

Materials Monthly

Making materials matter

March 2002

Levels of Structure

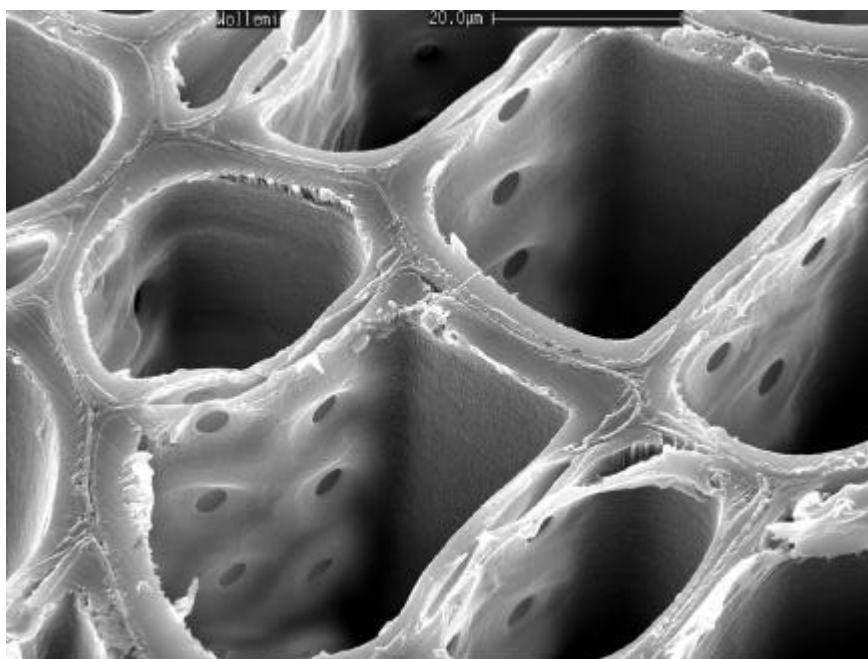
the photography of Roger Heady

23 March-12 April, 2002

Wood Workshop, Canberra School of Arts, ANU

*"...so, over that art
which you say adds to
nature, is an art that
nature makes"*

William Shakespeare
A Winter's Tale



◀◀
Transverse view of tracheids in the wood of Wollemi pine. Taken by Roger, this is the first electron microscope image of the wood of a new genus and species only discovered in 1994. Each vessel is around 0.05mm in diameter.

Anyone who has had anything to do with ANU's Electron Microscope Unit knows the quality of Dr Roger Heady's product. His meticulous approach and keen eye has resulted in some of the most stunning scanning electron micrographs ever produced at ANU.

Now you have an opportunity to see a collection of Roger's finest works in breathtaking detail in a new exhibition titled 'Levels in Structure'. The exhibition is being staged in the Wood Workshop of the Canberra School of Arts, and runs till April 12.

The genesis of the exhibit came from an interest of Rodney Hayward, Manager of the Wood Workshop, in the substructure of wood. "I like my students to appreciate that the character of the material they're crafting is based on the basic properties and organisation of the building blocks of wood," said

Rodney. "Wood and plant stems are stunningly complex and subtle materials, and one of the best ways of appreciating this is through the scanning electron microscope."

Rodney became aware of Roger's work and saw it as a perfect vehicle to demonstrate the complexity and levels of organisation at the ultra-fine level. He also saw how the micrographs revealed the mystery and intrinsic beauty of Nature's handiwork. "Structures made from natural materials give form to hierarchical substructures of many scales. The exoskeletons of radiolarians and diatoms, as just two examples, are absurdly ornate works of architecture about which why and how remains largely unknown."

For more information on the exhibition, contact Rodney on 6125 5835. For a glimpse of what's on show, see page 3.

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Volume III, Issue 3

Catalyst

Ideas, news and opportunities

Stains on steel

Scientists at the Imperial College of Science Technology and Medicine, UK, have established the cause of 'pitting' in stainless steel. The researchers have found how sulphides, an contaminant in steel-making, can lead to corrosion in stainless steel.

Stainless steel is an alloy with at least 12 per cent chromium, which creates a very thin layer of inert chromium oxide on the surface. This inert surface layer stops stainless steel from corroding. However, stainless steel does corrode in wet, salty environments like those near the sea. Previously it was thought that the sulphide impurities dissolved in wet chloride ions to form corrosive hydrogen sulphide.

The new research has found that the sulphur, which has a lower melting temperature than steel, stays molten for a short time after the steel has solidified. It's during this time the impurity particles 'suck' chromium out of the surrounding steel, creating an area of weakness in the steel which is called a 'pit initiation point'.

The pit serves as a point of weakness and can develop into a little hole in the stainless steel which will just keep growing. Pitting can penetrate several millimetres of steel in a few weeks or months and can lead to catastrophic failures.

The scientists used secondary ion mass spectrometry to observe the behaviour of sulphur in steel. The steel they used had a chromium level of 17-18 per cent, but in the areas around the sulphur impurities this was down to 12-14 per cent, leaving those areas vulnerable to corrosion.

More information: http://www.ic.ac.uk/templates/text_3.asp?P=3197

Molecular Circuits

Building circuits with molecules is going from the theoretical to the practical with the construction of rudimentary logic devices such as inverters or AND gates.

Hewlett Packard Laboratories recently announced two patents that are said to solve some small but bothersome problems with a molecular FPGA approach based on a switching molecule called rotaxane.

The HP patents detail a practical method for connecting molecular-scale circuits to the outside world and a method for defining circuit sub-blocks in a massive crossbar array of nanowires. A third patent describes an approach to memory arrays using rotaxane.

The design rules of molecular-electronics schemes hint at the scale of the problems the researchers' face. The erbium disilicide wires used in HP's process are 2 nanometers in diameter and are spaced 9 nanometers apart on a silicon substrate.

The HP design is based on a Manhattan architecture in which a parallel series of north-south wires intersects a similar series of east-west wires. Each wire crossing becomes a location for a molecular switch. Billions or perhaps trillions of gates could be put on a silicon die.

HP's effort is only one of many approaches that enlist chemical processes to build circuits. In other recent work, researchers at IBM showed that carbon nanotubes can behave like transistors with gain; a group at Delft University (in the Netherlands) built basic logic circuits with carbon nanotubes; and researchers at Harvard University used indium phosphide nanowires to demonstrate logic circuits.

Notre Dame (US) researchers are pursuing an essentially different approach with arrays of quantum-dot transistors that do not have to be wired up but instead influence their neighbours through electric fields.

The arrays would perform computation by emulating cellular automata, which can compute a wide range of algorithms. Recently, the quantum cellular automata were shown to be capable of producing gain.

More information: <http://www.electroline.com.au/elc/newsletter.asp>

Focussing ions

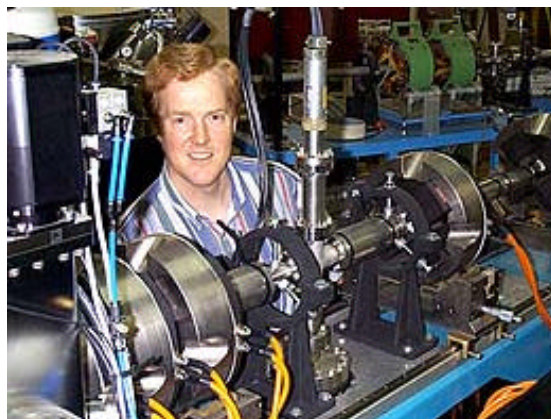
Innovative precision lenses, designed and built in Australia for focusing beams of high-energy ions, form the core of a new breed of high-energy ion beam microscope recently commissioned in Melbourne.

Designed by the CSIRO Division of Exploration and Mining in collaboration with the Microanalytical Research Centre (MARC) at the University of Melbourne, these special lenses open up a wide range of applications to science and industry.

The lens system, known as a magnetic quadrupole quintuplet, can focus high-energy ions produced by a million volt particle accelerator into a micrometre-sized, non-destructive beam to determine the composition and structure of a sample with high sensitivity.

"These special lenses also form the heart of CSIRO's new nuclear microprobe and produce spectacular results in geological research and the development of mineral exploration methods", says Dr Chris Ryan at the CSIRO Division of Exploration and Mining.

More information: <http://www.csiro.au/index.asp?type=mediaRelease&id=Prfocus&style=mediaRelease>



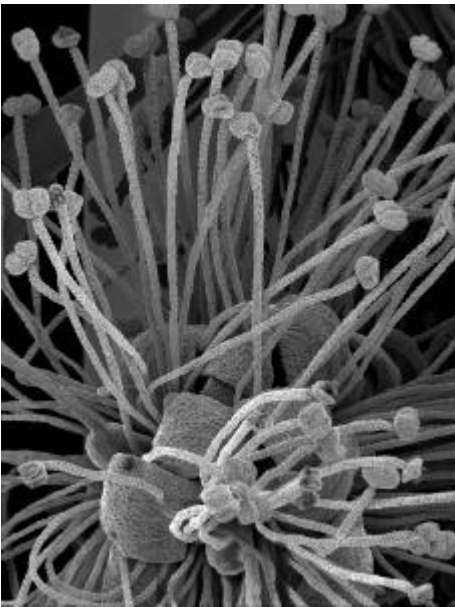
◀◀ Dr Chris Ryan with elements of the magnetic quadrupole quintuplet lens system on the new CSIRO-GEMOC Nuclear Microprobe.

Any intelligent food can make things bigger, more complex and more violent. It takes a touch of genius – and a lot of courage – to move in the opposite direction.

Albert Einstein (1879-1955)

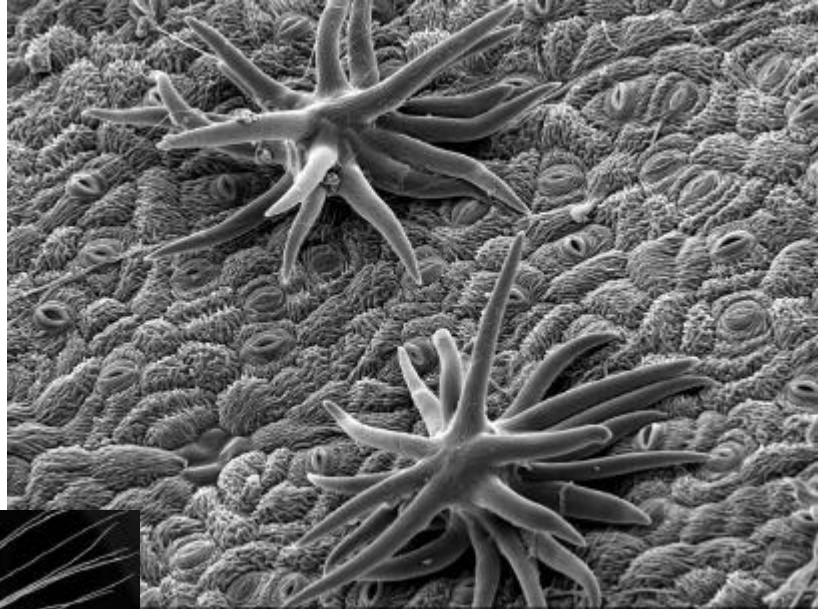
Levels of Structure

the photography of Roger Heady



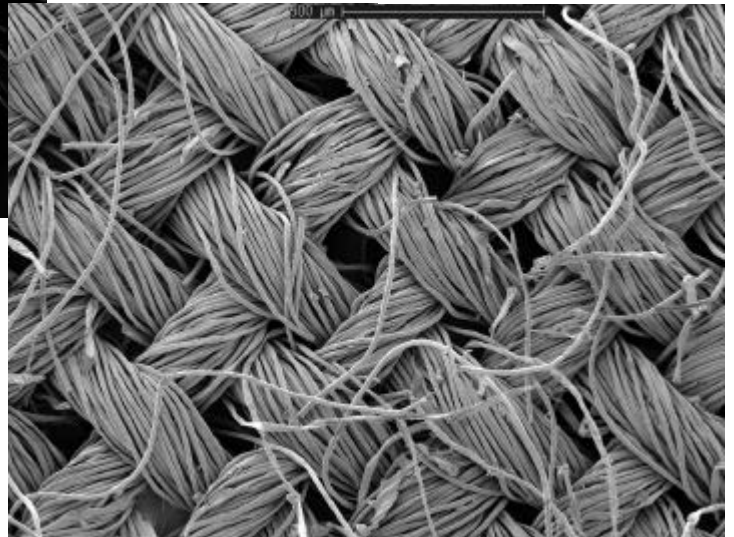
▲▲ Stamens of single wattle flower

▼▼ Dandelion seed



▲▲ Star-like hairs on the leaf of *Correa reflexa* (dusky bells)

▼▼ Weave of a polyester shirt



◀◀ *Our man Roger*

Most people know Roger as an excellent electron microscopist and an expert on wood structure (especially native Cypress pine, Wollemi pine and Aboriginal bark paintings). Not so many people are aware of his interesting past lives.

Roger worked as radio technician for the RAAF for 12 years serving in the Malaysia campaign and Vietnam (for which he

received a War Service Medal). Following this he served as an electronics technician at the Orroral Valley Satellite Tracking Station for 16 years. Always keen to extend the mind, Roger studied part-time while at Orroral earning a BAppSci, a Grad Dip in Electronics and a Grad Dip in Resource Management. He's been with ANU working in electron microscopy since 1983, studying part-time for his PhD through the nineties.

Positions vacant

Australia

Postdoc Fellow/fluid flow in ore systems
(closes 15/3/02)

RSES, ANU

<http://www.anu.edu.au/hr/jobs/academic.html#803>

Postdoc Fellow/gene transcription in immune responses, (closes 8/3/02)

JCSCMR, ANU

<http://www.anu.edu.au/hr/jobs/academic.html#761>

Official Analyst,

(closes 15/3/02)

Aust Racing Forensic Lab, Sydney

More info: (02) 8344 5001

Synthetic Organic Chemists

Alchemia, Queensland

www.alchemia.com.au

Professional Officer/Helicopter Structures

(closes 7/3/02)

DSTO, Melbourne

<http://www.dsto.defence.gov.au/>

Lecturer in Chemistry (2 positions),

(closes 15/3/02)

Uni of Melb

<http://www.hr.unimelb.edu.au/r/action.lasso?-database=hrjobs&-layout=posdetails&-response=detail.html&-recordID=35691&-token.cat=a&-search>

Overseas

Research positions (3)/Photonic Crystals

(closes 1/4/02)

University of Bath, UK

<http://jobs.ac.uk/jobfiles/HM331.html>

Professor of Materials

(closes 27/3/02)

Uni of Nottingham, UK

<http://jobs.ac.uk/jobfiles/HM326.html>

Professor of Materials

(closes 27/3/02)

Uni of Nottingham, UK

<http://jobs.ac.uk/jobfiles/HM326.html>

Postdoc res assoc/supercapacitors based on carbon nanotubes

(closes 27/3/02)

Uni of Cambridge, UK

<http://jobs.ac.uk/jobfiles/HM266.html>

Postdoc/Nanoscale materials

(closes 18/3/02)

Dartmouth College, UK

<http://jobs.ac.uk/cgi-bin/advsearch2.cgi>

Postdoc/Mineral Physics

(closes 18/3/02)

Uni of Cambridge, UK

<http://jobs.ac.uk/jobfiles/HL852.html>

For the Diary

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|--|------------------|
| ◀◆▶ Seminar: Why is the Nordic Area a World Leader in Mobile Telecommunications?
Government and Industry in the Development of Radical Innovation.
5:30pm, Sir Roland Wilson Building, ANU. Enquiries to Vicki Veness on 6125 9883 | 12 March, 2002 |
| ◀◆▶ Seminar: Human digestive strategy and its evolution, Dr Judith Caton
3pm, Manning Clark Theatre 4, ANU. Enquiries to Amanda Kennedy on 6125 0470 | 15 March, 2002 |
| ◀◆▶ Seminar: Biotech and IT Industry Development in Germany
- an alternative to the American model.
12:30pm, Sir Roland Wilson Building, ANU, Enquiries to Vicki Veness on 61259883 | 10 April, 2002 |
| ◀◆▶ Seminar: Take-up of ICT in Australian Firms: Perceptions, Policy and Potential
12:30pm, Sir Roland Wilson Building, ANU, Enquiries to Vicki Veness on 61259883 | 15 May, 2002 |
| ◀◆▶ Lecture: "Flaws in the Fabric: Why Physics and Chemistry have never
contributed generally to the Biological Sciences". Professor Barry Ninham.
4.45pm, Coombs Lecture Theatre, Enquiries to Russell Doust | 20 March, 2002 |
| ◀◆▶ ICPP 2002
11th International Congress on Plasma Physics, 2002, Manly, Sydney
http://www.ise.canberra.edu.au/ICPP2002/ | 15-19 July, 2002 |
| ◀◆▶ Seminar: 'Adventures with natural and "un-natural"
products chemistry to molecular biology' Prof TJ Simpson
11.00am, RSC, ANU,
Enquiries: Lew Mander, 6125 3761 | 15 March, 2002 |

Carry that weight

In January, CSEM hosted two sessions of students from the National Youth Science Forum. The year 12 students comes from all over Australia to spend two weeks in Canberra to learn about science, technology and engineering, and why they might consider science and engineering as a career.

During their two-week stay the students visit institutions all over Canberra, meet some of Australia's most respected researchers and have the opportunity to perform experiments and practicals.

CSEM introduced the students to the rich world of materials science and engineering, and gave them the opportunity to measure the strength of a single fibre of their hair and do an exercise on the importance of material stiffness..

More info on the National Youth Science Forum:
<http://www.nysf.edu.au>

Materials Grab Bag



▲▲ Paul Compston measures the strength of one of the student's hairs. Human hair, weight for weight, can be as strong as



▲▲ Students measure the stiffness of pieces of wood in a variety of configurations.



▶▶ NYSF students pose with the Department of Engineering's pet car

'Levels' a hit

There was a big turn out for the launch of the 'Levels of Structure' on Friday, 22 March at the Wood Workshop in the School of Arts. Scientists rubbed shoulders with artists, and everyone marvelled at the microscopic landscapes that Roger Heady had brought to life with ultra sharp focus.

CSEM's Director, Dr Zbigniew Stachurski, officially opened the event praising the effort and urging

everyone too attempted more collaborations between disciplines.



◀◀ Rodney Haward (left) and Roger Heady in front of some of the images on display.



▲▲ Art through a different lens

▼▼ Zbigniew opens the exhibition



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:**
(for those working around magnets) www.simplyphysics.com/flying_objects.html

Announcing
CSEM's August Semi-

The light fantastic
LOOKING AT MATERIALS WITH

nar

speaker: **Dr Elmer Krausz**
Research School of Chemistry,
ANU
venue: **Robertson LT, RSBS, Bld 46, ANU**

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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Fax: +61 2 6125 0746, Postal: Department of Forestry (#48), Australian National University ACT 0200

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