

Materials Monthly

Volume II, Issue 1

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Food for Thought

Centre for Science and Engineering of Materials



Cadbury UK's 400g Christmas bar.
Image from: www.dairymilk.co.uk/

“Food is such a familiar “material” to all of us that it is easy to overlook the science input required at all stages in its manufacture, from production to consumption.” Nevertheless, as the articles in the special Dec 2000 issue of the American Materials Research Society’s journal the *MRS Bulletin* seek to prove, “the materials science approach is every bit as valid—and as useful—for food as it is for any more conventional system studied in the materials science field. The familiar linkage of structure-property-processing serves equally well in the case of a chocolate bar as a steel bar.”

“Food is a challenge for the materials scientist for many reasons. It is almost invariably heterogeneous and multiphase; its raw materials may be very variable, depending on frequently unknown parameters such as the average temperature conditions in which a cereal crop has grown or the maturity of a cocoa bean at the time it was harvested; and it has so far proved impossible to find a straight forward correlation between

any standard mechanical test parameter and the qualities a consumer will describe (e.g., crisp or soggy, tough or soft). Nevertheless, in these complex, variable materials there is a richness of science that we are only just beginning to uncover which closely relates to the well-tested laws of crystalline and amorphous materials typically found in our laboratories.”

For example, a “key factor in the processing of chocolate is the requirement that it be shaped to suit its end use: novelty shapes for decoration, filled centers for boxed assortments, and so on. Hollow Easter eggs are a particular issue. Processing complex shapes is not that different from molding alloys or plastics. The same issues concerning flow around corners, weld lines, stagnation points, differential cooling rates, and coarsening of crystal structures all apply.”

Check out the full text of guest editor Dr A.M. Donald’s introduction at: www.mrs.org/publications/bulletin/

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Direct from the Director

Phil Evans, Forestry Department

Welcome to CSEM's first issue of *Materials Monthly* for 2001. I hope you have enjoyed reading the previous issues that we produced in 2000. If by chance you missed any of the issues, they are available on CSEM's web site in pdf format.

It would be apparent from our page three articles that highlight the research activities of the different groups on campus, that the material science research being conducted at ANU is rather different from that of many other materials science departments/centres. Traditionally such departments have focussed on structural materials, particularly metals. Accordingly, some of the first popular text books on materials science, such as Alexander and Street's 'Metals in the Service of Man' (Penguin Books, 1944) and McCabe and Bauers 'Metals, Atoms and Alloys' (Amer. Nat. Sci. Teachers Assoc., 1963) all concentrated on metals. Even later, more popular books such as Gordon's 'The New Science of Strong Materials, or Why You Don't Fall Through the Floor' (Pelican Books, 1968) emphasised metals and other structural materials such as concrete and wood. Nowadays such materials barely rate a mention in some materials science books. For example, Ball's book on new materials for the 21st century ('Made to Measure') concentrates much more on photonic materials, materials for clean energy, smart materials and polymers than on traditional materials. Greater emphasis is also given to the problems of materials selection (given the bewildering range of choices available for many applications) and the relationship between a materials structure and function.

These emerging materials and research themes which underpin many high technology industries, are ones in which the ANU is particularly strong (see www.anu.edu.au/CSEM for details) and in the coming year we will continue to promote your research to government and industry to try to ensure that it gets the recognition it deserves.

Both Jenny Edwards and Amanda Cook, CSEM's Communication Officer and Administrative Assistant respectively, will be leaving us in the next month. Jenny will be taking up the role of mother of two while Amanda is moving with her family to the warmer climate in Brisbane. I would like to take this opportunity to thank them both for their excellent work over the last year.

I will be overseas from 11 Feb - 2 March visiting universities and research institutions in China, Laos and Vietnam with the aim of developing a large research project through the Australian Centre for International Agricultural Research on value-added processing of eucalypt timber. We hope to have replacements for Jenny and Amanda before my departure.

Materials on Campus:



Introducing EME

Activities in this Department of the Research School of Physical Sciences and Engineering (RSPHYSSE) concentrate on the near-surface processing, modification and characterisation of materials and devices. Silicon, gallium arsenide and III-V compound semiconductor structures are emphasised but other materials, particularly the preparation of novel metallic alloys, are also of interest. The group collaborates widely with other staff of the RSPHYSSE and in addition has strong collaborative programs with other Australian and overseas universities and research laboratories. Our suite of experimental facilities are modern, extensive and provide a unique opportunity for research into advanced materials and processes. Equipment and facilities include: a 1.7MV tandem high current ion implanter, a Riber secondary ion mass spectrometry (SIMS) system for ultra sensitive elemental profiling, a metal organic chemical vapour deposition (MOCVD) reactor for growing III-V epitaxial layers, thin film deposition facilities, Rutherford backscattering (RBS) and channelling for near surface analysis, a ball milling laboratory, x-ray and DSC facilities for structural and thermal analysis, electrical analysis facilities, optical characterisation and testing, device processing capabilities, as well as access to transmission electron microscopy (TEM) and atomic force microscopy (AFM).

Ion Implantation

This area involves the physics and materials science of ion-irradiated semiconductors and related materials. Central to this research are the Department's world-class experimental facilities, including a 1.7MV high-energy ion-implanter, low energy implantation and a broad range of physical and electrical characterisation techniques to fully investigate ion-irradiated materials. Studies involve a broad spectrum from fundamental to applied research of major significance for the rapidly advancing semiconductor industry. Current studies include: the nature and evolution of radiation damage in semiconductors, ion-irradiation induced phase change; solid phase epitaxial crystallisation of amorphous layers, diffusion in crystalline and amorphous semiconductors, gettering of metals to defects, quantum-well intermixing; the formation of buried alloys such as silicon-germanium and compounds such as silicon dioxide, the electrical properties of ion-irradiated semiconductors, formation of nanocrystals for non-linear optics and many others.

Epitaxial Growth of Semiconductor Multilayers and Nanostructures

Novel multilayers of III-V semiconductors are grown by low pressure MOCVD. Research involves growth of atomically abrupt layers of GaAs/InGaAs/AlGaAs/InAlAs/InP on GaAs, InP and Si substrates for optoelectronics applications. Research also involves growth of doping superlattices, modulation doped heterostructures for the studies of carrier dynamics and carrier transport at low temperatures. Selected area epitaxy and self limiting growth of nanostructures such as quantum wires on patterned substrates is of current interest. Self-assembled growth of quantum dots and intermixing of quantum wells, wires and dots is a major research effort.

Materials Characterisation

The Department's extensive suite of materials analysis facilities and those of collaborators are extensively used to characterise electronic materials and study their properties. For example, point defects and their interactions are of intense fundamental and technological interest in both silicon and compound semiconductors and are studied by Deep Level Transient Spectroscopy (DLTS), particularly for defects controllably introduced by ion irradiation. The local atomic environment around defects and impurities in semiconductors is studied by the extended X-ray absorption fine structure (EXAFS) method using Synchrotron radiation and by perturbed angular correlation (PAC) using nuclear probes. The microstructure, extended defects and strain in novel layers grown by MOCVD and the evolution of microstructure in ion irradiated semiconductors are studied by TEM, double crystal X-ray and ion channeling techniques. Photoluminescence, optical reflectivity, photo voltage, cryogenic Hall effect and capacitance-voltage profiling are further optical and electrical methods used to characterise processed semiconductors.

Optoelectronic Device Processing

This area is mainly focussed on optoelectronic devices such as semiconductor lasers, optical modulators and fast photodetectors. The availability of state of the art growth and device processing facilities in-house will give an opportunity to design, grow and process novel devices. Current studies include: wavelength tunable quantum well lasers, visible modulators, high power quantum well lasers, ultrafast photodetectors, vertical cavity surface emitting lasers (VCSELs) and quantum wire / dot lasers.



Jobs & Scholarships



Australia

Research Scientists - Wood Coatings/Adhesives
CSIRO Forestry and Forest Products, Melbourne
rick.ede@ffp.csiro.au

Scientist - Environmental Assessment and Management
DASCeM Holdings Pty Ltd, Canberra
www.dascem.com.au
dascem@dynamite.com.au

O S

Senior Research Fellow - Inhibiting the Bacterial Colonisation of Surfaces: the Low-Surface-Energy Approach
Biomaterials and Drug Delivery Dept - University of Portsmouth
jobs.ac.uk/jobfiles/HH204.html

Research Associates - Processing, Modelling and Characterisation of Vapour Deposited Thin Films
Department of Materials - Imperial College of Science, Technology & Medicine
jobs.ac.uk/jobfiles/HH238.html

Post Doctoral Research Associate - Fabrication of Ceramic Casting Cores by Ink-jet Printing
Manchester Materials Science Centre - UMIST
jobs.ac.uk/jobfiles/LD579.html

Postdoctoral Research Associate - Nano-Optical Spectroscopy
Department of Physics - King's College London
jobs.ac.uk/jobfiles/HH057.html

Assistant/Associate Professor - Wood Composites
Department of Forestry, University of Idaho
forprod@uidaho.edu

Project Manager - Materials Microworld Museum Exhibition
Materials Research Society, USA
www.mrs.org/microworld/position/

PhD Scholarships - Optical Fibre & Photonic Technologies Research

Redfern Photonics Pty Ltd offers postgraduate scholarships to suitably qualified candidates with a good honours degree in science, engineering or applied mathematics to undertake theoretical or experimental research leading to a PhD thesis.
For further information email: p.thompson@redfernphotonics.com.au

CSEM Honours Scholarships - Materials Science

CSEM has two honours scholarships of up to \$5000 available in 2001. The project must be a) on materials; b) multidisciplinary and c) involve more than one department in CSEM.

Graduate R&D Opportunities - employment and scholarships for graduates from electrical/mechanical/manufacturing engineering, physics, information technology & combined science/engineering degrees

Industrial Research Institute, Swinburne University of Technology, Melbourne
dtoncich@swin.edu.au

PhD Studentships/Post-Doctoral Research Assistant - Condensed Matter Physics/Nanotechnology

Department of Physics - University of Durham
jobs.ac.uk/jobfiles/CD450.html

Position Wanted - Experienced Materials Scientist

I have wide experience in 1. the processing and characterisation of composites, ceramic fibres, ceramics for various applications, bio-ceramics, thin films and sol-gel techniques for various applications 2. teaching courses in composites, polymers, ceramics and metals. At present I am a principal investigator for a U.S. \$ 150,000 project sponsored by Malaysian Ministry of Science and Technology for the production of Alumina Fibres for Thermal Insulation and Composite Applications. I have 2 Ph.D, 2 MSc and numerous final year students working under my supervision. If given an opportunity, I am sure I will be an asset to your department and can contribute significantly to the interests of your department.

Dr. Ramanan Venkatesh email: ram5nan@hotmail.com
Materials and Mineral Resources Eng., Universiti Sains Malaysia

Centre for Science and Engineering of Materials www.anu.edu.au/CSEM

For Your Diary

- Raman Microscopy Workshop** March
Presented for CSEM by Vincent Otieno-Alego of the University of Canberra's Microscopy Unit for Materials Analysis. Contact Phil.Evans@anu.edu.au for more info.
- Australian Workshop on Nanotubes and Fullerenes at ANU** 3-4 May
see rshyssa.anu.edu.au/nanotube/awnf2001
- Australian Electrical and Electronic Manufacturer's Association inaugural national conference** 27-29 May
Cleaner, Greener, Smarter in Melbourne
see www.aeema.asn.au/conf2001/
- PICMET '01 (Portland Int. Conf. on Management of Eng. and Tech.)** Jul 29 - Aug 2
Theme: *"Technology Management in the Knowledge Era: Life in the e-World"*
see www.picmet.org
- AMPT '01 International Conference on Advances in Materials and Processing Technologies** 18-21 Sept
Madrid, Spain
see www.fundacion.uczm.es/ampt/

Two Journals Full of Good Material

The Materials Research Society in the US produces two monthly materials science journals:



See www.mrs.org/publications/jmr/jmra/

ANU only received this journal between 1988 and 1989. **Do any of you subscribe to this comprehensive materials publication?** It seems like a good resource to have on campus - we'd appreciate your opinions. Please check out the abstracts electronically and let us know what you think.



See www.mrs.org/publications/bulletin/

2001 themes include: Preserving Art Through the Ages, Computational Materials Science and Multiscale Modeling of Materials, Microelectromechanical Systems Technologies and Applications, Hybrid Organic-Inorganic Materials, High Thermal Conductivity Materials, Nanofabrication: Emerging Techniques and Applications, Materials Science Aspects of Photonic Crystals, Actinide Materials Science, Ecomaterials, New Aspects in Nanocrystal Research.

ANU has never received copies of this broadly themed publication. It sounds like it would be very useful to the budding undergraduate materials scientists we hope to attract to the ANU. Again, please let me know if you subscribe to it or what your impressions are.

Congratulations CSEM Members on the Recognition of your Excellent Work

Dr. Nicholas Welham of the Research School of Physical Sciences has been awarded the Rossiter W. Raymond Memorial Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers for 2001. The award, which recognizes the best paper published by AIME in a given period, is to be presented at the AIME Annual Banquet to be held in Denver, Colorado in late February 2001.

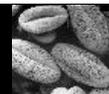
PhD student, Rico Cabangnon, has been recognised in the Far Eastern Economic Review's Young Inventors Award. Of the 300 applications received Rico was awarded the ranking of 13 for his project conducted in the Department of Forestry and titled "A Technique to Strengthen Wood-Wool Cement Boards for Use as Low-Cost Construction Material in the Phillipines".

New CRC for Functional Communication Surfaces

Congratulations to the CSEM members from the Department of Applied Maths, RSPHysSE, and the Department of Forestry through Carter Holt Harvey, involved in the latest round of Cooperative Research Centre bids. The CRC FCS was one of 19 successful new Centres announced by Senator Nick Minchin on 18 January this year. For more info see www.isr.gov.au/crc



Electron Microscopy Unit News



ANUEMU workshops in 2001

For honours students, post-grads, and anyone else interested. The dates for the first sessions of the annual "Microscopy, Images and Analysis" Workshops are as follows:

Image Processing	13th and 14 March
SEM	19th March
TEM	26th March
Microanalysis I	2nd April

Details on the web (www.anu.edu.au/EMU). A second round of sessions including specialised topics will be run later according to demand.

MACACT

A loose "Microscopy Consortium of the ACT" is up and running - see the website www.anu.edu.au/EMU/MACACT

Communication News

CSEM Promotional Folders and Inserts - we took delivery of our new and stylish CSEM promo materials just before Christmas. Let me know if you need to send some CSEM information in style! These materials will be used to target prospective students and research/industry partners.

PEA Day, 22 Feb - ANU's Pre-Enrolment Advice Day will see CSEM staffing an information desk at the Manning Clarke Centre and co-hosting a lunch-time sausage sizzle with the Centre for Public Awareness of Science.

Enrolment Days, 15, 16 & 19 February - to make sure any interested materials scientists do not escape our net, CSEM will need volunteers to staff a desk during the enrolment period. Phil will be OS (overseas) and Jenny will be OS (over-sized). **PLEASE help!** I will start assembling a roster.

Position Vacant - Jenny will be retiring from her role as Communication and Student Recruitment Officer for CSEM at the beginning of Feb to take up the even more demanding position of full-time Mum to two. Number two is due March 4. The position has just been advertised, spread the word to all enthusiastic science communicators.

CSEM

Centre for Science and 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 and Engineering

Institute of the Arts

Materials Workshops

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We welcome any feedback, enquiries or contributions.

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