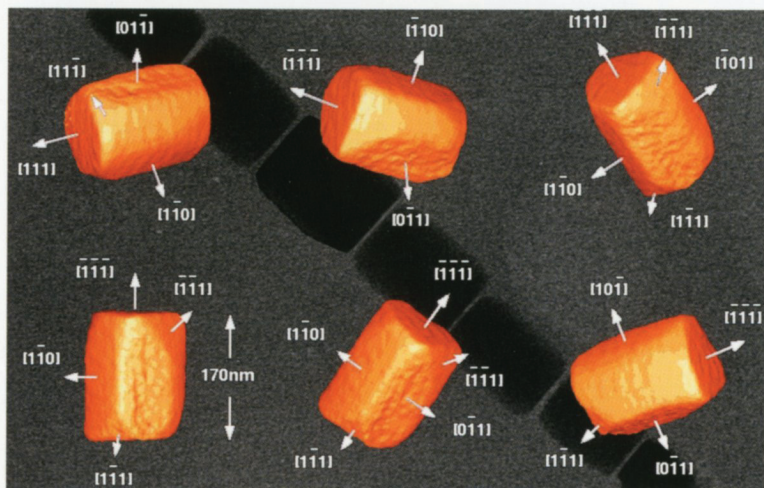


## The Truth is out there . . .

Dr Paul Midgley throws doubt on evidence for life on Mars:



Electron tomography shows the 3D shapes of magnetite nanocrystals.

"The discovery of tiny chains of crystals, which resembled those commonly associated with the backbones of magnetotactic bacteria, on the surface of a meteorite from Mars, was hailed as the first evidence of extra-terrestrial life. These crystals are small enough to be at the limits of resolution of conventional scanning electron microscopes, yet the entire evidence for the presence of life on Mars now rests on the shapes of a small fraction of the magnetite nanocrystals on the meteorite (known as ALH84001). Much has been written about the features of these that are considered to show unambiguous evidence for former life. We decided to use the best technique available to determine the precise crystallographic features of bacterial nanocrystals.

The electron microscope is one of the most versatile and powerful instruments for the complete chemical and structural analysis of any solid material. One drawback to the use of transmission electron microscopy has been that the information obtained has been from a 2D slice, which can make interpretation difficult. With the advent of nanoscale science and the prevalence of nanocatalysts used by chemists, it has become increasingly important to obtain three dimensional information about the structure and composition of nano-particles.

We are among the world leaders in developing a new form of electron tomography, whereby we use information from Rutherford scattering to build up a three dimensional image from a series of slices. The intensity of the signal is approximately proportional to the square of the atomic number, which provides compositional as well as structural information. Biologists have been using similar methods for years (since the 1970s) to look at the structure of bacteria and viruses, but it is only recently that tomography has been applied in the physical sciences.

By reconstructing three-dimensional shapes of the magnetite nanocrystals from three strains of bacteria, we were able to show that they each differed from the other. We can determine the 'biogenic signature' for each strain. The variations we have found show that it is not possible at present to prove definitively whether the chains of crystals found on the meteorite are biogenic in origin or not. The features they show could equally be inorganic in origin. However, we have shown that by using electron tomography it would be possible to produce an accurate 3D image of the supposed 'Martian magnetofossils.' We have the technology so we should now apply it."

For further information, please contact Dr Paul Midgley  
e-mail: [pam33@cam.ac.uk](mailto:pam33@cam.ac.uk)

## EDITORIAL

### Change and growth

Places of education are perhaps unique in that three times a year the whole system is re-invigorated as students return armed with stimulating and demanding questions for staff to answer. The annual intake of graduate students similarly challenge the work of their predecessors (and supervisors!). This applies particularly to institutions, such as Cambridge, with acknowledged first-class students.

As well as the normal flux in the student body, vigorous Departments are always changing and the Department of Materials Science and Metallurgy is no exception. New initiatives are being created continuously, and this edition of Material Eyes announces the setting up of the new Pfizer Institute for Pharmaceutical Materials Science. This will complement the increasing research activity within the Department in the field of Biomedical Materials. The formation of an interdisciplinary research cluster into biomaterials and tissue engineering was also announced earlier this year, attracting £2 million of research funding from the Cambridge-MIT Institute.

There have been some changes in the two other University Technology Centres in the Department, the Regenesys Centre and the Rolls Royce UTC. The Regenesys UTC was announced in February and is now becoming fully operational, Dr George Chen was appointed as the Assistant Director of Research, a Regenesys Research Fellow is being appointed, and the staff complement is now 5 and growing. The have been some dramatic changes in the Rolls Royce UTC in that two of the senior people, Dr Roger Reed and Dr David Knowles, have left to go, respectively, to a Chair at the University of British Columbia, and Industrial Research Ltd in New Zealand. We are sorry to lose their skills but wish them every success in their new posts. They have been replaced by Dr Sammy Tin from the U.S. and Dr Cathie Rae who are making major contributions to the Centre and will ensure its continued development and success.

In these changing times we are confident that we can use the opportunities presented to the benefit of academia and industry.

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## Pitting protection - a new surface treatment for stainless steels

Everyone knows that stainless steel is often the metal of choice in engineering situations where corrosion is an issue. However, stainless steels are often prone to pitting corrosion, and this is the cause of a huge number of failures of these alloys in service. Dr Tim Burstein explains:

"The small holes, or pits that characterise pitting corrosion in stainless steels can be slow to form, but once nucleated, the propagation rates of such pits are very fast. This is a dangerous combination since, coupled with the small sizes of corrosion pits, detection can be very difficult until failure of the component. Corrosion pits are often (but not always) caused by the presence of chloride ions. It is common for equipment designers to use materials near the edge of their limits to maximise cost benefits, and lower-grade stainless steels are generally more prone to pitting failure.

We have discovered a new surface treatment for stainless steels which raises their resistance to pitting corrosion substantially. It is early days yet, as we have still to determine the long-term durability of this treatment, and indeed to optimise the process. However, it looks extremely attractive at present. This surface treatment is not a coating as such, but a surface treatment of the alloy itself. Apart from its effectiveness, the advantages of this new treatment is its use of low-cost, non-toxic, environmentally friendly components. It is also easy to apply. The process is scientifically very interesting, since the treatment seems to interact with, and protect the very sites on the metal surface where pitting is most likely to occur: this mechanism is unique in surface engineering."

This work is being conducted jointly with Dr Ricardo Souto of the University of La Laguna (Spain). A patent is being applied for. It is anticipated that once the process is established more rigorously, it will find wide application, particularly in the food industry, where non-toxicity is so vital.



*Pitting corrosion along the seam-weld, induced by chloride ions, caused failure of this stainless steel tube.*

For further information, please contact Dr Tim Burstein  
Tel: 01223 334361

## Material Revolution

In a past issue of Material Eyes (Autumn 1998) we reported on the new electrodeoxidation process developed by Professor Derek Fray with one of his researchers, Dr George Chen and Dr Tom Farthing, a consultant on the project. That process promised to revolutionise the world of materials by enabling titanium to be extracted from its ore in such a way that the price would tumble to the levels of the more mundane stainless steel. Just imagine having a titanium sink to do the dishes in!

Well, that is all under development now, with heavy investment in British Titanium plc.

The University holds the patent, so in due course money will flow via the University to the Department and the inventors.

For non-titanium applications the inventors have, with money from the Cambridge University Challenge Fund, set up a spin-off company to exploit the technology for their own purposes. They will be using the same principle of extraction and applying it to other metals such as chromium, tantalum, and other high value metals used in the production of superconductors, such as niobium and niobium alloys.

The company, known as FFC Ltd, has a unit at Granta Park, established in the grounds of TWI at Abington. The idea is to produce



*FFC pilot plant in operation*

kilogramme quantities of metals at a fraction of the price at which they are normally produced. "By producing the metals in these sorts of quantities, buyers take our process seriously as they can see a bag full of the stuff" comments Derek Fray. "We can also make some alloys directly which has even greater cost benefits."

The setting up of this company reflects the new emphasis on entrepreneurship within the University. "It is generally true to say that commercial enterprise and the University don't mix well," says Derek Fray. "By setting up an independent company with its own employees we can set suitable priorities, and we are also likely to be taken more seriously by the outside world. In this way we can also retain ownership of a process we have developed, rather than licensing to larger concerns and losing control of the exploitation."

For more information, please contact Professor Derek Fray,  
Tel: 01223 334306

## Pfizer Institute for Pharmaceutical Materials Science

Although we all readily reach for a tablet when we have a headache or run a temperature, there is still work to be done to optimise the process whereby the drugs are incorporated within the tablets and released within our intestines. To improve knowledge in this area, a new research institute, The Pfizer Institute for Pharmaceutical Materials Science has been established within the University of Cambridge. The new Institute, an interdisciplinary venture, in combination with the Department of Chemistry, and the Cambridge Crystallographic Data Centre (CCDC) will have Professor Bill Bonfield from the Department of Materials Science and Metallurgy as its Director.

The aim of the Institute is to provide a focus for research into all aspects of the structure, manufacture and behaviour of 'solid dosage forms' such as tablets. One thrust will be on modelling the processes of molecular crystallisation using data supplied by the CCDC crystal structure database and from new experimental work. This will be aimed at improving powder compaction of pharmaceutical preparations, tableting, diffusion and release of the drugs. Literally thousands of crystal structures are already known and stored in the Cambridge Structural Database, which will provide a useful tool for the modellers.

By analysing the forces between molecules which create the three-dimensional architecture of a crystal, new materials can be developed. Once the whole process is properly understood at an atomic level, there will be scope for a radical approach to more stable tablets, drug delivery and new insights.

In addition to the Director, Professor Bill Bonfield, staff involved in the Department of Materials Science and Metallurgy will be Dr Ruth Cameron and Dr Serena Best who both have expertise in the development of biomedical materials, Dr James Elliott, recently appointed to the academic staff, (see profile on the back cover of this newsletter) and Professor Alan Windle. These last two academics both having extensive modelling expertise. Research in the Department of Chemistry will be led by Dr Bill Jones, who has expertise in understanding crystal packing at a quantitative level as well as crystal structure determination. Research at the CCDC will be co-ordinated by Dr Sam Motherwell.

Under the terms of the five-year agreement, Pfizer will initially support 21 staff and students who will work on jointly agreed research projects in the Institute.



*From left to right: Dr Serena Best; Dr James Elliott; Professor Bill Bonfield; Dr Ruth Cameron and Dr Sam Motherwell (not present: Dr Bill Jones and Professor Alan Windle)*

For further information please contact Dr Rachel Hobson (Industry Liaison Officer) Tel: 01223 334328





## Super modeller . . . – a profile of Dr James Elliott



They do say that a sign of age is when policemen look young. How about when University lecturers look like undergraduates? "It has been a bit of a problem for me," says the youthful looking Dr James Elliott, recently appointed to the academic staff. "I have to prove I know what I'm talking about pretty quickly, so that I'm not dismissed out of hand: but I do feel that I can relate well to the students, being closer in age to them, so that helps my teaching."

So saying, James has a convincing track record, having graduated in Physics from the Cavendish in 1995 before moving to Bristol where he completed a doctorate in polymer physics, picking up considerable expertise in computer modelling and X-ray diffraction. These skills brought him back to Cambridge as a post-doc in Professor Alan Windle's group, to continue research into modelling of materials, before being appointed as a lecturer in October 2001.

Why the change from being a physicist to a materials scientist? "Well, it is nice to put the laws of physics to good use and produce something practical," he explains. "I still get a buzz out of the fact that the polymer membrane that I worked on for my PhD is now being used in the fuel cells being developed in the Regenesys University Technology Centre embedded within the department."

"In the future, I will be heavily involved in the work of the new Pfizer Institute for Pharmaceutical Materials Science, modelling biomaterials. I also have a particular interest in working on the protein aggregates which appear to play a major role in Huntington's disease and other neurodegenerative disorders."

"My main teaching commitment is lecturing on the MPhil course in Materials Modelling, but I have also been teaching a Part III lecture course on polymers, which I really enjoy. I have to be careful to teach in a way that suits materials scientists rather than the way I was used to in physics."

James was an undergraduate at Christ's, and is now a Fellow at Fitzwilliam. He used to row and go off-road cycling when he lived in hillier parts of the country, but now has to make do with circuit training at the gym and squash to keep fit, with the occasional foray to the hills of the West Country in the vacations.

Dr James Elliott Tel: 01223 335987  
email [jae1001@cam.ac.uk](mailto:jae1001@cam.ac.uk)

*For any comments about  
this newsletter or alter-  
ations to your address,  
please contact Carol  
Ann Monteith by email  
[cm259@msm.cam.ac.uk](mailto:cm259@msm.cam.ac.uk)*

## Congratulations to:

**Professor Tony Kelly** on being awarded the Honorary Degree of Doctor of Engineering by The University of Hanyang, Korea.

**Professor Colin Humphreys** on being awarded the European Materials Gold Medal 2001 by the Federation of European Materials Societies.

**Professor Tim Burstein** on being invited to an Honorary Professorship by the University of Pretoria.

**Professor Harry Bhadeshia** on being awarded the Réaumur 2001 Award by Société Française de Métallurgie et Matériaux.

**Chris Rawlings** on being awarded Best Materials Science Student for 2001 as part of The 2001 SET (Science Engineering and Technology Awards).

**Dr Rafal Dunin-Borkowski** on winning two Highly Commended Awards in the Science Close Up Category with his pictures Crystals in a Nanotube and Magnetic Bacterium.

**Dr Paul Midgley** on his promotion to Senior Lecturer.

**Dr Martin Rist** on being appointed to a Lectureship in Materials Engineering at The Open University.

**Susan Rea** second-year PhD student in the Cambridge Centre for Medical Materials on achieving equal 1st Prize in the Student Poster Competition held as part of the IoM Materials Congress 2002.

**Jan Sandler** on winning a prize at The Physics Congress (CMD19CMMP) for the poster 'Structural transitions of carbon nonstructures under hydrostatic pressure.'

*This newsletter is written by Dr Sue Jackson, produced by Carol Ann Monteith and printed by L & R Print Ltd.*

