Schools Affiliate Scheme Newsletter

Issue 2

I hope that you found the first issue of this newsletter useful. Certainly the feedback I have received suggests this is so.

In this second issue we have our first careers page featuring Laura Walker, a graduate of Surrey University, now working for Marconi Materials Technology. Additionally the spotlight is well and truly on the Universities with details of courses available, a report on the recent Polymer Circus at Brunel University and details of the CIEC, (Chemical Industry Education Centre), based at York University.

Unfortunately, because of the relatively short time between the issue of the first newsletter and publication of this one, there has not been much time for your letters to be received, and so that section has been delayed till next term.

However we do value your comments so please do let us know what you think and what you would like to hear about.

For those of you interested in purchasing the Science Museum CD-ROM we have good news. We are negotiating a special discount price for members of the Schools Affiliate Scheme. I will let you know more when it is sorted out.

Finally, have you all seen the Tomorrows Materials booklet that came out last term? Comments from some schools suggest that they may not all have found their way into the right hands, and some packages were returned to sender! Every school has been sent a package containing 10 pupil's booklets plus 1 teacher's booklet. The package was addressed to the Head of Technology, so if you have not seen a copy you know who to speak to.

The Institute of Materials

1 Carlton House Terrace, London SW1Y 5DB

Tel 0171 451 7300
Fax 0171 839 1702

Website: http://www.instmat.co.uk

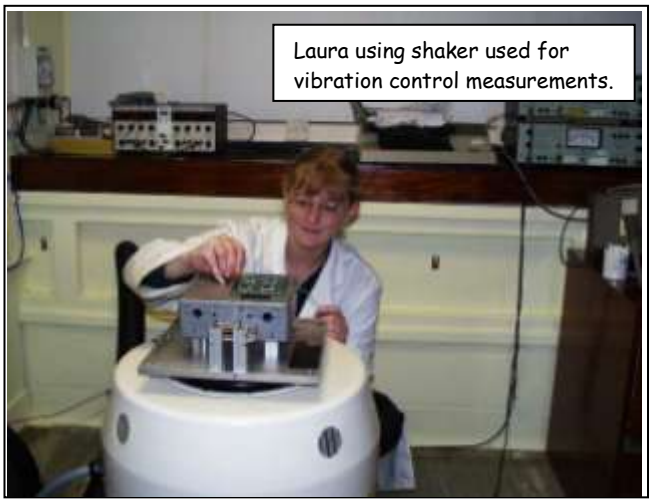
Ruth Withey
Scheme Co-ordinator
01454 882577
ruth.withey@virgin.net

Resources guide update

The Institute of Materials recently had a section in its website in which you can find details of resources produced by other organisations, be they be professional bodies such as ourselves, commercial publishers or industrial concerns which have an educational resources department. However, this resources guide is in need of updating. We have undertaken to contact the major organisations, which in the past have produced suitable resources, but there may be a local organisation that you have found useful which may be appropriate for inclusion. If this is the case, please let me know.

What's inside

“Surrey, Sandwiches and Scans”.

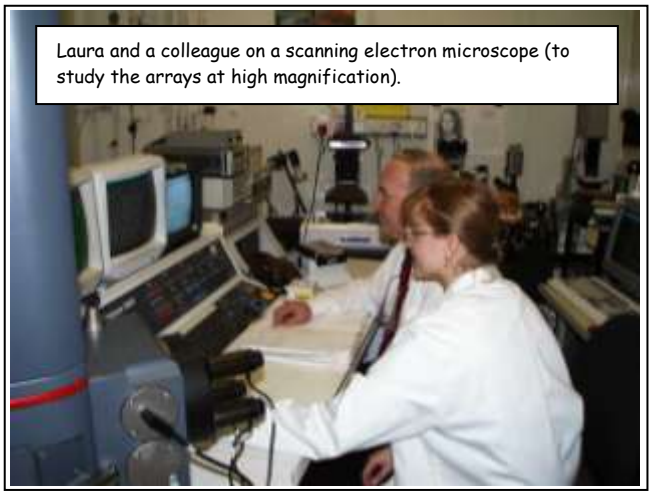


Laura using shaker used for vibration control measurements.

Name:	Laura Walker
Qualifications:	3 ‘A’ levels (Pure and Applied Mathematics, Physics, Chemistry.)
	BEng 2(i) (Hons).
Employer:	Marconi Materials Technology, Northamptonshire

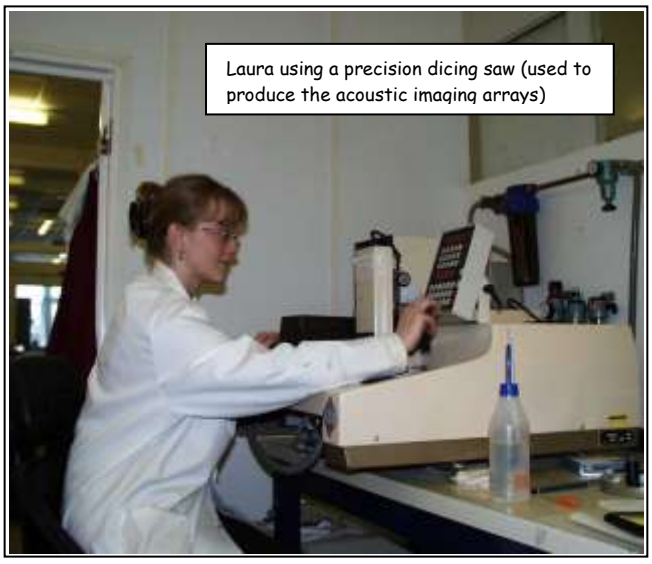
I was very lucky at school because I had some very good science teachers who supported my interest in pursuing a technical career. After completing my GCSE exams I went on to 6th Form College and, in my first year at college, I participated in a two day, residential WISE (Women In Science and Engineering) course, at Imperial College. The WISE course gave me the opportunity to find out about different areas of science and I initially decided to study Chemistry at University. Just before the UCAS application process began, a higher education open evening was held at my college. I went to speak to the representative from Surrey University (one of my choices for studying chemistry); once she found out about my interest in science, she started talking to me about her department - Materials Science. When I visited the materials department I was hooked! I decided to study Materials Science as I wanted to utilise my knowledge of both chemistry and physics within a practical application.

I studied at Surrey for four years on a sandwich course, in which a year was spent training in Industry. I worked at Kobe Steel Europe Ltd. in Guildford, on a variety of projects concerning the growth and characterisation of synthetic diamond. This work experience was invaluable to me, not just because of the technical knowledge I gained but also through the development of other business and interpersonal skills. Everyone in my year who participated in the industrial year training returned to University as a more confident and professional person, and I would recommend a sandwich course to anyone wishing to study a technical subject.



Laura and a colleague on a scanning electron microscope (to study the arrays at high magnification).

I am currently working in the Electroceramics and Acoustics group, at Marconi Materials Technology, on a European funded project on two dimensional imaging arrays. Ultrasonic imaging is a technique which is most commonly associated with pregnancy scans, but the possible applications are much further reaching. The imaging technology which is presently available has several limitations. Scans have to be performed manually and the images produced are only in two dimensions. Two dimensional imaging arrays offer the possibility of scanning in multiple directions and of obtaining three dimensional images. This has important implications in the field of medical imaging, where surgeons would be able to scan through organs looking for tumours. This technique has the possibility of removing a lot of the need for exploratory surgery and could, in some cases, replace harmful non-invasive techniques such as x-rays. Other important applications include underwater imaging and non-destructive testing. For instance, a diver’s helmet could be mounted with an imaging system, allowing them to see objects through low visibility waters.



Laura using a precision dicing saw (used to produce the acoustic imaging arrays)

My role as a Materials Engineer has included developing the materials and processing routes for the active parts of these devices. Although my degree has given me a good background in materials, in this type of job you constantly need to learn new skills and update your knowledge, which includes branching out into other fields. If you take up a technical career you have to appreciate that you don’t finish learning when you finish your academic career, which is one of the reasons why I enjoy it!

Material **world**

INVESTIGATING MATERIALS AND THEIR USES.

Video and Teachers Guide produced by BNFL.

The teachers guide is divided into 3 parts covering;

1. Properties and purposes of materials.
   Review of materials.
   The structure of materials.
2. Measuring physical properties.
   History of metals
   Structure of metals
   Bubble rafts
   Structure of plastics
   Mechanical testing
   The hardness test
3. Modifying materials.
   Two case studies to be used in conjunction with the video.

Guidance is given as to the background knowledge required for completion, the ideas to be covered, recommended assignments and grading criteria, and practical examples and demonstrations of the principles being covered. There are also numerous simple illustrations that could be easily copied in order to help explain the topics, or to ensure that the demonstrations are correctly undertaken to represent the issue in question. Tables of additional information are provided to ensure that similar processes or materials can easily be distinguished. Technical terms are explained in the glossary at the back of the book.

Our opinion.

Well laid out, with plenty of information around which to build lessons. Throughout the teachers guide, mention is made of the practical problems and consideration faced by industry, to enhance understanding, and show the relevance of each topic. There are plenty of explanations of terms, properties and phrases to ensure a clear understanding.

Good Points

- Excellent value for money
- Thorough explanation of each section, with clear illustrations.
- Practical demonstrations suggested for each topic.

Bad points

- Video very short, more examples to support other sections of the teacher's book would be useful.
- Teachers guide is in black and white.

Cost : £3.45 (currently reduced from £6.95)

Contact :
BNFL Education Unit, PO Box 10,
Wetherby, West Yorkshire, LS23 7EL

Tel 0500 141142

Ability level :
Unit 2 Advanced GNVQ Science

Size : Video 14 min. Teachers Guide 48pp

Although this scheme is run by the Institute of Materials we realise that Materials does not stand in isolation but as part of the whole science and engineering landscape. Accordingly, we shall be bringing you details of what is happening with other professional bodies. One exciting website, **www.chemsoc.org**, is run by The Royal Society of Chemistry.

Of particular interest is the new ***109 – Visual Elements,*** a stunning periodic table. **www.chemsoc.org/viselements.** Featuring graphic images of all the elements, chemical information and breathtaking periodic landscapes, this site is a good way to put the "WOW" back into science. 109-VE aims to produce a new and vibrant visual assessment of the startling diversity of material that constitutes the world in which we live, not simply by rendering images of the elements but also by investigating the manner in which they affect our daily lives in largely unseen and often unexpected ways. There are free downloads, including a screensaver and futuristic elemental wallpapers for your desktop.

University Courses

We recently invited the universities that run courses accredited by the Institute of Materials to say a little about why your pupils should want to become their students. This is what they had to say.

Materials Science at the University of Birmingham

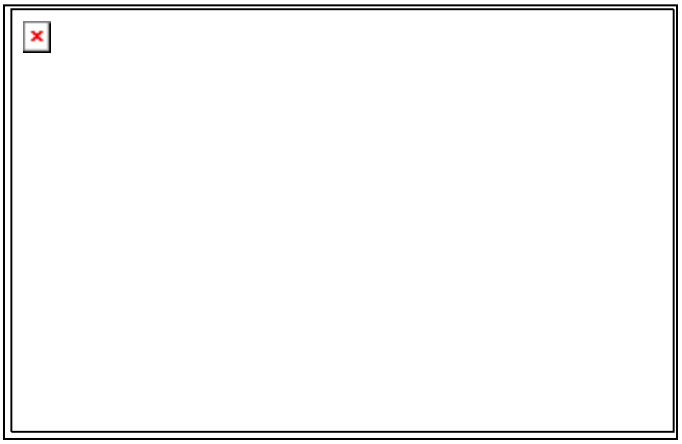
Materials Science and Engineering offer some of the best opportunities, of all degree subjects, for diverse and interesting careers: for example in areas such as automotive and aerospace manufacturing, medical materials, sports equipment development, biodegradable plastics packaging, or alternatively careers in finance or marketing etc. Unemployment for materials graduates from the University of Birmingham is less than 5% with many students having several career possibilities to choose from including employment with a multinational company or industrially funded research for a post graduate degree.

At Birmingham we offer degree courses in a variety of materials based courses based within one of the top teaching and research departments in the country. Our single honours Materials Engineering degree is accredited by the Institute of Materials (this is important as it allows students to progress to Chartered Engineer status and hence, potentially, to accelerated career promotions). We give students the opportunity to take options during the course, particularly in their final year, in areas such as aerospace materials, sports materials, biomedical materials, advanced polymers and ceramics. Our students also have the option of studying a language throughout their course.

We have introduced a new course in Sports and Materials Science following the recent trend for increased performance of advanced sporting equipment and the national increase in leisure time and desire for improved personal performance. This new course was praised in a recent article in The Guardian newspaper on 6th April 1999 "... *New developments and innovations in sports equipment have made a huge impact on performance. Chris Boardman's record breaking bicycle has been lauded as the consummate example of the appliance of Science. The Government wants the "boffins" to turn their attention to other high-tech sports equipment, from running shoes, tennis racquets, vaulting poles to playing surfaces and clothing. It makes Birmingham University's timing very apt.* ..." The course is the first of its kind in the country and there is no better University to run such a course as both departments (the School of Metallurgy and Materials and the School of Sports and Exercise Sciences) are highest ranked (5* and 5 respectively) in research.

We run two other joint courses; the first is Biomedical Materials Science which is run with the Schools of Medicine and Dentistry. On this course students study materials science, cell biology, human anatomy and physiology, engineering and experimental design with an aim of understanding the use and development of biomaterials such as artificial hips, bone substitutes, drug delivery systems, contact lenses etc. The other joint course is in Mechanical and Materials Engineering which is accredited by the Institute of Materials and the Institution of Mechanical Engineers. The course is designed to meet the growing need for engineers who can design products making the best use of advanced materials.

Overall the School of Metallurgy and Materials at the University of Birmingham is a vibrant place with an active student community. We have around 60 students in our first year split between our courses and about 20 academic staff so we soon get to know each other. The students have their own social group called BUMS (Birmingham University Metallurgical Society - we've kept our old name even through we are now much more diverse) and organise events such as an annual Ball, summer barbecue, quiz evenings etc. As a School we organise visits for our undergraduates to engineering and manufacturing companies to show them the uses of the science and engineering which they learn. Most of our students undergo work placements during their course, which we will organise if required. We are also in the fortunate position of being able to offer a number of scholarships and bursaries to our students, often linked to outside companies.



The photograph above shows some of our students being awarded prizes by Mr Rushforth (Assay Office in Birmingham) and Professor Smallman (School of Metallurgy and Materials).

Brunel University

Brunel University has a long history of educating students in Materials Engineering and producing excellent quality graduates rated highly by industry. Brunel is also famous for its sandwich courses. Our students have travelled to most of Europe and the USA to gain valuable industrial experience. Along with the opportunity to develop personal skills to add to their knowledge base, our students have the "graduateness" much sought after by today's industry.

We are an informal friendly Department and enjoy looking after our students. This year will see a new Head of Department, Jon Binner, formally of Nottingham University. Jon is keen to develop new courses, introducing elements such as Design to our existing portfolio of engineering and management courses. Please see our web site later in the year for more details.

The Department hosts teacher's courses, Insight courses and welcomes visits from schools. We are always pleased to provide speakers to visit schools. Please contact Lynn, our Admissions Tutor.

Loughborough University - Materials Engineering/Materials with Management Studies

The Institute of Polymer Technology and Materials Engineering (IPTME) is part of Loughborough University, located mid-way between Leicester and Nottingham in the beautiful Charnwood Forest area in the heart of England. A mile from campus, the M1 motorway provides rapid access to most destinations; London is only one and a half hours away by train and the nearby East Midlands International Airport extends one's horizons further.

Loughborough has a graduate recruitment record consistently rated amongst the best: Loughborough graduates are in the top 3 of the "1998 UK's Most Employable Graduates" survey. Employers target Loughborough looking for high calibre graduates with a keen interest in the world of work and excellent skills developed through the courses offered and opportunities provided for participating in campus life. This is reflected in the fact that new engineering graduates, head hunted for example by the Ford Motor Company, are reporting starting salaries in excess of £20,000 pa.

The University's sporting prowess and facilities are legendary, with both men and women having topped the UK universities league table for all sports for over 20 years. Our students are extremely well catered for, with access to some of the best facilities in the country, an impressive new sports hall, two all-weather artificial pitches and the new Dan Maskell Tennis Centre.

One of the many attractions of Loughborough is the relatively inexpensive cost of living, backed up by the good value of University accommodation. Accommodation is guaranteed for applicants making an early commitment to Loughborough. The single-site campus cuts out travelling expenses, with academic departments, halls and most of the facilities you need within a few minutes' walk. If a student wants to supplement their income, there's the student-run employment exchange, matching students to part-time jobs on campus and locally, and a variety of sponsorship opportunities.

The philosophy of the IPTME is based on the engineering application and use of materials, which when processed, are altered in structure and properties. This philosophy encompasses design considerations and business implications. The fact that the largest activity in the IPTME has always concerned polymers gives the Institute a unique outlook as most materials departments have developed from their historical predecessor of metallurgy. The Institute is particularly well equipped in the areas of materials characterisation and materials processing. In the past we have received the coveted Courtauld's Prize for innovative excellence in teaching and learning and, more recently, our teaching activities at both undergraduate and postgraduate levels were very highly rated by the Quality Assurance Agency for Higher Education. In addition, the work of the Institute's four research groups was highly rated in national research assessment exercises.

The Institute of Polymer Technology and Materials Engineering offers undergraduate degree programmes in Materials Engineering (BEng/MEng) and Materials with Management Studies (BEng) which are enhanced by its important research activities and close contacts with industry. Industrial links are substantial, with a number of top industrialists participating in our degree programmes and many opportunities to visit different companies offered to students.

A strong feature of the degree programmes is the opportunity to spend a year in industry between the 2nd and 3rd year, which leads to an additional University qualification - the Diploma in Industrial Studies. Indeed many of our students have spent an enjoyable year working on exciting projects at leading companies both in the UK and within continental Europe. We assist in finding placements, which have ranged from Formula 1 motor racing companies, aircraft and automotive companies, to marketing and business management positions within industry.

Study in Manchester; a vibrant and cosmopolitan student city.

UMIST and the University of Manchester work closely together in many areas of undergraduate life. One example is the Materials Science Centre, which has been a joint University department since 1988. Students enrolling on Materials Science courses at Manchester may apply through either University, according to personal preference, but will be taught together and enjoy the benefits of having access to all the sporting, social and academic activities of both Universities throughout their undergraduate career. Both University campuses are self-contained and are situated 5-10 minutes walk from the city-centre. With a total of 30,000 students, Manchester is something of a student city with a liberal and cosmopolitan atmosphere, and offers a social life that allows students both to work and play hard during their undergraduate career.

The Manchester Materials Science Centre has 25 academic staff, around 120 postgraduate and postdoctoral research staff and about 130 undergraduates. The undergraduate courses are all CEng accredited and offer a balance of academic training, project work where students get 'hands on' experience of modern research equipment (5*A rated), and soft skills development that are well received by employers. In fact UMIST and the University of Manchester consistently fill top three positions in the annual PIP survey where around 250 major employers in the UK express preferences for graduates from particular universities. This year, for example, the University of Manchester was first and UMIST third overall. The same survey consistently ranks the joint careers service in Manchester as the best in the country. UMIST and the University of Manchester together have a low proportion of graduates still seeking employment six months after graduating, currently 2.2% compared with a national average of 6.9% (HESA statistics). Links established through the ERASMUS and SOCRATES schemes enable students to study in other European Universities as part of the course. Additionally vacation work and sponsorship can be sought through departmental contacts or UMIST's skills exchange service. The jointly run UMIST/University of Manchester accommodation

service guarantees a place in a hall of residence for all new undergraduates in the first year. Students renting accommodation in the private sector are assisted by an accommodation bureau, Manchester Student Homes, supported by the Universities and the Student Unions, dealing with all letting issues and ensuring fairness from the student's (and the landlord's) point of view.

Finally, sport is big in Manchester. Apart from the obvious connections, the Commonwealth games will be held here in 2002, guaranteeing international standard facilities for a wide range of events and a UK focus for world wide sporting activity.

Picture caption: Materials in Action. The Commonwealth Games swimming facility currently being built adjacent to the Materials Science Centre.

Plymouth University

The University of Plymouth is the only institution in Europe that offers the graduate BEng (Hons) Degree in Composite Materials Engineering. This unique course pursues a progressive approach to learning that is both challenging and innovative. The degree is full accredited by both the Institute of Materials and the Institution of Mechanical Engineers, and provides excellent career opportunities in the composites industry. In recent years, graduates from this University of Plymouth course have found employment in a variety of technical fields, including:

- British Aerospace, GKN Westland, & Rolls Royce (aerospace)
- Activa, Ford and Lotus (automotive)
- McLaren and Williams (Grand Prix)

Plymouth's coastal location provides not only a beautiful place in which to study, but it is also ideally situated to study composite material for the marine industry. In 1998, final year students on the Composite Materials Engineering course were engaged in projects covering a diverse range of subject areas, for example:

- Fatigue of composites underwater
- Design and analysis of composite propellers
- Manufacturing options for aircraft wing panels
- Human powered water bicycle (with Saracen)
- Design and manufacture of mountain bike components

For further information on composite activities at Plymouth contact Dr David Plane.

James Llewellyn, a 1998 graduate from the University of Plymouth, with a rear suspension arm, for a mountain bike produced as a team assignment.

Department of Materials, Queen Mary and Westfield College, University of London.

We were the first Materials Department to be established in the UK and the first to offer a degree course in Biomedical Materials. Associated with the Department is the Interdisciplinary Research Centre in Biomedical Materials (IRC), an internationally recognised centre of excellence for current and future developments in biomedical materials. This major research institute, at the forefront of current knowledge, provides the backdrop to teaching of the subject.

Bio-Medical Materials Science and Engineering 4 year MEng degree

Materials and Mechanical Engineering 4 year MEng degree

Bio-Medical Materials Science and Engineering 3 year BEng degree

Materials Science & Engineering 3 year BEng degree

New materials are the challenge of the millennium - semiconductors, polymers, ceramics, metals, composites – they drive the advance of technology from global communications to surgical implants. These courses provide a thorough grounding in materials science covering the structure and properties of engineering materials integrated with processing and design in a holistic approach.

Biomedical Materials is the science that supports the health care industry, one of the fastest growing industries in the UK. The biomedical arena presents demanding new challenges for material performance in the rigorous environment of the human body. Biomedical materials are synthetic and biological materials designed to partially or totally replace tissues

or organs which have been affected by disease or damage as a result of trauma. Some examples include; cardiovascular implants, contact lenses, orthopaedic devices, dental materials, specialised splints and dressings. The development of such materials and devices is essential to improving the quality of life.

The Department prides itself on providing innovative teaching in a friendly and informal study environment. Our students develop an interdisciplinary approach together with computer and personal skills to equip them for rewarding careers in a wide range of industries.

(photo) body.jpg

Caption:
Ultimate tensile strength, 135 MPa
Corrosion resistance, 100 years+ service life
Fatigue resistance to 100 million cycles
not bad for a body tissue.

Queen's Anniversary Prize for Materials Engineering Degrees (Swansea University)

This Prize was awarded for the innovative postgraduate degree programmes in association with the UK aeroengine, steel and power industries which train high calibre graduates in materials engineering for future career success in industry and academia. The distinctive masters and doctorate degrees meet the highest educational standards required for graduate progression to Chartered Engineer status. The new structures and delivery styles are suitable for full and part-time study for courses of continuous professional development for staff employed full-time in industry.

The degree schemes integrate substantial industry-relevant research projects with training courses designed to enhance the technical capabilities as well as the personal, business and managerial skills of top graduates. Planned from the outset with industrial partners, the schemes are tailored for individual companies or sectors to meet their specific research, innovation and human resource needs. The research projects can be themed to complete major multidisciplinary tasks.

Project activities are performed in university, industry, industrial research labs or a combination of locations as appropriate. An outstanding equipment base has been established in the University, which benefits undergraduate teaching as well as postgraduate training and research. Organised as university / government / industry partnerships, these programmes provide a validated model for enhanced training of professional engineers.

Pictured above are postgraduate students from Swansea University's Materials Department on a recent trip to Buckingham Palace to collect a Queen's Anniversary Prize for Education. Pictured (l-r) are Adam Cietak, Susan Powell, Sharon Bishop, Debbie Wakeman and Liam Way.

Pictured below are Professor Robin Williams (Vice Chancellor) and Professor George Wilshire (Head of Department) being congratulated by The Queen.

Here are some contact detail should you wish to find out more about these universities

University	Admissions Tutor	Phone number *(Fax number)*	E-mail **Website**
Bath	Dr Tim J Mays	01225 826588 *01225 826098*	t.j.mays@bath.ac.uk **www.bath.ac.uk/~msstjm/home.html**
Birmingham	Dr Claire Davis	0121 414 5174 *0121 414 5232*	c.l.davis@bham.ac.uk **www.bham.ac.uk/metallurgy**
Brunel	Dr Lynn Gabrielson	01895 203253 *01895 812636*	lynn.gabrielson@brunel.ac.uk **www.brunel.ac.uk/depts/mt**
Cambridge	Dr John A Little	01223 334376 *01223 334567*	jal4@cus.cam.ac.uk **www.msm.cam.ac.uk**
Imperial	Dr Robin W Grimes	0171 594 6730 *0171 584 3194*	r.grimes@ic.ac.uk **www.mt.ic.ac.uk**
Leeds	Dr Rik Brydson	0113 233 2369 *0113 242 2531*	materials@leeds.ac.uk **www.materials.leeds.ac.uk**
Liverpool	Dr Paul R Chalker	0151-794-4313 *0151-794-4675*	pchalker@liv.ac.uk **www.liv.ac.uk/mateng**
Loughborough	Dr Rachel Thomson	01509 223155 *01509 223949*	r.c.thomson@lboro.ac.uk **www.lboro.ac.uk/departments/iptme/**
Manchester	Dr Colin Leach	0161 200 3561 *0161 200 3586*	colin.leach@man.ac.uk **www.umist.ac.uk/matsci/**
Newcastle	Dr A Anderson	0191 222 6216 *0191 222 8600*	sandy.anderson@ncl.ac.uk **www.ncl.ac.uk/mmmeng**
Nottingham			**www.nottingham.ac.uk/memd**
Oxford	Dr Chris Grosvenor	01865 273761 *01865 273764*	enquiries@materials.oxford.ac.uk **www.materials.ox.ac.uk**
Plymouth	Dr David Plane	01752 232647 *01752 233310*	dplane@plymouth.ac.uk **www.tech.plym.ac.uk/sme**
Queen Mary and Westfield	Cath Pedley	0171 975 5159 *0181 981 9804*	c.h.Pedley@qmw.ac.uk **www.materials.qmw.ac.uk**
Sheffield	Dr John M Parker	0114 22 25514 *0114 22 55943*	j.m.parker@sheffield.ac.uk **www.shef.ac.uk/~em**
Strathclyde			**www.strath.ac.uk/departments/mecheng**
Surrey	Dr Mark J Whiting	01483 259611 *01483 259508*	m.whiting@surrey.ac.uk **www.surrey.ac.uk/mme**
Swansea	Dr Cris Arnold	01792 295749 *01792 295244*	j.c.arnold@swansea.ac.uk **www.swansea.ac.uk/mateng**

Experiments: Cracking Composites.

That best way to understand composites and how combining two different materials can change the overall mechanical properties of a product is to actually make samples and test them. In the teachers pack of experiments we suggested mixing silly putty with sand to show the effect on tensile testing of voids, and ice and paper to show how a brittle material can be strengthened.

If you want to actually take measurements then try making plaster of paris test pieces containing different fibres and grains. Assigning different groups with different materials will allow the whole class to come together and compare results in an end of project testing session.

You could assign groups with the following fibres or grains:

1) Grains: choose a series of grain sizes and solubility, such as sugar, sand, and flour. How do grains of the same size compare if one is soluble in the plaster mix?

2) Fibres: Assign each group a fibre that is either stiff e.g. spaghetti, elastic e.g. elastic bands, or just flexible e.g. string. Within each group suggest that the fibres are laid down in different orientations for each test piece, and also that the fibre lengths are varied and or mixed.

Each combination of plaster and fibre/grain can then be made into a test piece. To get uniform test pieces cast them in identical moulds such as the base of a 1-litre fruit juice or milk container. These moulds should give good reproducibility, and are coated to prevent liquids leaking out and allow for easy removal of the test piece once set. If you have more than one class doing this project then get each class to undertake a different type of test or maybe retain a copy of this years results to compare with those achieved next year using a different test method.

Test methods, (see also p 19 of your Teacher's booklet).

- Cantilever bending: Clamp the sample at one end to see the effect on bending, of a load hung from the other end.
- Three point bending: Support the specimen at the ends and measure the deflection caused as a load suspended from the midpoint increases.
- Compression: Secure in a "G" clamp and measure the degrees of rotation of the handle until the sample snaps.

Remember to only compare "like" tests. Samples will not be directly comparable, unless you are absolutely sure that the only variable factor is the composite composition.

Industrial Application: Smart materials are now under development which monitor their own mechanical characteristics and indicate when failure is about to occur.

Smart Materials - The Cuddly Toaster.

Following feedback from the first newsletter, an extra section has been introduced to give you more information about advances in the world of technology. "Smart materials" is a bit of a buzz phrase at the moment, but what does it mean to the world we live in. Are these materials just for formula one racing cars and NASA scientists or can they make a practical difference to us. Clifford Friend and Christopher Thorpe from Cranfield University's Humanware Group think they are for everyone and for everyday use.

The cuddly toaster can change shape and "feel" to reflect different aspects about its surroundings, such as how hot it is, or how you, the user, are feeling – soft and gentle or firm and practical. Although still in the early stages of design, the principle behind the cuddly toaster is to look at an every day object and consider what more should it be able to do for the user. It might, for instance, retract any switches or handles whilst in the process of toasting and reproduce them when required. This would reduce the potential for children to harm themselves on the hotter parts.

The cuddly toaster is an illustration of the potential for adaptive materials in product design. So called ***"smart" materials*** include those that change physical characteristics under heat, electrical current or other stimulus, as well as those that retain a "memory" of an earlier shape to which they return.

The toaster is evidence of a wider philosophy which looks to redesign products in terms of their functions and the way people interact with them called 'Humanware'. When purchasing a toaster, a customer will not only consider the toaster's ability to make toast. Consideration will be given to how it will fit in with the kitchen décor, how easy it is to use or some other reason that gives pleasure in ownership or operation. For example, if the cuddly toaster is made from a material that is strain-rate sensitive. Grasp it firmly and it will feel like a stiff plastic, but hold it more gently and it will feel much softer, cuddly even, which may be just what you need first thing in the morning. However this line of thinking must be used with caution. Whilst a gauge could be bolted onto the toaster to show how brown the toast is, that may not be the answer. Pretty quickly products can become overloaded with technology thus reducing their aesthetic appearance and making them more difficult to use. At the root of the matter, the toaster is to make toast, so there is merit in making the way the product communicates as subtle and unobtrusive as possible. Then there is the question why do we want to know the colour of the toast? Many people are in a hurry in the morning and want to eat their toast whilst it is still hot, yet get on with other things whilst it is cooking. A toaster that changes colour for example would tell you about the toast from the other side of the room.

But even if most people wanted this sort of response from their toaster, would there still be resistance to a feature that increased the price of the toaster? The challenge for a toaster based on smart materials is to achieve enhanced performance at reasonable cost. The Russell Hobbs Millennium kettle may have answered these questions. It has proved that people will pay a premium for better performance. The real task for smart materials is to convince the customers that better performance is what they can deliver.

Friend and Thorpe insist that they are not interested in gimmickry. Domestic appliances are fertile ground to illustrate his ideas on design and on smart materials because they are used by human beings. There may also be scope for improvements in the field of consumer electronics. Aerospace, cockpits, and car dashboards are areas where smart materials may be useful to ease information overload, though here the task is much more complex than a toaster that merely changes colour.

Swansea University have improved fingerprint detection using Magnetic Flake.

The inside surfaces of the hands from fingertips to wrist contain minute ridges of skin, with the depressions between the ridges termed furrows. The ridges and furrows curve, so that every fingertip has a unique and distinctive ridge pattern. The ridges have pores along their length. A pore is the opening on the skin surface of a sweat gland duct, so that the ridges are coated with perspiration. Touching a surface with a finger leaves sweat contours which form a mirror image of the ridge pattern.

Latent fingerprints produced by perspiration are rarely clear enough to photograph directly and so some means of "development" is required to reveal the ridge pattern. Most commonly, the technique used is powder dusting, which normally involves the application of fine powders using a glass fibre or animal hair brush. The fine powder adheres strongly to the thin film of perspiration defining the ridge pattern with few powder particles remaining in the furrows between ridges after brushing. In the UK, aluminium flake is generally used for revealing fingerprints on most smooth, non-porous surfaces such as glass. Research within the Materials Engineering Department at Swansea University has resulted in the development of magnetic flake powders that offer several distinct advantages for developing fingerprints. One of the greatest benefits is that the powder can be applied and picked up by a "magna brush", an electromagnetic applicator. This means that the smearing often produced by conventional brushes can be avoided.

Although a range of different magnetic flake powders have been evaluated, two materials proved highly effective, namely pure iron and austenitic stainless steel. With both materials, fine flake can be produced by ball milling of powders produced by gas or air atomization of a thin stream of molten metal. For the pure iron and stainless steel, two types of flake product can then be manufactured, depending on the powder shape prior to milling. Initially spherical powders can be converted to flake with smooth surfaces and rounded outlines, whereas the flake obtained by milling irregularly-shaped powder has uneven and jagged outlines. The highly reflective smooth-surfaced flake allows bright visualisation of the ridge patterns of fingerprints found on dark surfaces, while the poorly-reflective uneven-surfaced flake results in a ridge pattern which appears dark against light backgrounds. In all cases, the best results were achieved with flake particles having a mean diameter of about 20 μm and a flake thickness of 0.5 μm.

The effectiveness of the magnetic flake powders for fingerprint detection was evaluated in extensive trials carried out with the Home Office Forensic Science Service. These assessment exercises used the magnetic flake powders and a wide range of commercially available products to reveal sets of identical fingerprints deposited on a variety of different types of surfaces, including glass plates, kitchen worktops, painted walls, plastic bags, paper and magazine covers. Additional independent trials were carried out by scene-of-crime officers attached to various police forces. These tests showed that the magnetic powders proved to be just as good as any others on smooth surfaces and were significantly better on porous, rougher surfaces. They also were found to be easier to apply, with less experience needed to produce good images.

One special advantage is offered by the magnetic flake technique since, unlike all traditional fingerprint powders, the magnetic flake particles can be retrieved from most surfaces simply by touching the surface with a strong rare-earth magnet. Devices generating strong magnetic fields can then allow complete removal of all traces of magnetic powder from rough or porous surfaces after the detection process has been completed, permitting fingerprint detection on valuable articles and even antique furniture without risk of devaluation.

Traditional procedures involving brush application of conventional fingerprint powders usually generate an airborne dust cloud, especially when dusting prints found on vertical or downward-facing surfaces. In contrast, particularly when used with applicators incorporating rare-earth permanent magnets, the magnetic flake powders can be applied even to downward-facing surfaces with minimal quantities of powder falling away from the applicator. By avoiding dust cloud generation, the magnetic flake fingerprint technology using non-toxic iron flake technology therefore eliminates any potential long-term respirable health risk to scene of crime officers.

Fingerprint detection is not the only way in which criminals can be linked conclusively with their crime scenes. For instance, burglars usually wear training shoes for quick and quiet movement, but the soles of even the same make and size of a training shoe are always slightly different because of variations in manufacturing operations and wear patterns. The magnetic flake powders are as effective as the best currently available dusting powders for revealing footwear impressions on surfaces such as window ledges, linoleum and floor tiles. To avoid detection, criminals should therefore seek to be light-footed as well as light-fingered, wearing gloves and walking on air.

A trip to the Circus

The Great Polymer Materials Circus

The Materials Engineering Department hosted its third annual 'Polymer Circus' just before the Easter break (24th March). The circus concept conceived by the department with the support of the University and the Institute of Materials has firmly established itself at Brunel and the concept is growing nation-wide. Around 130 school children (from 11 schools) assembled at the University refectory along with their teachers to learn about polymers. The mixture of displays, lectures and demonstrations helped to raise awareness of the versatility and importance of polymers in everyday life. The various aspects covered (by the display stands) were the issue of recycling and applications such as sports, medicine and packaging. The event was 'rounded-off' with a presentation to Mellow Lane School (Hayes) pupils who were the winners of a quiz. Apart from the sterling assistance from the Materials staff and students, support was also received from Prof. Heinz Wolff, Dr. Barbara Brockway (The Body Shop), Dr. Peter Barham (Bristol University), the National Physics Laboratory, and the IRC (Biomedical Materials) at Queen Mary and Westfield College. The organisers would like to thank everybody and the refectory staff for all the help and assistance. Planning for next years event has begun which has been boosted by the pledged support of the Shell Education Service.

The are several venues around the country that are organising these events and this is the third year that the Polymer Circus has been organised by the University of North London and the Institute of Materials' South-eastern Plastics and Rubber Group. In the past it has proved immensely popular with students and teaching staff alike.

It is an entertaining and stimulating afternoon aimed at opening student minds to the world of polymer materials. There is an overview of courses and career opportunities available, together with a greater appreciation of the profession as a whole.

The Chemical Industry Education Centre

About the CIEC

The Chemical Industry Education Centre helps to improve partnerships between schools and the chemical industry. The resulting better understanding between teachers and industrialists leads to young people being more highly motivated and consequently learning much more about science and technology. The Centre was founded in 1988 as a joint venture between the Chemical Industries Association and the University of York, and they are housed within the Department of Chemistry at the University and have strong links with the University of York Science Education Group.

The aims of the Centre are to:

- enhance the effective teaching of science and technology
- create enthusiasm in school students and children for science
- improve the level of understanding between schools and the chemical industry
- create a better understanding of the nature and role of the chemical industry within society

The CIEC catalogue contains a brief synopsis of each of the titles the Centre has published. The CIEC also provides in service training and the Schools Polymer Information Service is housed within the same group.

For more details CIEC can be contacted at:

Chemical Industry Education Centre.
Department of Chemistry
University of York
Heslington,
York YO10 5DD

www.york.ac.uk/org/ciec/content

The Schools Polymer Information Service

1. answers enquiries about plastics/polymers from teachers and pupils of all ages

2. offers a free directory of resources about plastics/polymers available to schools and colleges

3. provides some free literature on plastics/polymers

The service is funded by The British Plastics Federation, The Institute of Materials, The British Polymer Training Association and The Plastics Industry Education Fund.

Examples of enquiries are:

- What does PVC stand for?
- How do they make 'plastic'?
- Why is rubber stretchy?
- What does PETE mean?
- How do they make washing-up bowls?
- What is polyaniline?
- What is injection stretch blow moulding?
- Who makes PTFE?

On the website there is a directory of resources some of which are CIEC publications.

Issue 3. The third issue of this newsletter should arrive in time for the Oct half term.

Spotlight on the **Armourers and Braziers**. This company is well know for their financial support to projects aimed at developing and encouraging the teaching of materials and engineering.

Special feature on **Textbooks and study texts**.

A review of Biomaterials.

Watch out for the following in Materials World:

April

p 195 : Faster trip with lighter seats.

p 201 : Motoring into the future with MIM.

p 205 : Thermal spraying in the new Millennium.

p 213 : A Materials for melding humans and machines.

May

p 260/1: Free CD-ROMs for schools, Warships and Lasers, Cutting fire risks in aircraft, A stand that delivers.

p 279 : Nickel plating a monster mirror.

p 289 : Nature meets its match in engineering.

June

p 327: High achievers can fly the flag.

p 350: Attracting bright sparks to the steel industry.

p 350: The Royal Society and the Indusrial Revolution.