

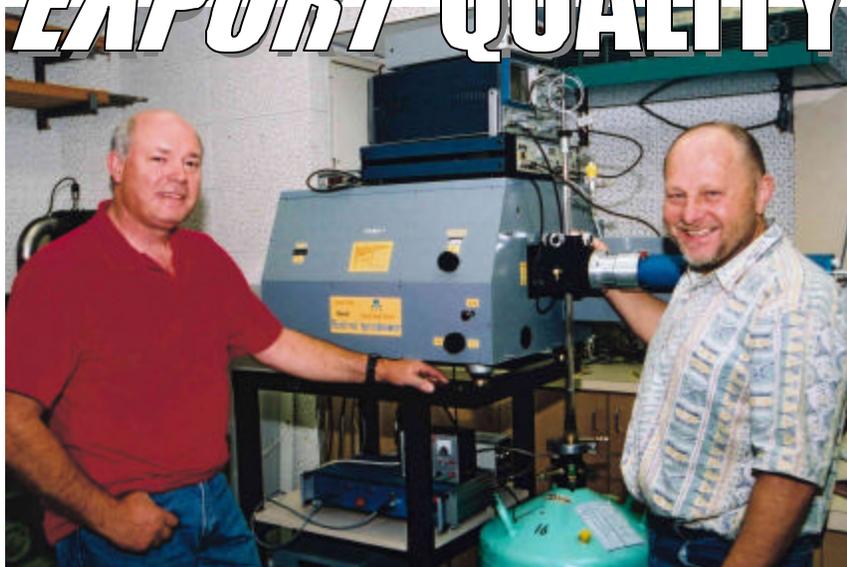
Materials Monthly

Making materials matter

December 2001

New micro-crystal spectrometer

EXPORT QUALITY



"We have the technology!" Keith Jackman (left) with Elmars Krausz, proud parents of an impressive new spectrometer.

The Laser and Optical Spectroscopy group of the Research School of Chemistry have just packaged and delivered a new prototype spectrometer they custom built for the University of Bonn. In the process they've established new benchmarks for quality and innovative materials technology.

The unique spectrometer system has been specifically designed for studying small crystals down to a tiny 20 microns. It's able to measure, with high precision, polarised absorption spectra of the crystals from the ultra violet (240 nanometres) to the near infra red (1.7microns). This allows a detailed 'mapping out' of the electronic structure of the crystalline material.

Importantly, sample handling and alignment has been greatly refined to enable rapid processing. Spectra can be quickly, easily and routinely measured in the very wide 5 degrees above absolute zero (- 268 C) to 200 C or higher range, using the simple and efficient helium flow tube technique.

The system incorporates modern electronics, optics, cryogenics and especially written

computer control software, and is based on pioneering work carried out by the Laser and Optical Spectroscopy group over the last decade.

And why is the University of Bonn after so precise and specialist a system? Because one of its leading chemists, Professor Robert Glaum, is studying the novel optical characteristics of a entirely new range of inorganic phosphates grown by chemical vapour transport synthesis. These inorganic phosphates (a classic optical material is KDP - potassium di-hydrogen phosphate) have high strength, thermal and chemical stability, and most importantly, very high laser damage thresholds. This makes these materials excellent candidates for use as laser media, polarisers and optical doublers.

Chemical vapour transport can provide high quality crystals in a wide range of forms with unusual co-ordination number and geometry, valence states and metal combinations. The vapour transport technique provides materials of the highest purity but the small size of the crystals produced has made it difficult to undertake the necessary spectroscopic measurements quickly and precisely. Which is where the RSC spectroscopic expertise comes in.

Professor Glaum has been both customer and collaborator with the scientists at RSC in developing the prototype micro-crystal spectrometer, and the result has been a stunning success with performance way beyond initial expectations.

The outcomes of this exercise could be far reaching. The work on inorganic phosphates will receive a big boost which could see the rapid development of miniaturised lasers, optical communications and sensor devices. And Australia, through the work of

Inside this MM

- 2 Direct Line
- 3 Advanced Engineering Lab
- 4 Jobs and Events
- 5 Grab bag: Sackler Prize, Nano trannies

Volume II, Issue 10

(Continued on page 2)

A vision for CSEM

As the new Director I'm sure many of you are wondering what direction I'll be looking to steer CSEM. Below is the vision I put to CSEM's Consultative Committee.

2001 has been an incredibly busy year for everyone at ANU. CSEM has done a great job of lifting the profile of Materials Science and Engineering, both on and off the campus. I'm hoping I can develop this good work further next year.

I look forward to working with CSEM's diverse range of members and stakeholders. If you have any views on what CSEM should be doing, I'd encourage you to share them with me.

In the meantime, have a happy and re-energising break over Christmas and New Year. Then, let's make 2002 a big year for materials science and engineering.

All the best

Zbigniew

A vision for CSEM

The commission for CSEM is to enhance ANU, which, in broad terms, determines the following actions:

- ◆ *must raise ANU profile, internationally and at home*
- ◆ *must benefit ANU staff and students*
- ◆ *must aim to improve quality and numbers of students joining ANU*

In these areas, CSEM must operate to achieve maximum benefit within the confines of a smallish budget. Therefore, it needs to choose its actions wisely. First priorities:

- ◆ *I will engage more actively and rely more heavily on the Consultative Committee in the decision making process.*
- ◆ *I will work with CSEM (and its staff) to continue its well established activities.*
- ◆ *From my 2-year experience as convenor of the Engineering*

Direct line



Zbigniew Stachurski
Director, CSEM

Program, I will create a web site for postgraduate applications in the MS&E Program open to all academic staff – this has been well received in RISE, RSPHys&E and FEIT.

- ◆ *CSEM must play an active role in enhancing MS&E undergraduate Programs; from next year ANU will have two named degrees: BSc (Materials) and BE (Materials).*
- ◆ *Negotiate inclusion of Materials Science and Engineering component in the new forthcoming Medical Degree.*
- ◆ *CSEM to act as caretaker for the Forestry Wood Laboratory.*

The CSEM Framework

1. Enhance ANU status at international level

- a. *promote international contacts*
 - ▶ CSEM sponsor attendance at MS&E conferences of international significance
 - ▶ seek international contacts with related organisations
- b. *encourage student exchange agreements with overseas institutions*
 - ▶ ANU-ETH (Zurich) already in place
 - ▶ ANU – INSA (Lyons) negotiated
 - ▶ seek advice for further connections – UMAP Program (www.detya.gov.au/iae/international)
- c. *assist staff in achieving international exchanges through*
 - ▶ AAS (www.science.org.au/internat)
 - ▶ FEAST (www.france.net.au/feast)
 - ▶ Association of Pacific Rim Universities (www.anu.edu.au/admin/vc)

(Continued on page 5)

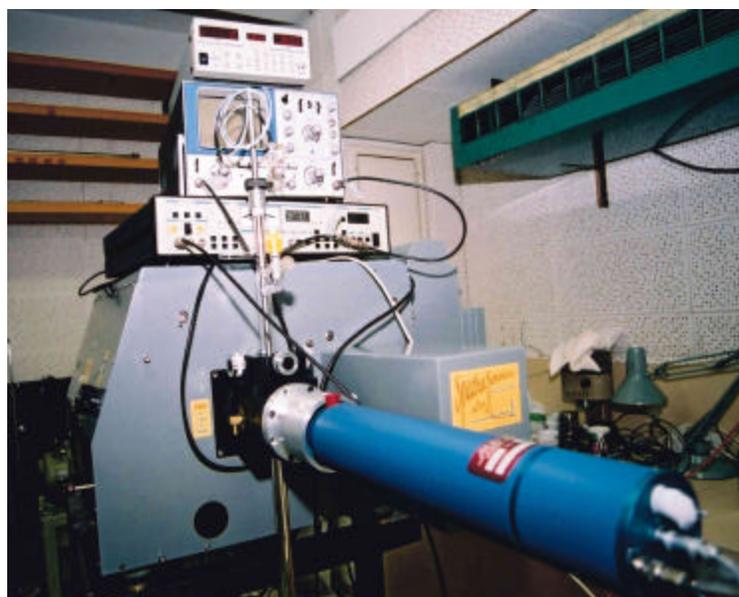
(Continued from page 1)

RSC's Laser and Optical Spectroscopy group, has once again demonstrated we are more than capable of developing and building world beating technology.

The Australian company Lastek in Adelaide (see <http://www.lastek.com.au>) has agreed to build future spectrometer systems on a commercial basis and is also interested in developing potential devices arising from this ANU/University of Bonn collaboration.

For more information contact Dr Elmars Krausz, Leader of the Laser and Optical Spectroscopy group (Elmars.Krausz@anu.edu.au).

RSC's prototype micro crystal spectrometer custom built for the University of Bonn. The spectrometer will be used in the development of an exciting new field of inorganic phosphate materials.



We have the technology

The technology behind materials science and engineering at ANU

Advanced Materials Engineering

The Department of Engineering (DoE), in the Faculty of Engineering and Information Technology, operates a well-equipped *Advanced Materials Laboratory* dedicated to the processing and characterization of fibre-reinforced/polymer-matrix composites. These composites are traditionally used in aerospace applications due to their superior specific properties (ie. strength and stiffness-to-weight ratios). However, for the same reason, engineering opportunities for composite materials exist not only in aerospace but also for a wider range of applications. Applications where composites have been exploited include sports goods such as fibre-glass poles for pole vaulting, marine and ship structures such as offshore platforms and ADI Minehunter frigates, civil engineering structures such as lightweight bridges, automotive parts such as car body-work, and in the transport industry as floor and wall panels for light rail systems.

The focus of composite research in Advanced Materials Group in the DoE is increasingly turning towards composites for these wider applications, and this article introduces the facilities and equipment in the group that are utilised for this purpose.

Processing equipment: Autoclave and Extruder

The autoclave (from the American Autoclave Co.) is used for high-temperature, high-pressure processing of composites. Its processing limits are a temperature of 400°C and a pressure of 2 MPa (300 psi). Autoclave processing produces aerospace quality composites with high fibre volume fraction (which translates to high stiffness and strength) and low void content.

A Haake Extruder is used for high temperature processing (up to 450°C) of thermoplastic polymers with a range of reinforcements. This process has mainly been used for combining chopped wood fibres with polypropylene, producing ribbons of consolidated composite material ready for further processing into structural components.



◀ The autoclave used by the Advanced Materials Lab to produce high tech composites.

Characterization: Instron Universal Testing Machine and Dinkum Impact Tester

The Instron is used for mechanical property characterisation, namely tensile, compression, bending and fracture testing. It can handle many different materials, from tough rubbery polymers to brittle ceramics. A number of fixtures also enable it to handle many different test specimen geometries. Work has

been conducted in the past on 2 metre square expanded metals walkways, whereas, at the other extreme, the machine can be configured to test the strength a single human hair – a popular demonstration during Open Days!



◀ The Dinkum Impact Tester used measure the impact damage on composites.

The laboratory also has an instrumented low-energy, low-velocity double pendulum impact tester. This tester was built in-house, and it introduces barely visible impact damage (BVID) to composites. This is a serious mode of damage for high-performance composites that, despite great strength and stiffness, are notoriously brittle. This impact tester therefore is an important tool for research aimed at improving the impact resistance of composites.

For more information

<http://engn.anu.edu.au/advmaterials.html>



Winging it

And what type of products can the Advanced Materials Lab turn out? Consider the model plane (pictured above) recently built by engineering students to compete in an international modelling challenge. Entrants must design and build a remote controlled aircraft able to take off in a limited distance using a 10 cc engine and only 0.75 m² of wing area. To keep the aircraft weight low, the ANU team used modern carbon fibres fabricated in the Advanced Materials Lab. It was constructed almost entirely from advanced materials such as carbon fibre and Kevlar.

The plane has a wingspan of three metres, and weighs only 4 kilograms, but is capable of lifting almost 10 kilograms – the equivalent of a Cessna lifting a family sedan.

Positions vacant

Australia

Director (closes 25/1/02)

RSPHySE, ANU

<http://www.anu.edu.au/hr/jobs/rsphysse.pdf>

Postdoc Fellowships/3 positions: Quantum Optics, Quantum Info, Gravity Wave Detection

(closes 20/12/01), Dept of Physics, ANU

<http://www.anu.edu.au/hr/jobs/academic.html#715>

Fellow/Snr Fellow/2 positions: Organic Chemistry, Physical Chemistry (closes 1/3/01)

RSC, ANU

More info: <http://www.anu.edu.au/hr/jobs/academic.html#699>

Postdoc Fellows 3 positions (closes 4/1/02)

inorganic nanostructures, more info: (03) 9545 2595

carbon nanotubes, more info: (02) 9490 5000

flexible fractal antennas, more info: (03) 9545 2528

CSIRO Molecular Science, Melb&Syd

Petroleum Geologist – Group Leader, (closes 24/1/02)

Geoscience Australia

http://www.agso.gov.au/jobs/positions/20011108_4.jsp

Postdoc Fellow/Organic geochemistry, biogeochemistry, (closes 31/12/01)

School of Geosciences, Sydney Uni

<http://bull.ucc.usyd.edu.au/personnel/FMPro?-db=personnel.fm&-format=jobdetail.html&Ref=A45/002149&-find=>

Overseas

Associate/Full Professor MSE

(closes 15/1/02)

University of Florida, USA

http://www.mrs.org/career_services/classified/ads/florida.html

Research Associate/Officer Nanotechnology, (closes 28/12/01)

Institute of Materials Sci & Engineering, Singapore

<http://www.imre.org.sg/appointment/appointment.htm>

Assist Professor, Dept of Chem & Materials Engineer. (closes 1/2/02)

San Jose State Uni, USA

http://www.mrs.org/career_services/classified/ads/sanjose.html

Postdoc Research Assistant/Electronic Properties of Semiconducting Nanotubes (closes 1/2/02)

University of London, UK

<http://jobs.ac.uk/jobfiles/RA718.html>

Research Fellowship/Nanotechnology(closes 31/1/02)

Toshiba Research & Development Centre, Japan

<http://jobs.ac.uk/jobfiles/RA558.html>

Research Fellow/synthetic colloid chemistry

(closes 11/1/02), University of Sussex, UK

<http://jobs.ac.uk/jobfiles/BD420.html>

Professor/Polymer Science,

(closes 15/1/02)

Swiss Federal Institute of Technology Lausanne

http://www.mrs.org/career_services/classified/ads/ecole.html

For the Diary

- ▶▶▶ Dynamic Summer, 15th Canberra International Physics Summer School 21 January–Feb 1, 2002
Topics in Non-linear dynamics, Collective Phenomena and Complexity, ANU, Canberra
see http://www.rsphysse.anu.edu.au/theophys/CTP/SUMMERSCHOOLS/2002_SS_DS/index.shtml
- ▶▶▶ ANZIAM 2002 2-6 February, 2002
38th Applied Mathematics Conference, Rydges Eaglehawk Resort, Canberra
see <http://www.ma.adfa.edu.au/anziham2002.html>
- ▶▶▶ GEM 12 3-6 February, 2002
12th Gaseous Electronics Meeting, Batemans Bay, NSW
see <http://www.rsphysse.anu.edu.au/admin/gem/>
- ▶▶▶ ICPP 2002 15-19 July, 2002
11th International Conference on Plasma Physics, Manly, Sydney
see <http://www.mcebc.gov.my/Matrade/ASP-Bin/Public/EventDetails.asp?EventID=235>
- ▶▶▶ WCPT 4 21-25 July, 2002
4th World Conference on Particle Technology, Convention/Exhibition Centre, Sydney
see <http://www.wcpt4.com/index.htm>
- ▶▶▶ ICNDST-8 21-26 July, 2002
8th International Conference on New Diamond Science and Technology, Uni of Melbourne, Melbourne
see <http://www.conferences.unimelb.edu.au/icndst-8/>

Materials Grab Bag

(Continued from page 2: A Vision for CSEM)

- d. *improve and maintain CSEM web site*
 - ▶ seek feedback from users
 - ▶ increase connectivity – source of contacts
 - ▶ include teaching resources (online demos as in <http://www.physicsdemos.com/>)
 - ▶ include research resources – reference to www.anu.edu.au/pad/expert/
2. Enhance ANU status within Australia
 - a. *contacts with other MS&E organizations – aim to establish national MS&E symposium under CSEM auspices*
 - b. *Australia wide CSEM prize of \$ 2,000 for 3/4th year student in MS&E activity*
 - c. *CSEM Summer School scholarships*
 - d. *maintain CSEM Hons scholarships*
 - e. *enhance links with NYSF and CPAS*
3. Enhance ANU status on campus
 - a. *maintain CSEM seminar series*
 - b. *maintain and promote Materials Monthly*
 - c. *strive for CSEM to become centre of expertise*
4. Benefit to ANU Staff
 - a. *monthly seminar series – perhaps more outside invited speakers*
 - b. *monthly newsletter (Materials Monthly) - promoting individual research teams/staff, exposing machinery/equipment, enhancing links and collaboration*
 - c. *funding of Summer School and Hons scholarships to attract top students*
 - d. *funding subsidy for conferences of special significance to MS&E*
5. Benefit to ANU Students
 - a. *respond to the needs of students in the i-Learning environment*
 - b. *facilitate undergraduate student's access to the extensive and sophisticated materials characterisation equipment*
 - c. *mount a graduate course in Materials Characterisation in association with EMU and other departments*
 - d. *provide up-to-date information on scholarships and jobs in MS&E*

Calls for nominations for the Sackler Prize in Physical Sciences, 2002

Each year the Sackler Prize, worth \$35,000 is awarded to an outstanding young scientist (under 40) who has demonstrated originality and excellence in a specified area of physical sciences. The field for the year 2002 is the Physics of Engineered Materials.

The prize is administered by Tel-Aviv University. Selection is made by a panel of outstanding scientists from around the world from the nominated field.

Nominations should be submitted in writing by 31 January, 2002. Nominations need to come from the VC, Deans or Professors.

Contact CSEM if you'd like a copy of the entry form or visit http://www.tau.ac.il/~spps/sackler_prize/prize.htm for more information.

SLAG – WHAT IS IT GOOD FOR?

CSIRO Sustainable Materials Engineering have spent the last year conducting trials on slag left over from electric arc furnaces used to produce steel. They've demonstrated that this waste product is perfect for recycling into a range of useful products for building roads and pavements, thereby replacing the use of virgin quarried products. The slag material provides a particularly good skid resistance to road surfaces.

60,000 tonnes of slag is produced every year from the electric arc furnaces operated by Smorgon Steel Group (the industry partner in this research). Up until these tests, the slag has been either stockpiled, land filled or used to stabilise boggy private roads in rural areas.

The aim of this research is to continue to improve the overall environmental and financial performance of the steel making process.

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

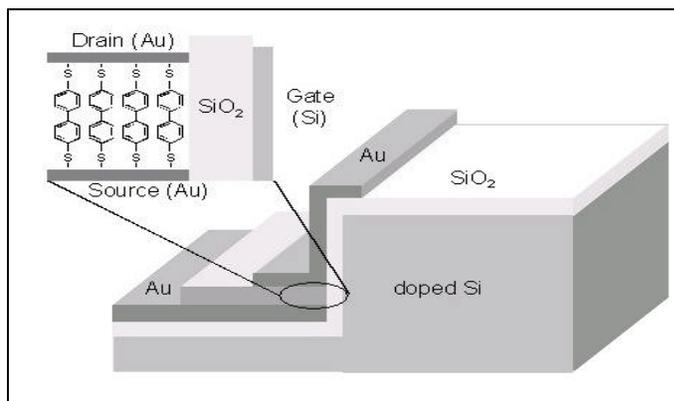
Nanoelectronics transistors just got tinier

How many transistors can you fit on the head of a pin? 10 million if you're using the new organic nanotransistors recently announced by the team of Hendrik Schon, Zhenan Bao and Hong Meng from Bell Labs. They've succeeded in fabricating molecular-scale transistors that can be individually controlled.

Bell Labs' 'nanotransistors' appear to rival conventional silicon transistors in performance. They're made using a class of organic semiconductor material known as thiols. In addition to carbon, thiols contain hydrogen and sulfur.

The main challenges in making nanotransistors are fabricating electrodes that are separated by only a few molecules and attaching electrical contacts to the tiny devices. The Bell Labs researchers were able to overcome these hurdles by using a self-assembly technique and a clever design.

More info: <http://www.bell-labs.com/news/2001/november/8/1.html>



▲ A schematic drawing of a molecular-scale transistor, roughly a million times smaller than a grain of sand.

MM webspotting: the Science of Christmas

- ◆ **The physics of Christmas**
<http://www.aps.org/apsnews/1299/129919.html>
- ◆ **Christmas science jokes**
<http://www.xs4all.nl/~jcdverha/scijokes/Christmas.html>
with poems and carols (including all your favourite classics such as 'The Chemistry Teacher's Coming To Town', 'I'm Dreaming Of A White Precipitate' and 'Silent Labs').
- ◆ **Science of Christmas Trees (wood science)**
<http://www.esf.edu/pubprog/brochure/xmastree/xmastree.htm>
- ◆ **How Christmas works**
<http://www.howstuffworks.com/christmas.htm>
- ◆ **Why does a Christmas pudding take so long to steam?**
<http://www.sciencenet.org.uk/database/Biology/Original/b00006d.html>
- ◆ ***Euphorbia pulcherrima* - the science and myths of a Christmas flower**
<http://www.exn.ca/Stories/1996/12/18/03.asp>

ARC Federation Fellowships

10 Fellowships remaining

Supplementary Round now Open!

By providing an internationally competitive salary (\$225K per year for five years), the Federation Fellowships will support and encourage outstanding Australian researchers to stay in, or return to, Australia to conduct research of significant national economic, environmental and social benefit.

Closing Date: Friday, 8 February, 2002

More information: <http://www.arc.gov.au/ncgp/fellowships/default.htm>

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

Materials Monthly

Volume II, Issue 10

December 2001

Contacting CSEM

Zbigniew Stachurski, Director Phone: +61 2 6125 5681

Email: zbigniew.stachurski@anu.edu.au

David Salt, Communications Officer Phone: +61 2 6125 3525

Email: david.salt@anu.edu.au

Sylvana Ransley, Admin Officer Phone: +61 2 6125 3525

Email: sylvana.ransley@anu.edu.au

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

Location: ANU 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