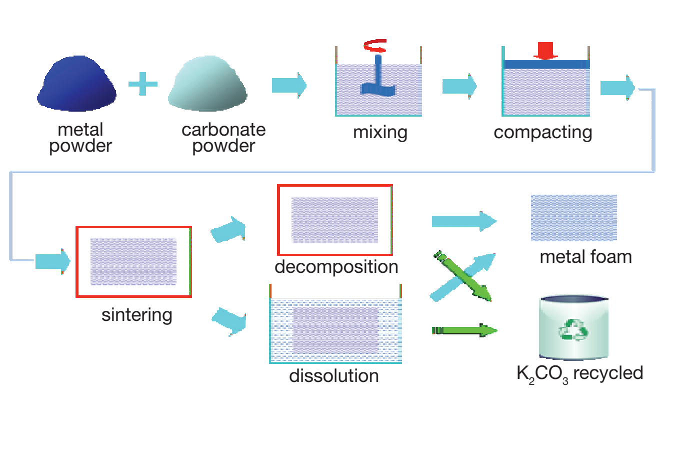
The optimum material for heat transfer or exchange is open-celled with a high ratio of pores to material, through which a coolant can be passed. Most commercial heat dissipation products, like heat pipes, use sintered copper, which has limited ranges of porosity and pore size. Porous copper produced by LCS can have a wide range of porosity and well controlled pore shape and size. It has a much greater surface area than the same volume of sintered copper, which significantly improves heat transfer due to the increase of surface area in contact with the coolant.

'The LCS porous copper can remove heat at a rate of 1MW/m2 while maintaining the component temperature below 85°C. The heat transfer coefficient was found to be as high as 140kW/m2K,' observes David Mullen of Thermacore.

'This material…achieves similar performance as micro-channel heat sinks cooled by two-phase flow with a water flow rate 10 times lower...With this material we can produce lighter, more efficient heat exchangers for applications like radiators, refrigerators, air conditioners…and computers, which become increasingly prone to overheating as they miniaturise.' The graph, right, shows the typical heat transfer characteristics of an LCS copper foam as a function of porosity and water flow rate, with maximum performance at around 65% porosity.

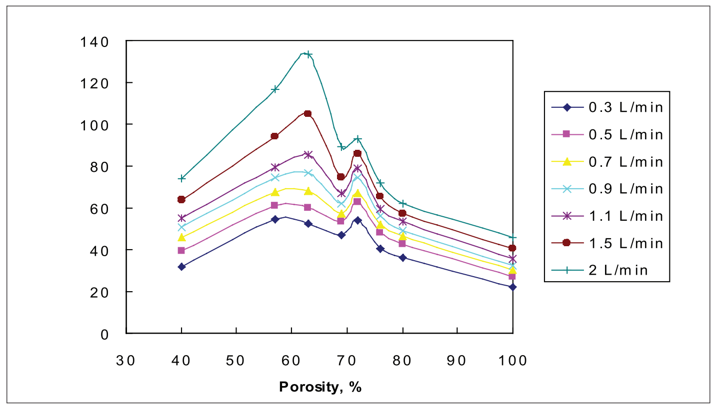
Outside the applications area of electronics' cooling, the consortium has already received interest in porous nickel components for heat engine applications, as catalyst supports and in fuel cells.

Schematic of the LCS process

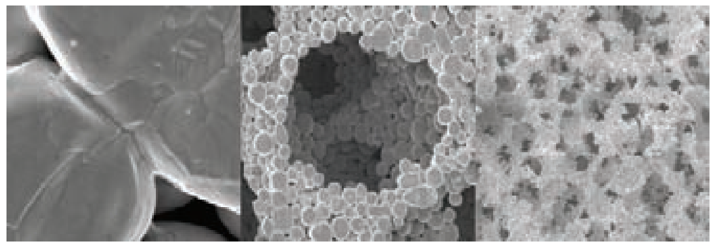


A 10cm diameter porous copper disc manufactured by the LCS process

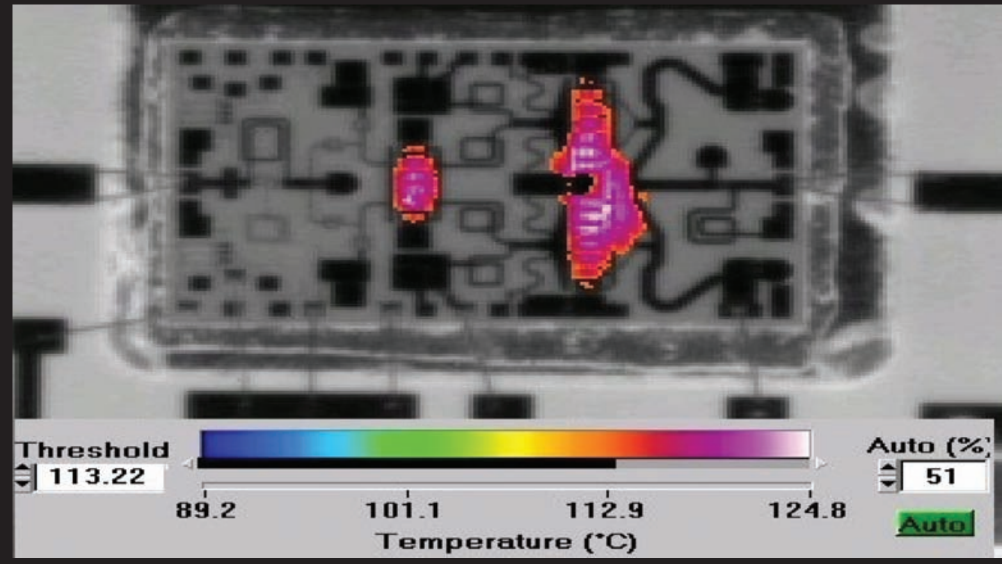
Heat transfer coefficient of porous copper made by the LCS process. The pore size was nominally 700microns



Microstructure of porous copper made using LCS



Taking the heat off electronic devices



The hot regions on an integrated circuit due to the drive and output transistors

Chris Oxley and Richard Hopper from De Montfort University, Leicester, discuss a new infrared thermal characterisation technique.

As electronic devices shrink in size and packing density increases, methods for accurately measuring the temperature of micro-dimensioned structures are highly desirable. A state-of-the-art infrared (IR) microscope facility has been set-up at De Montfort University, Leicester, and a novel technique developed to improve the accuracy of thermal measurements on very small structures.

The facility has been used to make thermal measurements for a range of applications, which include – junction temperature and thermal resistance of discrete electronic devices, optimising the thermal layout of integrated circuits, thermal profiling of micro-electro-mechanical systems (MEMs), detection of hot-spots and packaging for medical isotopes.

INFRARED IMAGING

Infrared thermal imaging has been available for a number of decades and is based on the work of Planck who discovered a relationship between emitted radiation, temperature and wavelength. The graph far right illustrates the spectral distribution of emitted IR radiation from a black body, which is the most efficient emitter, at a number of different temperatures. The total power radiated, W, by the black body rises as temperature increases and is given by the relationship W =T4, is Stefan's constant.

Most materials are grey bodies and emit radiation W at some fraction of the black body radiation, which is characterised by a parameter known as surface emissivity (es). This is defined as the ratio of the emitted IR radiation from a grey body compared to a black body at the same temperature and wavelength. If the surface emissivity of an object is known and the radiation from the object is measured, the surface temperature of the object can be calculated.

FACILITIES AT DE MONTFORT UNIVERSITY

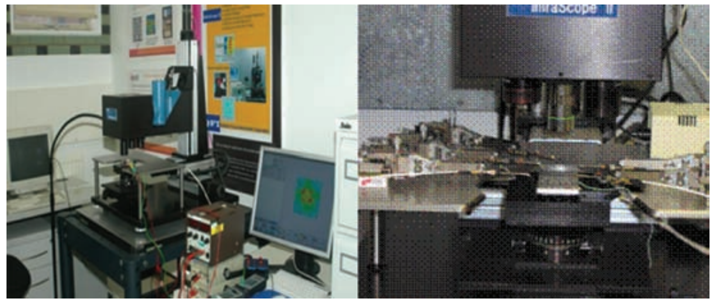
At De Montfort University, a state-of-the-art IR microscopy facility, with funding from EPSRC and HIRF, has been set-up to measure the temperature of micro-electronic components.

The microscope is a Quantum Focus instrument (see image right, top) using a 256x256 indium antimonide detector array. The instrument has a thermal spatial resolution of 2.8 microns and a field of view of approximately 1mm2. The temperature sensitivity is 0.10C, with a temperature range of 3000C. The instrument has a DC probe station (seei mage right) that enables devices to be electrically DC probed during thermal measurements.

The electronic device to be measured is placed on a heated-stage under the microscope objective (see image right, middle), and the device is heated to a known temperature. The radiation from different parts of the electronic device is measured using the IR microscope and the data stored in a computer. Knowing the radiation emitted from a black-body at the same temperature as the electronic device from an internal calibration curve enables the surface emissivity across the surface of the electronic device to be computed. The electronic device is then DC biased and the emitted radiation re-measured. Knowing the surface emissivity the temperature profile can be displayed. This is a powerful technique as hot areas can be easily identified (see main image, above).

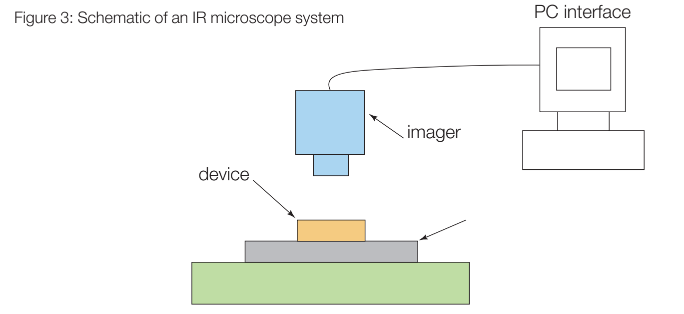
The accuracy of the temperature measurement is dependent on knowledge of the surface emissivity. A number of factors can give rise to problems when measuring surface emissivity, for example when materials have low emissivity or are transparent to IR radiation. Materials with a very low surface emissivity emit a small amount of radiation that can be similar in magnitude to the level of background radiation reflected from the surface, resulting in artificially elevated surface emissivity. Many metals used in electronic device fabrication, for example gold, have low emissivity and high reflection values.

Materials which are transparent to IR radiation result in radiation being collected from the front and back surfaces of the device and any interfaces within the material, again giving a superficially high emissivity. This results in temperatures lower than the actual value. The traditional method of overcoming this problem is to coat the device with

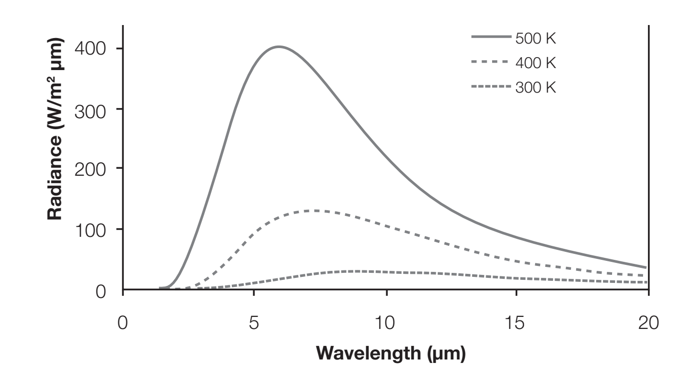


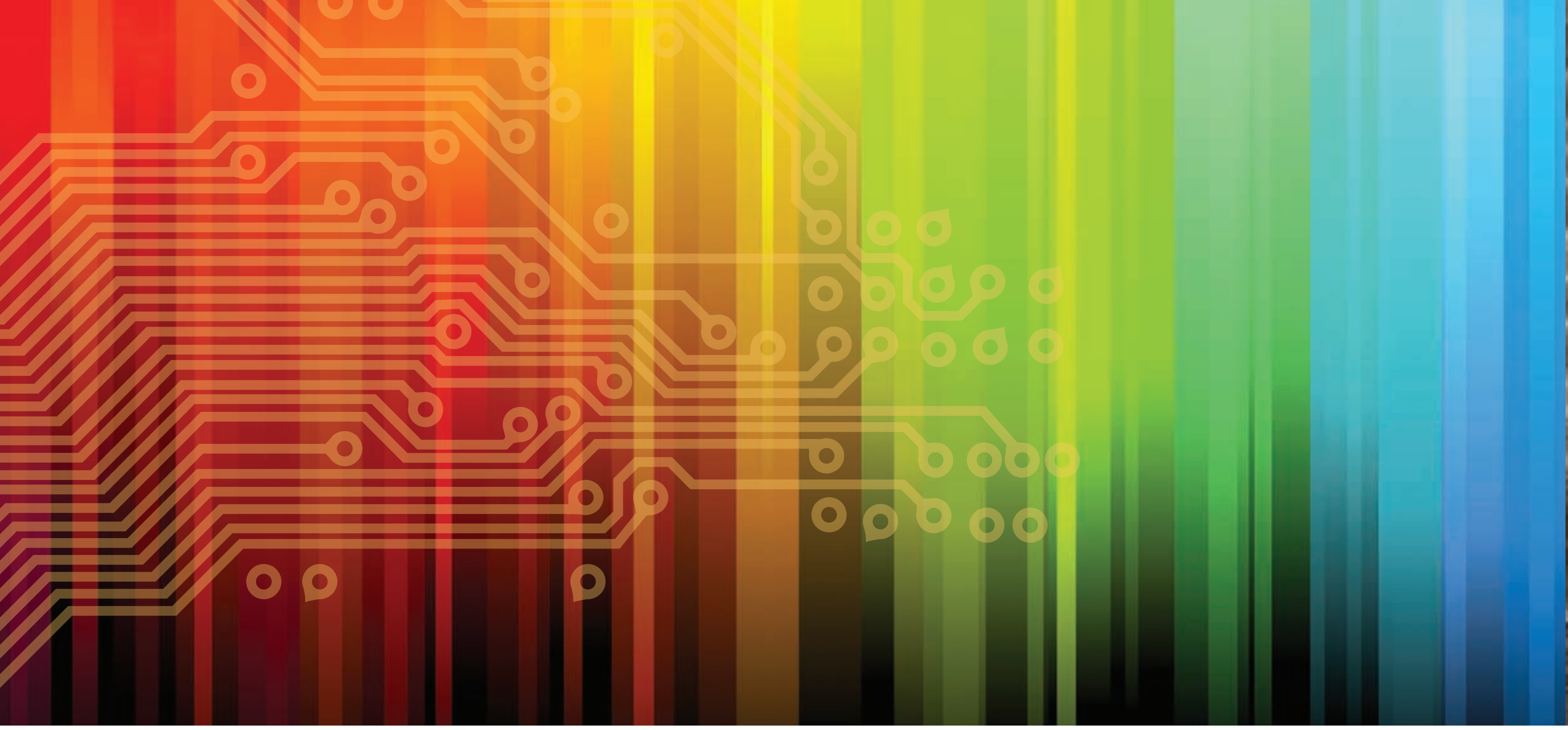
Quantum Focus microscope and micro-probe station

Figure 3: Schematic of an IR microscope system



Planck's radiation curve





a high emissivity coating. However, this can cause heat-spreading and damage the device.

MEASURING WITH MORE ACCURACY

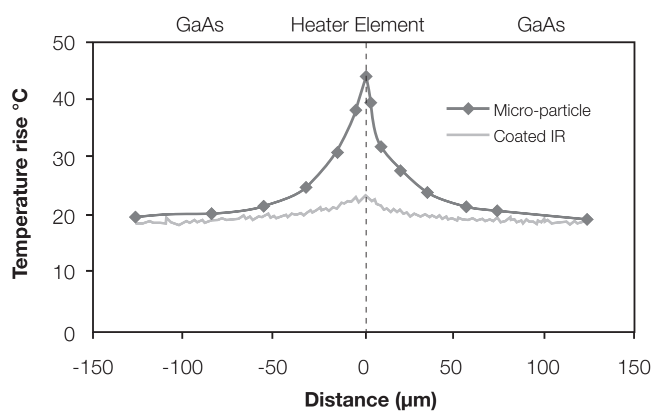
A novel 'micro-particle' IR measurement technique for micro-electronic devices has been developed at De Montfort that overcomes the above problems of not accurately knowing the surface emissivity of the material. The technique has measured the spot temperature and temperature profile for applications including photonic and MEM devices. The graph, right, top, shows a comparison between temperature profiles, measured across a micro-heater structure. Conventional IR measurements show unrealistically low temperatures on both the low emissivity metal heater element and optically transparent silicon dioxide layer. In contrast, the micro-particle technique shows a realistic surface temperature profile across the structure.

A further structure with a three micron wide gold metalised heater element between two ohmic contacts on a gallium arsenide substrate has been measured. A DC current is passed through the heater element. The graph, right, bottom, shows a comparison between thermal measurements using the micro-particle technique and conventional IR, where the heater element has been coated to improve emissivity. The measurement clearly shows the higher spatial thermal resolution of the new technique compared to standard IR measurement and the device with a high emissivity coating.

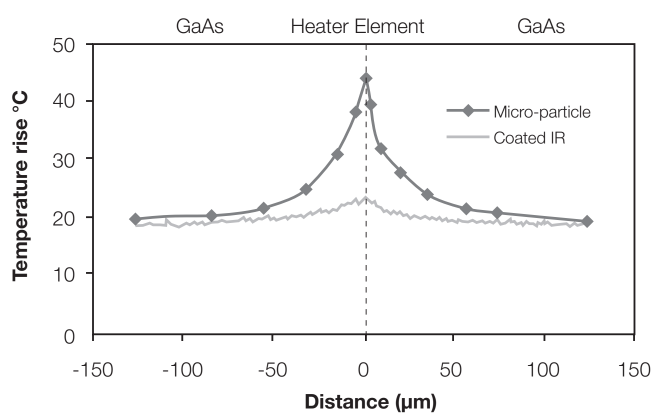
Conventional IR thermal microscopy measurements can obtain real 2D thermal images, and the micro-particle technique improves the accuracy of IR temperature measurements on transparent semiconductors and low emissivity metals. This method has been successful in obtaining more accurate thermal profile measurements on MEM and photonic devices.

Contact Chris Oxley, Electronic Engineering, Faculty of Technology, De Montfort University, Leicester, LE1 9BH.
E-mail: **choxley@dmu.ac.uk**

Micro-particle and conventional IR temperature profiles measured across a metalised heater structure fabricated on silicon dioxide



Improved thermal spatial resolution



Big support for small technology

The Materials KTN, with assistance from the University of Glasgow, has funding available for nanotechnology to assist UK companies.

SPARK Awards funded by the University of Glasgow have been launched in collaboration with the Materials KTN to help the UK nanotechnology community improve their industrial performance by exploiting technology for product and process innovation.

Awards of up to £5,000 are available for UK-based companies to fund problem solving, proof-of-concept technology demonstration and other development activities in nanotechnology. The grants are available for companies wishing to work with the University for the first time, on technology-based projects. The research must be carried out by, or in collaboration with, the University and projects must be completed within four months of receipt of the funding.

The University of Glasgow received an EPSRC-funded Knowledge Transfer Account (KTA), a £2.5m project to address the barriers to the commercialisation of research outputs. The KTAs encourage engagement with industrial partners looking to adopt nanotechnology, to increase the volume of research outputs that have a positive impact on society and the UK economy.

Priority will be given to proposals which –

- Promise rapid results beyond completion of the work.
- Have high leverage of future value for the company.
- Have the potential to generate significant future collaborations.
- Develop novel and/or innovative products or technologies.
- Will deliver value for the UK nanotechnology community.

For an application form, contact Matthew Thornton, tel: 01302 380905, e-mail: **matthew.thornton@materialsktn.net**

Defending the realm

Robin Young from the Material KTN's transport sector reports on a polymers conference that explored defence and aerospace applications.

The 2nd International Conference on Polymers in Defence and Aerospace Applications was held in Hamburg, Gemany, from 11-11 February. With a dense and wide ranging technical programme, sessions included electronic materials and applications, composites, carbon nanofibre-based materials, inorganic nanomaterials, and coatings. The conference had a strong industrial bias.

Keynote papers covered the strategic focus of the UK Defence and Aerospace KTN. Case studies on coatings for solar radiation abatement, self-healing of fibre-reinforced polymer composites and integrating shape memory alloys into composites to improve damage tolerance and lightening strike protection were presented. High performance applications of phosphazene elastomers, now produced in 15t/y quantities in Texas, USA, were described by Billy Goodwin from Materials Science Inc, USA. He pointed to the extreme low Tg (-70°C) and high thermal stabilities of these materials. The topic was continued by Theo Dingemans, of Delft University of Technology in The Netherlands, who discussed aromatic liquid crystal polymers.

Applications of centrifugal mixing of polyurethane foams were described by Karen Foster from the UK's Atomic Weapons Establishment (AWE) in Reading, revealing that the technique may offer benefits compared to handmixing processes. Novel processes and defence applications arising from inkjet printing of functional materials were also described, including printing adhesives for composites joining, conformal circuitry, flame resistant and camouflage coatings, textured surfaces, flexible displays, integrated electronics and optical engineering.

Selective laser sintering of syntactic foams based on glass microballoons and nylon is being investigated in a project at AWE Aldermarston. Highly tailored syntactic foam structures from CAD files with excellent specific properties for composites manufacturing are reported.

Opportunities for conductive polymers based on chimeric polymerisation of a difunctional monomer were presented by Dhana Lakshmi of Cranfield University. The thermo-oxidative stability of these materials and their low moisture uptake point to potential applications in molecular imprinted polymers for nanosensors, lithographic patterning, solar cells, supercapacitors and batteries.

New applications and the advantages of fluoropolymers were also considered. This material system supports electroactive polymer variants that can be engineered to have intrinsic piezo, pyro and ferroelectric properties for sensors, ultrasound imaging and non-volatile printed memories. Applications in the energy sector, notably in fuel cells and portable photovoltaic systems, were described.

Design for manufacture is an increasingly important theme. Chris Bailey from Greenwich University outlined two UK projects (FLEXONLEAD and FAMOBS) on advanced computational modelling to support design methodologies for packaging electronic components.

Analytical techniques based on microfocus X-ray diffraction at the European Synchrotron Radiation Facility in Grenoble were presented. This technique probes the deep structure and micromechanics operating in situ in performance composites undergoing separate or combined thermomechanical stresses. Case studies included fibre characterisation and imaging of woven composite microgeometry, thermal and stress induced lattice distortions and imaging of stress transfer in composite systems.

No materials conference is complete without a nanotechnology theme and this event covered – carbon nanofibres in glass fibre-reinforced polymers as a tool for strain and damage sensing for structural health monitoring, multifunctional composites with carbon nanotubes for space applications, and non-woven carbon fibre veil structures for electromagnetic shielding. Studies of nanoclays and nanosilica additions to phenolic-based glass composites for ablative rocket combustion chambers revealed a clear advantage with silica processing. A talk on nanoparticulate and nickel powder additions to polyurethane-based high performance shape memory polymers and composites included a demonstration of some unique thermo/moisture responsive features.

The conference closed with papers on industrial coatings. Geoff Armstrong, Indestructible Paint Ltd, Birmingham, described specialist systems developed to meet the performance, protection and decorative needs of composites for the defence and aerospace industries. Brian Burkitt, NuSil Technology LLC, USA, described silicone-based formulations to reduce the adhesion of ice to aerospace or engineering structures that offer lower adhesion levels compared to Teflon coatings.

Contact Robin Young, e-mail: **robin.young@materialsktn.net.**

POWDERS 2010

23.06.10

HOLYWELL PARK, LOUGHBOROUGH

This meeting will review past achievements and seek to set future targets for the Materials KTN's activities in the role of powders in addressing:

- Surface engineering
- Power generation material enhancements
- Magnetic material developments
- Additive layer (rapid) manufacturing
- Healthcare applications
- Defence and security applications
- Ceramics processing

TO REGISTER, PLEASE GO TO

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Patching it up

A Framework Programme 7 is funding a project on composite patch repairs for marine and civil engineering applications.

In January 2010 a European consortium of 15 organisations began a Framework Programme 7-funded project on Composite Patch Repair for Marine and Civil Engineering Infrastructure Applications, Co-Patch.

Co-Patch is a novel and potentially effective repair and/or reinforcement method for large steel structures. Two basic structural types will be dealt with – marine structures (mainly steel ships) and iron/steel civil engineering structures (bridges, transmission towers, etc). It is hoped that patches will significantly reduce maintenance costs and, in the case of metallic bridges, prolong their design life and address the consequences of increasing live loads. The proposed technology creates a new market and gives the partners the opportunity to provide high technology and high added-value services worldwide. This will improve Europe's competitiveness in specialised and advanced repair works.

Composite material patching is a promising method for repairing and/or reinforcing metallic structures. Its effectiveness and cost benefits have been proven in the aerospace industry for several years. Composite patches have prevented crack growth and extended the lifetime of repaired structures. In this context, a composite patch works as a crack arrestor by decreasing the stress in the area of the crack tip. One of the aims of Co-Patch is to investigate whether this holds true in marine and civil environments. Composite patching can help mitigate the effects of corrosion and loss of section.

PLANS FOR THE PROJECT

The main objectives of the Co-Patch project are to demonstrate that composite patch repairs or reinforcements can be environmentally stable and, therefore, they can be used for long-term repair of steel marine structures and steel civil engineering infrastructure applications. The project has the following activities planned –

- To demonstrate that Co-Patch leads to the effective repair and/or reinforcement of a steel structural member using theoretical analyses, numerical simulations and experimental testing.
- To determine, evaluate and quantify the efficiency of Co-Patch reinforcements.
- To develop procedures for the design and application of Co-Patch reinforcements.
- To evaluate existing or develop new sensor-based monitoring techniques.
- To demonstrate the effectiveness of the developed design tools and procedures with full-scale tests.
- To develop an internationally recognised training programme for personnel.

INVITATION TO STAKEHOLDERS

The Co-Patch consortium is inviting interested stakeholders to follow the project activities (see main article), within the framework of a relevant stakeholders' forum. Potential benefits of taking part include –

- Gaining information and immediate updates about the development of a state-of-the-art repair technology for marine and civil metallic structures.
- Having immediate, direct and first-hand access to the results of the project.
- The chance to affect the development of this technology by contributing experience towards a final product which will best fit your demands and requirements.
- Creating new business activities.
- Participating in a forum with major European organisations and exploring the possibility of future collaborations.
- Having your assets take part in full-scale tests.

To get involved with the Co-Patch project, contact Dr Farshad Salamat-Zadeh, TWI Ltd, Granta Park, Great Abington, Cambridge, CB21 6AL. Tel: 01223 899 000.
Website: **www.co-patch.com**

Knowledge Transfer Network

Materials

The Materials KTN leads on materials developments that underpin innovation in key application sectors, covering a wide range of materials, such as polymers, composites, technical textiles and metals. It also covers materials-related technologies, such as particulate engineering and smart materials and structures. It has specialist activities covering product design, packaging, and sustainable materials for transport applications. Membership across the KTN is over 9,200 individuals from over 5,700 organisations.

The Materials KTN is –

- Raising awareness of materials development, manufacturing processes, design concepts and application technologies.
- Exchanging and creating knowledge and information about advances in materials.
- Encouraging and brokering collaboration between its member organisations and supporting them to access public and private finance.
- Influencing Government policy and technology strategy by helping to shape national policy, funding schemes and vision in line with industry needs.

Follow us on Twitter, @materialsktn

2010 EVENTS

MAY

Supply Chain Mapping
5 May, Venue TBC

Smart Polymer Systems
5-6 May, Atlanta, USA
Supported by the Materials KTN

Natural Fibres
11 May, Manchester

Hybrid and Electric Vehicles – Design for Disassembly
18 May, MIRA

Applications of Materials for Ballistic Impact
18 May, Venue TBC

Medical Textiles
19 May, Manchester

Functional Foams
TBC May, Begbrook

Innovation for Low Carbon Vehicles
TBC May, AMP, Rotterham

Packaging Minimisation
TBC May, IOM3, Grantham

JUNE

Anti-infection Surface Design
2 June, Keele

Biodegradable Plastics
2 June, BPF, London

High Temperature Materials in Energy Generation
9 June, Rolls Royce, Derby

Managing Innovation in Textiles
10-11 June, Friends Meeting House, Manchester

Packaging Minimisation
TBC June, IOM3, Grantham

Polymer Reuse
TBC June, Cornwall

Bio Packaging for Food
23 June, Harper Adam University, Midlands

Powders Annual Event
23 June, Venue TBC

Near net Shaping in Energy Generation
29 June, Venue TBC

Natural Materials in Construction
29 June, Metropolitan Works

Biodegradable Polymers for Construction
TBC June, Nottingham University

JULY

Emerging Health and Legislation Challenges for Rubber
2 July, IOM3, London

SEPTEMBER

Retail Waste Challenge
21-22 September, London

Rheology Powder Suspensions
TBC September, Leeds

Aesthetic and Functional Designs in Composites
TBC September, RCA, London

For further details on these events and many others, visit the Materials KTN's events page at: **www.materialsktn.net.**