



**The Institute of Materials, Minerals and Mining**

**HAPPY NEW YEAR**

**Schools  
Affiliate  
Schemes**  
Issue 13  
Spring Term 2002

Hello again and welcome to the first newsletter of 2003. I hope you had a relaxing Christmas break (not too many mince pies and turkey sandwiches!) and are ready to face the new term.

This term, and indeed this year, got off to a flying start with a very successful exhibition at the annual ASE meeting in Birmingham where it was great to put many faces to names, followed by a hectic schedule of talks in January.

This issue of the newsletter focuses on careers in materials, with the launch of the new careers booklet 'Takes you in all directions' due to take place early in the year. You will also find the dates of the UCAS Higher Education Conventions we will be attending on page 3. We went to seven events in the 2001 – 2002 academic year and spoke to a large number of students and teachers. This year we are planning to visit some new venues so keep your eyes peeled and pip along and say hello!

I will also be attending Polymer Study Tours in Trowbridge, Edinburgh and Manchester this year. These courses are a great way for you to boost your knowledge on polymers and more details can be found on page 7.

As you can see from my diary on page 4 I am going to be incredibly busy visiting schools this term. However, if you would like to book a presentation for the summer term, or even the autumn term next year, please get in touch and we can discuss your requirements. Many of you have tried contacting me this term and found it virtually impossible by phone. If you would like to get in touch by far the most reliable way is to send me an e-mail as I always check this first when I return to the office (diane.talbot@iom3.org).

Finally, don't forget that if you have any comments on this newsletter, the resources or the scheme in general please let us know. If you have any ideas for articles or suggestions for areas you would like covering get in touch!

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## Career profile – Dr Emily Boswell

Packaging is a huge area which many of us take for granted.. However new materials and packaging technologies are being developed all the time. Emily, a materials scientist, works at the forefront of this vital field.

- What did you study?** D. Phil. Materials Science (Electronic Materials) (1992 to 1996)  
MA Metallurgy & the Science of Materials (1988 to 1992)  
A-levels in Physics, Chemistry, Maths and Further Maths
- Where did you study?** University of Oxford (Trinity College)  
Department of Materials
- Where do you work?** Procter and Gamble Technical Centres in Surrey as a Senior Scientist, Corporate Packaging and Prototyping Europe
- What do you do?** I work in a group that develops new packages and devices for the different business units at Procter and Gamble (P&G), a company which sells Fast Moving Consumer Goods. Examples of our different business units include Health & Beautycare, Babycare & Feminine Protection, Food & Beverages, Pharmaceuticals, Fabric & Homecare, Fine Fragrances. We are a relatively small group who act as a type of internal consultancy, helping the business units develop more upstream ideas than they would normally work on. Within our group, I am a materials expert, trying to use my knowledge of materials science to solve problems or develop new materials for packaging. Most of the materials I work on are polymer-based, and I have a polymer laboratory to carry out testing.
- Favourite projects?** I have been working on the development of a new polymer – elastomeric polypropylene. Normally, polypropylene is a stiff, hard material typically used to make shampoo caps. However, the use of a particular metallocene catalyst causes the arrangement of methyl groups along the polymer backbone to be disrupted, altering the crystallinity of the polypropylene, making it elastic. We are investigating how it can be used to replace the relatively expensive elastomers currently used in packaging, devices and other products (e.g. nappies). The elastic polypropylene also has other novel properties and we hope it will be more environmentally friendly than alternative elastic materials currently on the market.
- Who do you work with?** Procter and Gamble is a very international company, so I work closely with colleagues in other countries. My immediate team is split between the UK, Belgium and Germany and I regularly travel there for meetings. Our group includes other materials/polymer scientists, experts in consumer understanding, experts in device design, industrial designers and workshop technicians. We also work closely with our colleagues in different business units throughout the world. Outside of P&G, I work with universities and external institutes/laboratories to get material analysis and development carried out. I regularly attend conferences and exhibitions around the world, and have presented at some of these.
- Why do you enjoy your job?** I enjoy my job, because I get to use materials science in a commercial environment, solving problems important to the business. I am given a lot of freedom to investigate new ideas and I am always very busy. I also enjoy learning about a wide range of different scientific areas that I have not been involved in before.

## UCAS Higher Education Conventions 2003

In 2002 we attended seven UCAS Higher Education Conventions located all around the country. This year the plan is to attend seven again but in slightly different venues, some of which we have not exhibited at before. For many years we have been the only professional Institute to attend these events to promote a subject rather than a particular university. It is the ideal opportunity for your students to come and talk to us about careers in materials or specific applications for project work. This is where we will be exhibiting:

5 – 6 March	Manchester, GMEX Arena
24 March	Keele University
2 May	Cardiff
8 – 9 May	Newcastle, Telewest Arena
1 – 2 July	Sheffield, Sheffield Arena
4 – 5 July	London, Earls Court
September	Aberdeen , University of Aberdeen.

## Employment Opportunity!

Fancy a new job? If the answer is yes then this might be of interest to you. The Royal Armouries at the Tower of London are looking for a qualified teacher with a science or engineering degree (preferably in Materials) to develop and teach a series of materials science sessions based around the Royal Armouries collections. The post will be based at the Tower of London in their fantastic new Education Centre and will be for three years.

The successful candidate will be responsible to introducing materials science tools and techniques to the Education Centre and looking at materials through history from a scientific perspective. The Tower provides the perfect environment for discussing the materials used for construction, armour and weaponry throughout the ages. Support materials will also be developed to allow groups to carry out follow up activities when they return to school.

For more information about the post and an application form please send a postcard quoting TOWER ED to: Recruitment, Royal Armouries, Armouries Drive, Leeds, LS10 1LT.

## Courses for Students

Its getting to that time of year again when taster courses for students start to be advertised. There are three national schemes in particular which focus on careers in science, technology and engineering. These are the Headstart, Insight and Smallpiece Trust programmes.

Headstart courses are run by the Royal Academy of Engineering at a number of universities around the country. They give year 12 (Scottish year 5) students the chance to find out more about university life and carry out a number of engineering based projects. More information about Headstart is provided in the enclosed leaflet but if you have any other questions you can find out more on the website ([www.headstartcourses.org.uk](http://www.headstartcourses.org.uk)) or contact their Director, David Ozhall, on 01707 871505 or e-mail [enquiries@headstartcourses.org.uk](mailto:enquiries@headstartcourses.org.uk)

Insight courses are similar but are just for girls, to try and encourage women in to engineering careers. Again they run at a number of university venues around the country. For more information contact Angela Townsend on 01923 652309.

In the past I have helped to run both of the above courses and can strongly recommend them, The students make loads of new friends and learn a vast amount in a short time.

Finally the Smallpiece Trust run a number of courses for students and teachers throughout the year. The latest is a special course focussing on Materials that will be taking place in Oxford in March. For more information on this course and other Smallpiece initiatives you can contact the Trust on 01926 333200 or e-mail [gen@smallpiece.org.uk](mailto:gen@smallpiece.org.uk) and details of all of their events can be found on their website: [www.smallpiecetrust.org.uk](http://www.smallpiecetrust.org.uk)

## Diane's Diary

After a very hectic Autumn term comes an even more hectic Spring. This is where I will be this term!

- 09/01 The Wilderness School, Sevenoaks
- 14/01 Skipton Girls' School
- 21/01 Ampleforth College
- 22/01 St Wilfrids Primary School, Sheffield
- 27/01 Hundred of Hoo School, Rochester
- 28/01 Dame Alice Owens School, Potters Bar
- 29/01 The Judd School, Tonbridge
- 30/01 King Edward VI, Southampton
- 06/02 The Ladies' College, Cheltenham
- 07/02 Bedford LEA Home Educators Materials Day
- 13/02 St Maary's Catholic High School, Manchester
- 26/02 Sandbach School
- 07/03 The Ferrers School, Wellingborough
- 10/03 Spen Valley High School, Liversedge
- 12/03 Westminster School
- 13/03 Queen Elizabeth's School, Barnet
- 17/03 Newquay Tretherras School
- 18/03 Ilfracombe College
- 26/03 Canon Slade School, Bolton
- 02/04 Castle Hill School, Gainsborough
- 03/04 Kings of Wessex School, Cheddar

In addition to the I will also be visiting the following:

- 13/02 Tyne & Wear LEA teachers workshop day
- 19/02 Young Engineers Forum, London
- 20/02 CIEC York, teachers course
- 5&6/03 UCAS Fair, Manchester
- 11/03 Stockport LEA Primary event
- 14/03 Physics teachers day at Ampleforth College
- 19/03 Primary Day at Liverpool Hope University
- 29,30,31/03 Institute of Physics update course, Malvern
- 08/04 ASE London Science Technicians Conference

There are still a few spaces left for presentations next term, if you would like to book me or discuss the type of presentation

## Materials that are music to your ears

How many of us relax by listening to our favourite music? We take it very much for granted that we can go out and buy the latest CD and record this on to a tape (or CD-R) for the car. But when did you last think about the materials technology that has brought those sweet sounds to your ears?

Early recordings were made on wax drums. These were followed by records made from Shellac and Bakelite, early types of polymers. Vinyl records are still available but they are not as popular now as they take up lots of space and can store relatively small amounts of music. They are also rendered pretty useless if they are scratched. Records are an analogue method of data storage and are made by pressing the warm polymer on to a nickel master which has a raised track. This track forms the groove running from the edge to the centre of the record in which the stylus runs. When the stylus travels in the groove it is actually carving out the shape of the sound wave from which the music is made. So if it is damaged as the stylus passes over the scratch it carves out the sound of the scratch, which is often most unpleasant!

Records were succeeded by magnetic recording media (such as tapes and floppy discs). With these it is the orientation of small magnetic particles on the surface of the tape which stores the music. Magnetic tape consists of a thin polymer substrate on to which a thin coating of iron oxide ( $\text{Fe}_3\text{O}_4$ ) is bound. A dry lubricant is also present to prevent wear as the tape is passed through the read / write head. A single cassette contains 135m of tape. Of course the great advantage of magnetic tapes is that they are easily changed and the data can be stored for 10 to 20 years!

Compact Disc (CD) technology has largely replaced magnetic tapes when it comes to storing music. A standard disc can hold 74 minutes of music or 783MB of information. CDs are made by injection moulding polycarbonate into a 120mm diameter disc which is 1.2mm thick. On a prerecorded CD the polymer disc is impressed with a spiral of tiny bumps (the shortest are 0.83 microns long and they are all 125nm high) which runs from the centre of the disc to the outside. If you were to unwind the track it would be 0.5 microns wide and 5 kilometres long!

fragile metal layer the top of the disc is coated in acrylic before application of the label.

When you play the CD, a laser is shone on to the underside of the disc and is reflected back from the aluminium layer. However, the height of the bumps is one quarter of the wavelength of the light used and this means that the laser beam is either reflected back or destructive interference occurs, eliminating the reflection, giving the 1 and 0 digital signal which is converted back to music by the software in your stereo.



If you think this is cunning then you will be really impressed with CD-Rs! Obviously if you are to be able to record data at home the disc cannot be impressed with bumps so plain discs are produced with a layer of blue / green dye between the polycarbonate and aluminium. When you 'burn' a disc this is what you are effectively doing. The write laser has a higher power than the read laser and this burns small areas of the dye. The read laser can reflect back from the unaffected areas but not from those that have been burnt, again giving the 1 and 0 digital information.

### Copper on the Web

Way back in my very first issue of the newsletter I wrote about Industry Supports Education, the company responsible for the School Science web-site. Since then several new resources have become available on the site including a number of activities supported by the Copper Development Association (CDA). There are three resources for Key Stage 3 and three for Key Stage 4, one each on a biology-, chemistry- and physics-related topic.

The KS4 resources build on the information in the KS3 resource and they look at copper for life and health, extracting copper and looking at a copper mine, and the use of copper in electromagnets and motors.

The interactive site has a glossary and roll over diagrams which show special features and sequences. To test the knowledge and understanding of the students there are quick questions at the end of each page and a quiz at the end of each unit.

Another new feature on the site is a virtual tour of an oil refinery, well worth a look.

The school science site is free to use and you can access it at [www.schoolscience.co.uk](http://www.schoolscience.co.uk)

### Would you like to have your say about Education at the Institute?

The Institute has an Education Committee made up of representatives from industry and academia with an interest in materials education.

We are looking for teachers of both science and design technology to join the committee, as we feel we do not have enough input from school level at the moment.

The committee usually meets three or four times a year at venues around the country. The meetings usually last most of the day, but if we had members from schools we would be willing to change the times to accommodate the school day. Travelling expenses and supply cover (where necessary) would be covered by the Institute.

If you would like to find out more or would like to come to a meeting to see what its all about please contact me.

## **ASE Annual Meeting goes to Brum**

We a New Year hangover still lurking the Spring Term kicked off at full speed with the Annual Meeting of the Association for Science Education , which ran from 3rd to 5th January. This year the event was held at the University of Birmingham, where I studied and worked and it was quite strange for me going back as a bit of an outsider (I managed to visit a few of my old haunts though including my favourite Balti restaurant).



We exhibited for the full three days and had a very busy time, everyone really enjoyed the artefacts on our stand and I believe I overheard one person saying they thought ours was the most fun stand at the exhibition (well I think it was a draw between us and the Big Bug Show, as you can see from the photo I got all the stickers!). It was great to meet so many of you and put faces to the names and I was pleased to hear some positive feedback about the new features in the newsletter, it seems I'm doing it right (if you think otherwise please let me know!). We also made a large number of new contacts ranging from teachers to web-designers, publishers and resource manufacturers whom we hope will be helpful in the next stages of the development of the Advanced level course. The materials department at the university also ran a successful workshop and lecture.

Next year the meeting will be held in Reading between the 8th and 10th January. Watch this space for more information.

## **Armourers and Brasiers – CORUS Scholarship Awards 2002**

On the 16th December 2002 students and their guests assembled at Armourers Hall in the centre of the City of London for the presentation of the 2002 Armourers and Brasiers – CORUS scholarships. Ten awards were presented to the students in the upper sixth and each received £250 and materials books to the value of £50. The judges commented on the high quality of the applicants and winners this year and wished them all well with their future studies.

Following a welcome to the Hall by the Master of the Company, Mr Richard Crabb, the awards were presented by Alan Johnson from CORUS and the Master. After photographs the winners had lunch in the fabulous Livery Hall and were then treated to a tour of the Hall by Commander Tim Sloane, the Clerk of the Company.

The scheme is now in its third year and to give you a quick reminder it is open to any student in year 12 that has an interest in studying a materials related degree course at one of the participating universities. The awards are made in the upper sixth year and if the students continue on to study materials the scholarship will continue to run. In these times of student debt this is the ideal opportunity for your students to get some extra funds!

For information about the 2003 Scholarships in England and Wales please contact Carolyn Green ([c.a.green@bham.ac.uk](mailto:c.a.green@bham.ac.uk) or 0121 414 5175) or Martin Strangwood ([m.strangwood@bham.ac.uk](mailto:m.strangwood@bham.ac.uk) or 0121 414 5169) at Metallurgy and Materials, University of Birmingham, Edgbaston, Birmingham, B15 2TT.

A similar scheme also runs in Scotland, although last year the response was very poor and no awards were made. For more details of the Scottish Scheme please contact Professor Alan Hendry at the University of Strathclyde by e-mailing [A.Hendry@mecheng.strath.ac.uk](mailto:A.Hendry@mecheng.strath.ac.uk) or call 0141 553 4152.

## Polymer Study Tours

The Polymer Study Tours have been running since 1987 and have so far provided over 1300 secondary science and technology teachers with insight into the polymer industry. The free, three and a half day residential courses are run at three venues around the country: Napier University, Edinburgh (22 to 25 June), Manchester Metropolitan University (2 to 5 July) and Wiltshire College, Trowbridge (29 June to 2 July). A typical course includes lectures and workshops on polymer science and technology, polymer testing and identification, the polymer industry and its markets, the sustainable environment, careers and qualification information and sources of further information. In addition to the college based activities the courses also give teachers a unique opportunity to visit major plastics companies and link classroom activities to the real world. This year I will be taking part in all three events. Course delegates will be able to take away notes, samples and classroom materials and each will receive a certificate of attendance from the Polymer NTO for their CPD portfolio.

If you would like more information about the courses and an application form please contact Wendi Beamson, Polymer NTO, Halesfield 7, Telford, Shropshire, TF7 4NA, telephone 01952 587020. Alternatively I have a few forms here in Doncaster.

## Break-time Challenge

Some time before Christmas I attended the Sheffield Metallurgical and Engineering Association quiz night and was very impressed with the questions. Infact I was so impressed with three of them that I thought I would put them in the next few newsletters to keep you amused!

First write out the alphabet. Then work out the only two letter which are NOT used in any chemical symbol and cross these out of your alphabet. Next cross out the symbols for xenon, krypton,

## Autumn Open Day Programme

Last term we co-ordinated a series of open days at materials departments around the country. Feedback from the staff and students that attended and from the Universities themselves has been very positive and we are planning to run similar events again on a larger scale this year so watch this space (flyer enclosed).

Thank you to all of those who attended despite the short notice. I hope you enjoyed it!

## Radioactive Waste Management at the University of Sheffield

The Department of Engineering Materials at the University of Sheffield is adapting its undergraduate Materials Science and Engineering courses to include greater emphasis on courses relevant to their new BNFL-funded Immobilisation Science Laboratory (ISL). Several new members of staff have been appointed with interests ranging from: immobilisation of cement, ceramic and glassy matrices, the geological aspects of radioactive nuclear waste disposal (including processing and packaging), modelling and surface engineering.

The problem of waste disposal, which is currently a topic of national concern, is being tackled in the ISL where researchers are investigating the fundamental science underpinning the immobilisation of such waste in different matrices. Only simulated wastes are used at Sheffield, but comparable studies on actual radioactive material will be carried out in the new active laboratories at Sellafield to confirm the relevance of the data. The ISL at Sheffield hopes to increase public awareness of immobilisation science by holding open days where members of the public, press and environmental pressure groups can quiz the experts. Watch this space for further information.

To find out more about Materials Science and Engineering at the University of Sheffield please contact Dr John Parker on 0114 222 5514 or e-mail [j.m.parker@sheffield.ac.uk](mailto:j.m.parker@sheffield.ac.uk).

## **HYDROGEN, the building block of the Universe**

Hydrogen is the building block of the Universe and it first formed in the early stages after the Big Bang. Fusion of hydrogen atoms produced helium, the reaction which fuels our Sun. Here are a few interesting facts about the oldest element around.

- ⊙ Hydrogen atoms consist of one electron and one proton and it is the lightest element with an atomic mass of 1.00794g.
  - ⊙ Hydrogen was discovered in London by Henry Cavendish in 1766 and its name derives from the Greek words 'hydro' meaning water, and 'genes' meaning generator.
- 
- ⊙ The Sun is comprised of 750,000,000 parts per billion (ppb) of hydrogen by weight and 930,000,000 ppb by atoms. This is compared to 1,500,000 ppb by weight or 31,000,000 ppb by atoms in the Earth's crust.
  - ⊙ Hydrogen is the most abundant element on Earth in water, H<sub>2</sub>O
  - ⊙ Although hydrogen is the lightest element and has atomic number one, it does not have the lowest melting and boiling points (its values are 14.01K and 20.28K respectively). This honour goes to the element at number two, helium, which melts at 0.95K and boils at 4.22K.
  - ⊙ Hydrogen atoms bond covalently to form H<sub>2</sub> molecules, as this ensures a full electron shell
  - ⊙ Hydrogen is a colourless, odourless gas which burns in air if ignited, with a characteristic red flame. The only product of the combustion of hydrogen is water, in the reaction:  
$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$
  - ⊙ Small amounts of hydrogen can be produced in the laboratory by the reaction of calcium hydride and water or iron filings and sulphuric acid.
  - ⊙ Hydrogen can form H<sup>+</sup> or H<sup>-</sup> ions, by either losing its electron or gaining another.
  - ⊙ Hydrogen is manufactured industrially from methane, however, it can also be extracted from water, which is abundant in supply.
  - ⊙ Solid hydrogen has a hexagonal close packed crystal structure and if it is compressed enough will exhibit metallic properties.
  - ⊙ Hydrogen has two isotopes, deuterium, which is naturally occurring, and tritium which has a half-life of 12.32 years. Heavy water is made with deuterium (D<sub>2</sub>O) and it has been used in the nuclear power industry.
  - ⊙ Hydrogen has been demonstrated to show superfluidity, a type of quantum behaviour in which the fluid has no viscosity. Until recently this property had only been seen in helium.
  - ⊙ Hydrogen is used in the Haber Process to fix nitrogen from the air and produce ammonia. It is also used in the hydrogenation of fats and oils (for example to manufacture margarine).
  - ⊙ It is used in the reduction of metallic ores and in welding.
  - ⊙ Liquid hydrogen is used as a rocket fuel (with liquid oxygen) and in superconductivity where it is used to cool the superconducting material to very low temperatures.
  - ⊙ We have always relied on hydrogen as a fuel, as it is present in all organic compounds including coal, natural gas and oil.
  - ⊙ The next step is to use pure hydrogen as a fuel as the only by-product is water and this is much more environmentally friendly than burning fossil fuels. At present the 'Hydrogen Economy' is limited by our ability to extract hydrogen and store it safely.
  - ⊙ Iceland is aiming to be the first nation to get its energy solely from hydrogen. The hydrogen will be extracted from water and the energy to do this will be produced hydroelectrically. Iceland also possesses a vast geothermal energy supply which can be tapped.

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