

Materials Monthly

Making materials matter

August 2001

Biomaterials

THE NEW FRONTIER OF MEDICINE

CSEM's third *Materials Seminar* for 2001 featured Professor Arthur Brandwood* who provided an interesting and informative overview of the recent history and potential future of medical implants.

The central tenet of Brandwood's presentation was that despite the extensive growth in use of medical implants in the last 50 years, the basic science involved hasn't really come that far. What's more, it appears that attempts to further develop traditional uses of medical implants seems to have hit a brick wall. Researchers are refining the technology going into implants such as hip replacements, heart valves and blood vessel stents (ie, they're getting stronger, smaller or cleverer), but there haven't been any dramatic improvements in treatment in recent years.

For example, even though researchers are forever experimenting with design modifications for hip implants, they haven't really changed significantly in decades. And for all their tinkering, today's hip replacements are still experiencing many of the problems associated with the early models.

However, where traditional approaches appear to be yielding diminishing returns, research in the areas of tissue engineering, biomimetics and gene tech look like producing a revolution that could change the fundamental approach to medical implants. Instead of building materials to replace or augment a body part, the new breed of biomaterials will work with the body so that it heals itself. Tissue engineering is all about guiding and encouraging tissues to naturally regenerate the part that is damaged or broken. Biomimetics examines how nature constructs its many materials and looks to mimic a natural material's property and behaviour. Gene tech may in future allow scientists to grow

replacement tissues and organs that can be implanted without risking rejection.

Biomaterials may be changing the way we look at implants in the decades to come. For more information, visit the Australian Society for Biomaterials' website (www.biomaterials.org.au/).

**Arthur Brandwood is a Visiting Professor at the Graduate School of Biomedical Engineering, UNSW. He chairs the ISO Technical Committee 150 Working Group on Tissue Engineering, is a Founder member and Past President of the Australian Society for Biomaterials (which meets at ANU next March) and was the Director at the Biomaterials and Engineering Laboratories for the Therapeutic Goods Administration.*



Prof Brandwood with a range of traditional medical implants at the CSEM Seminar. Biomaterials look like revolutionising the field.

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Volume II, Issue 6



Direct from the Director

Phil Evans, School of Resources, Environment & Society

After fifteen and a half years I have decided to part company with the Department of Forestry (now renamed the School of Resources, Environment and Society after its recent merger with the Department of Geography) to take up a position at the University of British Columbia, Faculty of Forestry. My departure, which will occur towards the end of October, means it will be necessary to find a new Director for CSEM. The CSEM's Consultative Committee*, is now seeking expressions of interest in the Directors position.

The Director's job is a fairly onerous one bringing with it many additional responsibilities on top of normal teaching research and administrative duties, but nevertheless I have found the position to be both interesting and rewarding. There are no guidelines for running a virtual research centre and therefore as Director I have had the opportunity to develop new university-wide initiatives, and see some of them bear fruit. Such opportunities comes rarely in academia and therefore I hope some of you will throw your hat into the ring and contact Denis Evans at the RSC with an expression of interest in the position.

You will take over a Centre that is well on the way to achieving its aims of increasing student recruitment, enhancing interactions between materials scientists on campus and raising the external profile of materials science at ANU. For example, post graduate students residing within our graduate program number 7 with 11 affili-

ated students. Our interdisciplinary undergraduate program is starting to make an impact and through the efforts of David Salt, and his predecessor Jenny Edwards, there is now a much greater awareness of the materials science on campus and externally.

These activities are very much in tune with current policy directions at the ANU and in particular the recent decision by the VC to create 11 National (virtual) Institutes spanning several departments. The role and relationship of CSEM and the other existing virtual centres on campus to the proposed National Institutes has yet to be articulated by senior management at ANU. However CSEM has clearly demonstrated that a virtual centre running on a shoe-string budget of \$65k p.a. can have a impact out of all proportion to its size and therefore there is every reason to believe that it will continue in future.

***CSEM's Consultative Committee**
Prof Denis Evans, Chair (RSC); Dr Phil Evans, Director CSEM (SRES); Mr Karin Ahrling (Dept of Chem); Dr John FitzGerald (RSES); Dr Heather Kennett (Dept of Physics); Dr Elmars Krausz (RSC); Dr Marc Ridgway (RSPHySE); Dr John Thompson (Dept of Industry, Science and Resources); Dr Zbigniew Stachurski (Dept of Engineering).

Some thoughts on

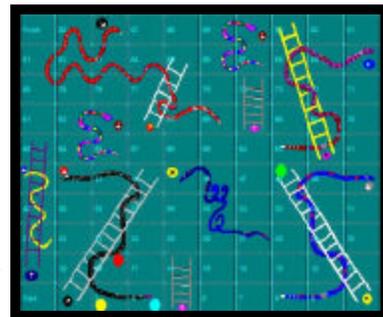
product development

A word from ANUTECH's Tony Cooke

Ignoring the obvious pun, advances in material wealth of the last few centuries are firmly rooted in advances in material science. Indeed since prehistory, technology has advanced with improvements in our understanding of materials; but the rate of advance in the last few centuries and particularly the last hundred years has increased enormously because of our knowledge and its systematic extension. Knowledge and understanding are only the start of the path towards material wealth embodied in useful products and you may wonder how your knowledge can be put to use.

Development of useful products is at best difficult and at worst a nightmare. Product development is a bit like a game of three-dimensional Snakes and Ladders for blind players where snakes predominate and the third dimension represents either other teams working towards similar products or different winning outcomes. Each level of the game is of different degree of difficulty and if you start on the wrong level you are disadvantaged because discovering an easier level, means you start again.

It should not be surprising that the way to avoid the snakes is research - social research not technical research. Social research shows players the worth of the game as the community outside views it and whether they will buy it. However, social research has to be done in the wider community to get the broader view. Furthermore, if you stick to just playing the game it is very difficult to be objective from within. So your social research needs to be unbiased and of wide view and it is also best to get outside advice.



This is where ANUTECH can help. We can provide unbiased advice on the product, assist in determining its potential markets, help with planning and pre-commercial development, protection of Intellectual property and introduction to commercial partners. **And you thought that your research was the only research necessary!**

Want to pursue commercial opportunities for your research - contact ANUTECH: **Tony Cooke** - Technology Manager Physical Sciences and Engineering Ext 50613 / tony.cooke@anutech.com.au

Materials on campus: NMR

Nuclear Magnetic Resonance at ANU

The ANU's Nuclear Magnetic Resonance Centre (UNMRC) is located within the Chemistry Faculties building and overseen by the Research School of Chemistry. The Centre provides a service in NMR spectroscopy to the University community at large (and users external to the University where appropriate). This service includes access to modern NMR equipment, service spectra for occasional users, training in NMR methods for regular users and consultation on applications of UNMRC. The NMRC is run by Max Keniry, the Facility Coordinator, together with Chris Blake, Tin Culfane and Peta Simmonds.

The Centre operates six NMR spectrometers that cover a range of frequencies and nuclei, and which run a diversity of applications. The UNMRC is equipped to handle all of the common 2D experiments. There are also a range of software options (e.g. linear prediction, digital signal processing) and hardware options (e.g. waveform generators for pulse shaping and pulsed field generators) available to obtain the most out of the acquired spectrum.

The Centre staff have implemented all of the standard 1D and 2D experiments on the spectrometers, and many other non-standard experiments. On request, the UNMRC staff will attempt to implement any published NMR experiment. Where possible, the Centre encourages all users to operate the spectrometers and prepare their own samples for themselves. The Centre provides training to this end on request.

New at the UNMRC: Solid State NMR

One of the most exciting new developments at the UNMRC was the recent installation of a magic angle spinning probe on the Inova 300 spectrometer. The probe allows experiments to be performed on samples in a solid state and is available for general use. In the first instance, routine spectra of three nuclei, ^{13}C , ^{31}P , ^{29}Si can be acquired. Other nuclei will be added to this list at a future date or on request.

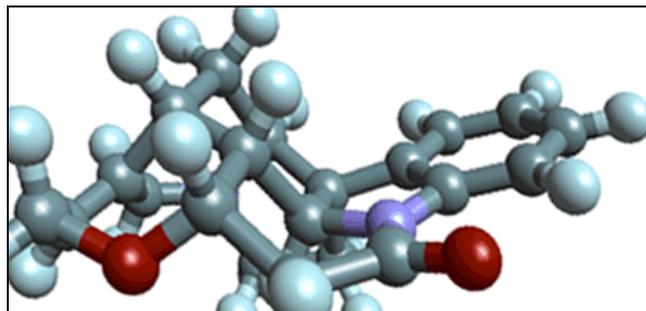
The solid-state probe is capable of performing cross-polarization experiments and spins the solid sample at 54° in order to narrow the resonance lines produced. Many solid samples can now be studied using NMR techniques including polymers, insoluble solids and minerals. Any enquiries regarding training or service should be directed to Peta Simmonds (6125 3731) or Chris Blake (6125 8074).



Max Keniry with a 5mm zirconia rotor that holds the solid sample.

For more information on the UNMRC visit <http://bloch.anu.edu.au/index.html>

Chemistry's cornerstone



Nuclear Magnetic Resonance (NMR) is a cornerstone to molecular chemistry, biology and modern materials science. It's one of the few non-destructive methods for analysing molecular structure, and provides a wealth of information on what atoms make up a molecule, how they are arranged (eg rings, layered molecular segments, etc) and how the molecule is folded or twisted in three dimensions.

NMR grew out of basic molecular science in the 1940s. It was first demonstrated by Felix Bloch and William Hansen at Stanford University and Edward Purcell at Harvard University in 1946. They showed that when certain atoms are placed in a strong magnetic field, they absorb energy at a specific frequency. By measuring the energy that is absorbed and then radiated by these atoms, it is possible to identify what they are. NMR spectrometers are based on this concept and are capable of detecting and amplifying the absorption and emission of energy from atoms with such precision that it's possible to calculate the structure of molecules.

NMR has been one of the basic enabling technologies that have been behind the development of the materials that have characterised the 20th Century such as polyester, paints and a variety of other plastics and petrochemical products. Today, many labs operate whole batteries of NMR systems performing a wide range of duties including measuring the moisture content of food, doing quality control in pharmaceuticals, performing advanced biomedical studies and helping probe the basic structure and function of RNA and DNA.

When asked 'what does NMR mean to chemistry?', Martin Packard, one of the early pioneers of the technology, responded by saying "without it, they'd be out of business".

For a good background on the science of NMR, see <http://www.cis.rit.edu/htbooks/nmr/>

Jobs & Scholarships

Australia

Postdoctoral Fellow/Inorganic Chemistry (closes 31/8/01)

Research School of Chemistry, ANU
<http://www.anu.edu.au/hr/jobs/academic.html#rsc423>

Postdoctoral Fellow, Nanostructure of Milk (closes 15/9/01)

RSC, ANU, www.anu.edu.au/hr/jobs/academic.html#466

Overseas

Professor of Materials (closes 14/9/01)

University of Nottingham, UK
<http://jobs.ac.uk/jobfiles/IF187.html>

Research Assistant/Chiral crystallisation (closes 3/9/01)

University Collage of London, UK
<http://jobs.ac.uk/jobfiles/IF157.html>

Post Doc Res Associate, Optical Physics (closes 30/8/01)

Imperial College, UK
<http://jobs.ac.uk/jobfiles/HJ991.html>

Doctoral Student, Wood Science of Fast Growing Poplar Hybrids

Laval University, Quebec
Tony.Zhang@QC.Forintek.ca

Postdoctoral Research Associate, Novel glasses for photonics (available 31/8/01)

University of Nottingham, UK
<http://jobs.ac.uk/jobfiles/SA632.html>

Research Associate, thermal analysis-isotope ratio mass spectrometry (closes 31/8/01)

Uni of Newcastle upon Tyne, UK
<http://jobs.ac.uk/jobfiles/SA618.html>

Research Fellowship, Magnetic Multilayers & Nano- magnets (closes 10/9/01)

University of Southampton, UK
<http://jobs.ac.uk/jobfiles/HK132.html>

Short tem contract, Laser Cleaning of Oxidised Materials (closes 30/9/01)

University of Burgundy, France
<http://jobs.ac.uk/jobfiles/WA167.html>

Research Fellow, reagents for rapid synthesis (closes 31/8/01)

University of Southampton, UK
<http://jobs.ac.uk/jobfiles/TB150.html>

Assist Director, Centre for Ni base Alloys (commences 1/10/01)

University of Cambridge, UK
<http://www.msm.cam.ac.uk/Department/adverts/Current-adverts/RRADR.html>

For the Diary

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|---|--------------------|
| ▶▶ Hydrogen Effects on Material Behaviour and Corrosion Deformation
International Conference, Moran, Wyoming
see http://www.ca.sandia.gov/jacksonconference/ | 16-21 September |
| ▶▶ CFFPR 2001
International Conference of Forestry & Forest Products Research, Kuala Lumpur, Malaysia
see http://www.mcebc.gov.my/Matrade/ASP-Bin/Public/EventDetails.asp?EventID=235 | 1 - 3 October |
| ▶▶ CMT 25
25 International Workshop on Condensed Matter Theories, Canberra
see http://www.rspysse.anu.edu.au/theophys/CTP/WORKSHOPS/CMT25_2001/index.shtml | 3-8 December |
| ▶▶ Beyond the Human Genome
The Pharmaceutical Industry in the New Millennium, Melbourne
see http://www.rspysse.anu.edu.au/theophys/CTP/WORKSHOPS/CMT25_2001/index.shtml | 6-8 February, 2002 |
| ▶▶ Polymeric Biomaterials
Aust Society for Biomaterials & RACI Polymer Division; Beechworth, Victoria
http://www.hsn.csiro.au/BeyondGenome/ | 6-8 February, 2002 |

UN Interest in ANU Wood Composites

Last month, ANU's Forest Products Technology lab was visited by a United Nations Technical Advisor to find out more about the work being done on wood-cement composites.

Dr Mike Patto is the UN's Chief Technical Advisor to Pakistan in the field of salinity. He's interested in ANU's research on wood-cement composites, in particular wood-wool cement board (WWCB), because this product may be a potential end use for *Eucalyptus camaldulensis* plantations in Pakistan. Dr Patto is investigating small to medium scale industries which could produce wood-based composite panels.

For several years researchers in the ANU Forest Products Technology group have been investigating how to improve the structural strength of wood-wool cement boards for use in low-cost housing in the Philippines. Dr Patto is interested in investigating whether the composite boards might also be used in Pakistan. Rico Cabangon, Kate Semple and Phil Evans demonstrated how the boards are made and tested in the lab, and discussed with Dr Patto the possibility of running a feasibility study on wood-wool cement boards containing *E. camaldulensis* in Pakistan.

While in Canberra, the ANU researchers took Dr Patto to inspect an innovative engineering project being run by the firm Decoin to develop and market simple low-cost housing kits ('top-hat' frames and fastenings to be combined with locally available building materials such as wood composite boards).

Dr Patto will report back to the UN and hopes to initiate trials of Decoin's low-cost, eco-friendly housing system and a WWCB pilot study in Pakistan.

More information: mpatto@brain.net.pk, or lpatto@bigpond.net.au



Rico Cabangon (left) and Kate Semple show Dr Patto (centre) a wood-wool cement board and the raw wood fibre from which it was made.

Material Grab: Corrosion Map

CSIRO scientists have produced a new map of Australia to help battle the corrosion that attacks everything from motor vehicles, to the Sydney Harbour Bridge, garden sheds and even farmers' fences.

see: www.dbce.csiro.au/whatsnew/viewpress.cfm?press_id=95

Summer Research Scholars

Are you completing a course leading to an honours degree this year? . . . next year? (or do you know a student who is?) Perhaps you're thinking about a higher degree? Then why not think about one of the following ANU Summer Research Scholarships. (Note, the scholarships are primarily intended for currently enrolled undergraduate students in universities in Australia and New Zealand.)

Research School of Chemistry

rsc.anu.edu.au/RSC/Positions/GradStudies-Scholarships/SummerResSchol.html

closing date: 31 August 2001

Res School of Phys Sciences and Engineering

www.rspysse.anu.edu.au/School_Pages/vac.html

closing date: 10 September 2001

Research School of Biological Sciences

biology.anu.edu.au/rsbweb/scholarships.shtml#sum

closing date: 31 August 2001

Research School of Earth Sciences

rses.anu.edu.au/admin/info/Summer.html

closing date: 31 August 2001

John Curtin School of Medical Research

jcsmr.anu.edu.au/students/jcsmr_scholar.htm#src

See ya Pete

Peter Beutel, recently left ANU to take up a position at ACT Forests. Peter was a Senior Technical Officer in the School of Resource, Environment & Society (formerly the Department of Forestry), a post he held for 12 years. He was active in many and varied roles



in the department being responsible for overseeing much of the functioning of the wood technology area. Peter also gave a lot of his time helping Phil set up and maintain the current iteration of CSEM. He will be missed by everyone. Here's an ode to Peter penned by Roger Heady from the Electron Microscope Unit, one of the many materials researchers who benefited from Peter's help. It was read to Peter at his farewell.

Pete, since you've been at Forestry
Wood science has taken flight
You have a knack, its plain to see
To fix and make things right
Your expertise it is so wide
You've helped me to achieve
You've been my friend, helper and guide
I'm sad you're going to leave.

On field trips gathering cores of wood
I've enjoyed your company
Those Narrandera, Gympie
times were good
And you were a great help to me
Out in the bush with a corer blunt
I couldn't get my cypress pine

Yet you cored five trees without a grunt
Your strength, much more than mine.
I don't want you to go, that's very true
But know you are committed
And a man's gotta do
what a man's gotta do
To best live as he's fitted
So "See ya" Pete and all the best
Working with you has been just great
You've done well here, passed every test
You'll do well there, good on ya mate!

MM webspotting: MS&E at CSIRO

◆ **CSIRO Built Environment**

<http://www.dbce.csiro.au/>

◆ **CSIRO Manufacturing Science and Technology**

<http://www.cmst.csiro.au/>

◆ **CSIRO Molecular Science**

<http://www.molsci.csiro.au/>

◆ **CSIRO Telecommunications and Industrial Physics**

<http://www.tip.csiro.au/>

◆ **CSIRO Energy Technology**

<http://www.det.csiro.au/>

◆ **CSIRO Mathematical and Information Sciences**

<http://www.cmis.csiro.au/>

◆◆ **CSEM's fab Links Page:** www.anu.edu.au/CSEM/links.html

◆◆ **UFMOs: Unbelievable Flying Magnetic Objects:**

Announcing CSEM's August Seminar

The light fantastic LOOKING AT MATERIALS WITH LIGHT

speaker: **Dr Elmer Krausz**

Research School of Chemistry,
ANU

venue: **Robertson LT, RSBS, Bld 46, ANU**

date: **Wednesday, 29 August, 2001**

time: **4pm** (drinks/nibbles following lecture)

CSEM

Centre for Science & Engineering of Materials

Faculties

Department of Chemistry

Department of Engineering

Department of Forestry

Department of Geology

Department of Physics

Institute of Advanced Studies

Research School of Biological Sciences

Research School of Chemistry

Research School of Earth Sciences

John Curtin School of Medical Research

Research School of Physical Sciences & Engineering

Institute of the Arts

Materials Workshops

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Location: Department of Forestry (#48), Wood Sciences Building, Linnaeus Way, ANU

Materials Monthly comes out in the first half of each month. We welcome your feedback and contributions. Please send them to David Salt, Editor, *Materials Monthly*, care of CSEM. Please let us know if you wish to be added to our electronic or postal mailing lists.

Electronic copies of *Materials Monthly* can be accessed at: www.anu.edu.au/CSEM