



MATERIALS CONGRESS 2008

From 13-15 May, Grantham played host to Materials Congress 2008.
Materials World reports

A European Perspective

Three plenary addresses tackled the theme of 'Materials for the Future' from different world perspectives. Globalisation and growing competition is the future of materials science, explained Gerd Schumacher in his plenary lecture, 'Materials for the Future – A European Perspective', on the opening day of Materials Congress.

Excellent researchers are required, alongside government investment in R&D and global monitoring of activities, growth and trends. Schumacher urged scientists to monitor the strategic research agendas published by the European Commission to better understand which areas are top priority and being awarded funding.

Materials Euroroads was highlighted as an example of a relevant dialogue platform in which both the European Commission and IOM³ have participated to map the future of materials science and encourage collaboration. A report on the latest meeting of Materials Euroroads will feature in the next issue of *Materials World*.

A Singaporean and East Asian Perspective

In the second plenary lecture, Dr Michael Khor Khiam Aik from Nanyang Technological University (NTU) in Singapore gave an overview of the research and progress being made in East Asia. Aik has strong links to the Institute, having served as President of the affiliated Institute of Materials (East Asia) since 1996.

He described the shift in Singapore from labour intensive in the 1960s, having a skills and technology focus in the 1980s, to knowledge intensive in the 21st century. As evidence of this, R&D funding in the region was 1.9% of GDP in 2000, in 2006 it rose to 2.5%, and a 0.5% increase in 2010 is predicted, with a budget in excess of US\$13bln. The number of papers and citations from Asia has also risen significantly, especially in nanotechnology, microelectronics, materials for devices, eco-materials and photovoltaics.

The National Framework for Innovations and Enterprise in Singapore splits knowledge into three main areas – creation (research and environment), diffusion (creation and support structure) and usage (R&D). This can be seen in plastic films and protective coatings, and also in a tagging system that was developed and sold to a large company in India. Nanyang Technological University and MIT in the USA have undertaken joint projects such as researching quantum dots for improved bandwidth. Aik stressed the need to increase exposure,

R&D and implementation by attracting new talent and forming systems and networks to harness their work. He highlighted the research fellowship from the National Research Foundation at NTU as an advance in this direction.

A UK Perspective

David Bott, in his address on the final day of Congress, gave an overview of the work of Materials UK. The group is focusing on energy, sustainability and design, which must be seen as interconnected, he said.

Materials UK, along with the Materials KTN, are creating debate over the lifecycle of materials to raise awareness of which materials and process routes are best in the long-term.

Materials UK has worked with engineers throughout the supply chain to gauge what is required for the materials of the future. In addition, by improving process efficiency, it is hoped that the UK can make better use of its resources. Bott echoed the need to pass knowledge on to the next generation. 'Those [young] people are incredibly valuable.'

To meet world demand from emerging economies, a 'more sensible use of materials' is needed. Copper and zinc reserves will be insufficient to satisfy lifestyle choices. As the wealth of countries rises, demand for products places more strain on existing resources. 'People are increasingly designing in and selling on sustainability,' explained Bott, but with no regulation, consumers are being misled.

He stressed the importance of materials scientists working with designers, such as in the Materials and Design Exchange node of the Materials KTN, to inform their materials selection. Design needs to take a holistic approach and be a fundamental part of any new product. Bott commented, 'People make decisions based on emotion', and it is the perception of materials that must be challenged in a time of increasing environmental awareness.

Rupal Mehta, Martin Parley, and Zoe Chiverton



David Bott of Materials UK stressed the importance of understanding users' needs to design, by displaying a ballet shoe that incorporates a shock absorbing material

Breaking the steel barrier



The Alstom stand at Materials Congress 2008

‘The clock is ticking to retrofit existing plants and build new ones. The main message is we have to do it pretty urgently,’ said Michal Bialkowski of Alstom Power Systems, Baden, Switzerland, at the company’s masteclass for Advanced materials for energy.

The session provided an insight into the challenges facing the entire power supply chain as regulations concerning emissions from oxides of carbon, sulphur and nitrogen, as well as particulate emissions, kick in.

Alongside nuclear energy and renewable options, coal remains an important resource for future energy needs. Materials science is pushed to new limits as the industry attempts to upgrade existing coal-fired plants and build new ones operating at higher temperatures and pressures for greater efficiency and reduced emissions.

Rod Vanstone of Alstom Power, UK, explained that ‘the current state-of-art is at 600°C and, in the future, we will see those temperatures rise to 700°C. The properties we will need from materials include creep strength, mechanical strength, steam oxidation resistance, flue gas corrosion resistance, and weldability (especially for the furnace walls). Over the last 20 years, industry has responded to the challenges by taking advantage of collaborative frameworks for materials R&D’.

An example is the AD700 demonstration plant in Germany. Financed by the EU’s Fifth Framework Programme and supported by industry, the

focus is on establishing the technology for ultra-supercritical pulverised coal-fired power plants with steam conditions at 700°C using new nickel-based alloys. The use of steel is believed to have reached its limits at these temperatures, and materials suppliers such as Goodwin Steel Castings Ltd, Stoke on Trent, UK, are increasingly researching nickel-based alloys.

Steve Birk of Goodwin discussed how the 625 nickel-chromium-molybdenum alloy has proved most suitable, and the company is looking to scale up and test larger castings. ‘We all have to look at solidification simulation for nickel alloys to better understand how they fit, compare molten metal capacity and improve analysis capability.’

Throwing down the gauntlet to global competition, he added, ‘I was at a conference last week in the US, and they are working on advanced supercritical plants at 760°C. We are working at 700°C. At 760°C [the materials] are even more difficult to weld and cast, and thermally complex. I am sure the European project will be up and running before this one gets off the drawing board!’

Rupal Mehta

Reducing the load



Jaguar and Land Rover’s Lightweight vehicle strategy masterclass explored state-of-the-art technologies for reducing vehicle weight. Several of their cars were on display including the Jaguar XF (see image).

Smith and Nephew hosted the Biomaterials for orthopaedics and wound management masterclass.

A national profile for materials

In a first of its kind for any discipline in the UK, a report presenting a national profile of materials education was launched at Materials Congress 2008. It is designed to provide evidence to departmental heads in higher education to help organise teaching and aid effective dialogue between academia and industry.

‘Why should you care about this?’ Professor Peter Goodhew asked delegates at the launch of the *National Strategic Profile for higher education programmes in materials*. The Director of the UK Centre for Materials Education, who helped steer the research, answered, ‘Because we tried to address the issue of what graduates know, what they do and why you should hire them’.

The team found that the number of university departments for materials had reduced over the past decade, but student numbers for studies involving materials content had remained static. ‘[The field] is bigger than you think. That’s the good news,’ said Goodhew.

However, the trend is towards biomaterials and sports materials. Furthermore, less than half of undergraduates had ‘A’ levels in all three of mathematics, chemistry and physics. ‘This has a significant impact on what you can teach and how fast,’ explained Goodhew. A survey also showed that materials graduates did not feel they were as prepared for the workplace as their teachers did.

Richard Dolby, past President of IOM³ and Chair of the national profile steering group, concluded, ‘This report will be useful for academics and industry on how to recruit young people into materials. Less than 30% of our output of graduates go into industry – we have to do better’. The report is available at www.materials.ac.uk/subject-profile/report.asp.

Rupal Mehta

Making the right choices

With raw materials running out, finding alternatives is increasingly important. In the Eco-design – materials for a sustainable society symposium, Nick Morley from Oakdene Hollins, Aylesbury, UK, said, ‘There are a lot of at risk materials so we need to [increase security around] access to raw materials to ensure economic and military sufficiency’. At risk materials such as copper are hard to recover due to use in electrical devices, and the only way to recycle the metal is through wiring. According to Morley, copper will reach its limits by 2050. ‘We need policies to...prevent irrecoverable disposition...by developing substitutes, creating stockpiles and encouraging recycling.’

Robert Ayres from INSEAD in Paris, France, discussed the ‘Age of Substitutability’. ‘Economists say when shortages loom substitutions increase, and alternatives have always been sought – oil was made from coal by the Nazis, but coal supplies are not limitless.’ Aluminium is a good substitute for copper but is labour intensive and can present a fire hazard.

Lifecycle analysis is an important tool for sustainability, showing that the whole life of a material can be planned for. Alan Griffin from Corus RD&T, UK, said, ‘Good data is needed through better transparency from companies to allow cradle-to-grave assessments’. Analysis identifies environmental issues that can then be addressed at the design stage.

New environmental regulations are forcing changes that will improve materials used in manufacturing processes. ‘Implementing REACH...is time consuming [for companies], but by tracking all chemicals in products the health benefits will save an estimated 50bn euros over 30 years,’ said Caroline Phillips from Rolls-Royce plc, UK.

Martin Parley

On the surface

Young Researchers' Lecture Competition



The Young Researchers' Lecture Competition saw 11 contestants compete over two-days. After a 10-minute presentation, they faced questions from a demanding audience and a panel of judges.

Dr James Curran of Keronite International Ltd, UK, (see image) emerged as the winner with a clearly delivered talk on 'Plasma Electrolytic Oxidation (PEO)'.

His presentation was pitched at a level

appropriate to an audience who were not all familiar with PEO. This allowed him to introduce technical details without losing clarity of expression. He confidently answered questions such as why this method of producing coatings has a low stiffness. Chair of the judges Rod Turner, of Tecvac Ltd, UK, praised Curran's 'very interesting' lecture, while acknowledging that across the board the 'standard was very high indeed'.

Runner up was Steve Edge, also from Tecvac, who spoke on an 'Erosion Test for Evaluating Solid Particle Erosion Resistance of EB-PVD Coatings'. His research was instigated by Tecvac's requirement for an erosion test that would also be a tool for knowledge capture. Though the final test method was successful and could rank the suitability of different coatings and substrates, an inability to control all the variables led to repeatability problems.

Simulation workshops

The lecture competition was sandwiched between two simulation workshops. The first challenge was to design a robust solution for aeroplane turbine blades. Using a computer model, teams chose whether or not to coat components and by which process, the coating's thickness, and the design gap between parts. Adhering to client demands such as a minimum of 5,000 lifecycles, teams selected the best combination of variables. This stressed the real world necessity of trying many different iterations pitted against time constraints.

The biomedical workshop involved fitting patients with hip systems, balancing cost to the patient and healthcare provider against failure time of the joint. The age of the patient and materials selection gave delegates 'an idea of choices and the affect [they] have'. The winning team from the workshops received an all expenses paid trip to CSM Instrument's R&D facility in Peseux, Switzerland.

Zoe Chiverton



Delegates enjoy a networking opportunity over coffee in the marquee



Ryan McCurdy, Oxford Brookes University, UK, discussed debonding adhesive joints for dismantling

Pulling to pieces

Disassembly emerged as the main theme of the Materials KTN-sponsored Materials technologies for end-of-life symposium. The session looked at several aspects of end-of-life, including waste recovery and the ease of dismantling components.

'What we're trying to do is educate [companies],' said John Davidson, Managing Director of Milled Carbon Ltd, UK, as he laid out the challenges his company faces collecting carbon fibre for reprocessing. The sector needs to be end-of-life aware so that 'waste' is stored

in the correct manner, and dismantling of vehicles maximises the return of material. Commercial viability is also a major consideration – many materials are not reprocessed for financial reasons.

In a similar vein, de-bonding automotive glazing and disbanding adhesive joints should aid ease of recycling. The necessity to design for disassembly was stressed by Robert Quarshie, Operations Director of the Materials KTN and chair of the session.

An area of end-of-vehicle-life not often considered is airbags, explained Mike Dodds of Automotive Recycling Technologies in Daventry, UK, as the Environment Agency does not enforce their detonation. With some 1.3bln airbags in vehicles in Europe, and the number set to rise, the task of removal is substantial. Automotive Recycling Technologies has designed a safe method of detonation.

The company's product is affixed to the outside of the car by magnets and connected to the deployment switch inside the vehicle. From a safe distance, the device is activated and the airbags deployed one at a time at the press of a button. The airbag material can be recycled, but unless in large volumes, it is not commercially viable.

Zoe Chiverton

Building for the future

The keynote speaker at the Construction materials for a changing world session, Jane Thornback, from the UK's Construction Products Association said, 'Sustainability is hard for construction processes because they are the major contributor to carbon emissions. The UK Government wants 240,000 new homes by 2016 and to increase social housing by 45,000 units per year, but these can't be met without reducing the environmental impact of construction. We have to change the way we design and build'. The industry needs to remove carbon from the manufacturing process and make better heating, insulation and glazing products to increase energy efficiency. 'We need to design out waste and achieve more with less, with environmentally responsible sourcing schemes and looking at how they do things in other countries.'

Colin Hills from Greenwich University, UK, discussed how to use CO₂ gas as a resource to pretreat landfills using lime mortars. 'The carbonating ability of thermal wastes using calcium oxide will reduce the pH of hazardous substances. It makes contaminated water from the soil perfectly drinkable.' The resulting pellets can be made to differing strengths and therefore offer possibility of reuse elsewhere.

Arnold Black, Network Director from the Resource Efficiency KTN, said, 'We need to concentrate on material scarcity and resource efficiency. Construction materials should be made from waste such as light blocks and aggregate using pulverised fuel ash'. There is also the need to innovate materials and supply chains. 'Companies [should] pick up these developments before the researchers run out of money, but they don't, so...they have no money to produce further innovations,' he said.

Martin Parley