CSEM's
Materials Monthly
August 2003 — Making materials matter

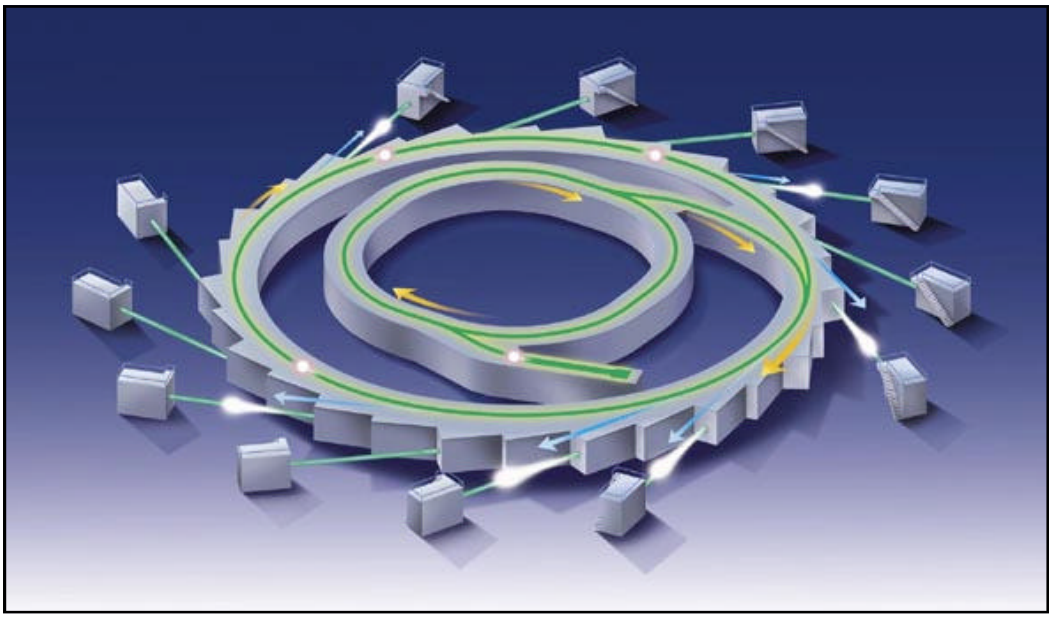
Revving up for the Synchrotron

ANU to host Synchrotron Summer School

In four years time Australia will join an elite list of leading-technology nations that own and operate their own synchrotron. In four months time ANU will play host to a summer school that will start revving up the young scientists that will hopefully be driving this massive project.

Titled **Photons @ Work**, the Synchrotron Summer School will provide a rich grounding in synchrotron science and technology. It will run from the 27 January through till the 5 February 2004, and is being staged at the Leonard Huxley Building, ANU.

The school is being modeled on those run annually in the USA and Europe. Speakers will be internationally respected experts, drawn from both overseas and Australia. The program will combine formal teaching and lecture sessions with informal discussions and tutorials. There will also be ample opportunities to mix socially with presenters.



▼▼ Stylised floor plan of the proposed Australian Synchrotron (Credit: Michael Payne Graphic Design, see http://www.synchrotron.vic.gov.au/)

Who should be there

The primary targets of the school are young scientists (honours students, graduate students and early-career researchers) from Australia and overseas. It's hoped they'll come from every part of the science spectrum: biological, medical, chemical, earth, materials and physical sciences and engineering.

Participants will be expected to have a moderate under-

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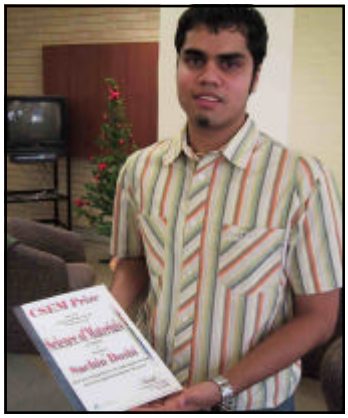
Attention all undergrads!

Are you in the running for the CSEM Prize?

Once again CSEM is running the CSEM Prize for students studying materials science and engineering in their Honours year. Each prize is worth $2,000 and will go to the student judged as having the best final year thesis.

One award will go to the best thesis in the field of the 'Science of Materials'. The other will go to the thesis in the field of 'Application of Materials'.

The beauty of the awards is that they don't require the students to go to much additional work to enter. If you're enrolled in a program leading to the award of an undergraduate Bachelor degree at ANU and are submitting your final year Honours thesis this year, you're eligible. All you have to do is submit a copy of your thesis to the Director of CSEM by the 30 November. **See page 5 for details.**



▲▲ Winner of the 2002 CSEM Prize for 'Science of Materials', Sachin Doshi, for work on quantum well lasers.

Revving up for the Synchrotron

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standing of maths and physics (suitable for honours students with a science major). The Summer School will enable people not yet using synchrotron radiation to identify new experimental techniques relevant to their area of study and current synchrotron users to enhance their skills.

Registration for the school is a measly $100 for full-time students and $200 for others. Plus, the The Australian Institute of Nuclear Science and Engineering (AINSE) has agreed to provide a generous number of travel bursaries. However, there are only a limited number of places available in the school so get in quick.

CSEM is proud to be one of the sponsors of the summer school, and we're encouraging all CSEM members to consider if they know of any students who might benefit from being part of the school. If so, do them a favour and let them know about it today.

The objectives of Photons@work

- inform and educate young scientists and potential users of the Australian Synchrotron Research Program facilities and the Australian Synchrotron
- increase the domestic synchrotron radiation user base
- raise awareness of the scientific opportunities afforded by synchrotron radiation
- raise awareness of Australian synchrotron radiation research and expertise
- raise awareness of the Australian Synchrotron as an important new national facility
- enhance the potential for interaction or collaboration with both international and domestic invited speakers.

Techniques being explored

- x-ray absorption (NEXAFS, XANES, EXAFS)
- spectroscopic techniques (PES, XAS, XES, IR)
- diffraction techniques (XRD, protein crystallography, MAD)
- scattering techniques (SAXS/WAXS, IXS)

More information on Photons@work

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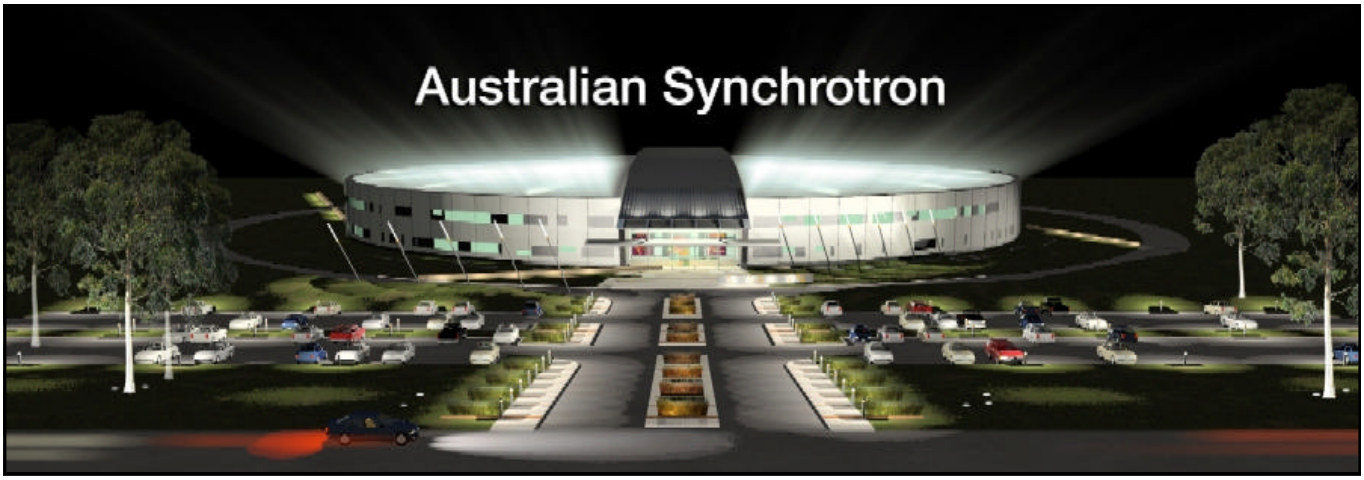
Chris Glover
sync.school@anu.edu.au, 6125 0519

Web: http://wwwrsphysse.anu.edu.au/sync.school/index.html



What is a synchrotron?

Synchrotrons are particle accelerators – massive machines built to accelerate sub-atomic particles to almost the speed of light. They produce synchrotron radiation – an amazing form of light that researchers are shining on molecules, atoms, crystals and innovative new materials in order to understand their structure and behaviour. Synchrotron radiation gives researchers unparalleled power and precision in probing the fundamental nature of matter.

Synchrotron radiation – also referred to as synchrotron light – is a type of electromagnetic radiation. What makes it so special? Well, for a start, most devices can only generate one type of electromagnetic radiation. For example, light globes emit visible light, heat lamps emit infrared light and X-rays tubes emit X-rays. Each device emits a set range of wavelengths. Synchrotron radiation extends over a broad range, from the infrared to X-rays. Different parts of this broad spectrum can be used for different purposes.

What's more, the intensity of light being produced is staggering – a million times brighter than sunlight and a billion times greater than the radiation from a typical laboratory X-ray source. This makes synchrotron radiation possibly the most powerful light produced by humans. The emerging beams are extremely fine – just a few thousandths of a millimetre across – and are emitted in extremely short pulses, typically 10-100 picoseconds in length (a picosecond is a trillionth of a second).

More info: http://www.science.org.au/nova/068/068key.htm

Words of substance

"The ability to quote is a serviceable substitute for wit."

- W. Somerset Maugham

Blowing glass at ANU

"Scientific glassblowing takes years to learn but decades to master," says Chris Tomkins, head glassblower at the Research School of Chemistry. And Chris should know. He's one of the last glassblowers around who's still practicing this highly skilled trade.

▲▲ Chris with one of is creations, a mercury diffusion pump.

Unfortunately, like so many of the specialised technical trades that once flourished within the research schools on campus, scientific glassblowing is no longer a widely practiced craft.

"There used to be seven glassblowers on campus," says Chris. "This included workshops at the John Curtin School, RSES and RSPhySE. RSC had three glassblowers to service its needs."

Now it's just Chris and his off-sider, Paul Siu. Their glassblowing workshop not only produces specialised scientific glassware for RSC but for all of ANU. On request, it's also available to do work for other labs around Canberra and the region. Indeed, in recent years its been commissioned to blow glass for CSIRO, ADFA, Geoscience Australia, the Therapeutic Goods Administration and the ACT Government (EcoWise). They've also done work for interstate institutions including Flinders and Sturt universities.

Glass productions

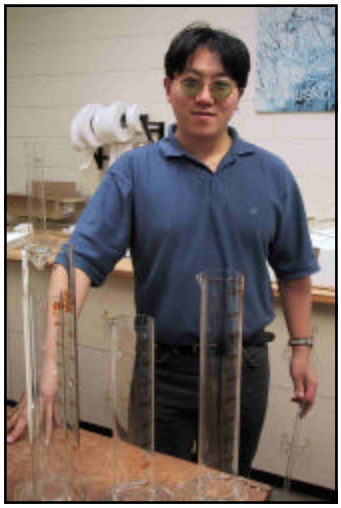
The RSC workshop is well equipped to undertake the production of almost any scientific glassware you could dream up. However, before wasting too much time on drawing up an elaborate design, Chris recommends you consult him first as he has a good idea of what's practical, what works and what will stand the test of time.

▲▲ Chris operates one of the workshops three glass lathes.

The workshop operates three glass lathes of different sizes on which glass is turned, blown and worked. There's also a work bench for fine work, an annealing oven, and a range of diamond saws, drills and sanders. The workshop also possesses a polarising viewer that reveals stored tension in the glass (see 'Carry that weight').

▲▲ Almost every creation in the workshop begins as a length of glass tubing.

Almost all scientific glassware begins life as a tube or rod of glass. This gets blown, stretched, cut and joined into a bewildering range of shapes and forms. Some of the creations having the complexity and challenge of building an intricate ship inside a bottle.



▲▲ Paul with measuring cylinders repaired by the workshop.

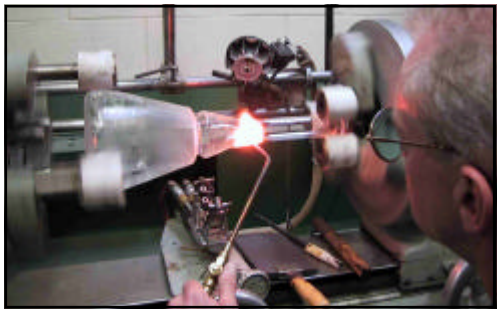
Just under a quarter of the work done by the workshop involves repairing damaged glassware. The repair will only be considered if it costs less than 50% of the replacement value of the item. Although, when a standard 1000 ml measuring cylinder costs upwards of $200, this is worth considering.

The glass of choice

Some 90% of the work uses borosilicate glass. Borosilicate glass is any silicate glass having at least 5% boric oxide in its composition. It's the glass of choice because it has high resistance to temperature change and chemical corrosion. Trade names of borosilicate glass that many people are familiar with are Pyrex (Corning) or Kimax (Kimble). The RSC workshop mainly uses Duran (Schott) glass.

The remaining 10% of the work makes use of pure quartz glass. Pure quartz glass is more resistant to thermal shock, and doesn't block UV light so it's the glass of choice for some specific applications where UV transmission is important. Quartz glass, however, is a very expensive glass and difficult to work with.

Borosilicate glass is softened and worked using a flame that burns a propane/oxygen mix. Quartz glass is often worked using a hydrogen/oxygen flame.



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▲▲ Borosilicate glass being worked with a propane/oxygen flame.

Opportunities

Yankee nanotech grants

The American National Science Foundation has just announced a call for proposals in the field of nanotechnology. While Australian institutions cannot directly receive funds, there may be links we can build on. In particular, if we have existing links with US institutions, it is possible to work with them to supplement our research.

Proposals are being called in three areas:
A. Nanoscale Interdisciplinary Research Teams (NIRT)
B. Nanoscale Exploratory Research (NER)
C. Nanoscale Science and Engineering Centers (NSEC)

Synergistic collaboration among researchers, and collaborations or partnerships with industry or government laboratories is encouraged. For foreign participants, the US institution may provide funds under participant support costs for travel and per diem for visits to the U.S. institution, as consistent with applicable international agreements.

Deadline for proposals are 22 October, 2003. **More info: www.nsf.gov/pubs/2003/nsf03043/nsf03043.htm**

Inky, by Cameron Robbins, one of the many artists associated with Synapse. ▶▶

Synapse

The Australia Council is pleased to announce Synapse, a program that aims to encourage creative and experimental collaborations between scientists and artists which further enhance public engagement with both science and art. Here are three components of the program.

▶ **Through the ARC Linkage program**, the Australia Council will provide support as an Industry Partner for arts/science research collaborations. **See www.ozco.gov.au/newmediaarts for more info.**

▶ **The Synapse Database** provides details about artists, scientists, organisations and projects in the area of cross-disciplinary research across the fields of arts and science in Australia. The Synapse Database is managed by the Australian Network for Art and Technology (www.anat.org.au **See www.synapse.net.au for more info.**

▶ **Synapse Residencies** involves artists working within science organisations for three to six months. The residencies aim to encourage future artist placements within science organisations in Australia and internationally. **Please email synapse@ozco.gov.au for more info.**

Diary: conferences and seminars

✧▶▶ **ACOVS 5** — **30 Sep—3rd Oct**
5th Australian Conference on Vibrational Spectroscopy
Monash University, Melbourne, http://www.sci.monash.edu.au/acovs/index.html

✧▶▶ **Materials 2003** — **1-3 October**
Adaptive materials for a modern society (IMEA), Uni of Technology, Sydney
The Australian Materials Technology Network will be launched at this conference.
http://www.mateng.asn.au/MAT2003/

✧▶▶ **FEMMS 2003** — **5-10 October**
9th Frontiers of Electron Microscopy in Materials Science 2003
Claremont Resort and Spa, Berkeley, CA, http://femms2003.llnl.gov/

✧▶▶ **New Materials and Complexity** — **3-7 November**
incorporating the Australian fundamentals of soft matter workshop
Canberra and Kiola (NSW), http://wwwrsphysse.anu.edu.au/newmaterials

✧▶▶ **2nd International Symposium on Ultrafine Grained Structures** — **11-13 November**
Geelong, Victoria, http://www.mateng.asn.au/ISUGS/

✧▶▶ **SC2004** — **19-23 Jan 2004**
Southern Connections (biology and earth history of the southern continenents
Uni of Cape Town, Cape Town South Africa, http://web.uct.ac.za/conferences/sc2004/

✧▶▶ **Photons@work** — **27 Jan—5 Feb 2004**
Australian Synchrotron Summer School, ANU, http://wwwrsphysse.anu.edu.au/sync.school/

Materials Grab Bag

Blowing glass at ANU

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Carry that weight

When an object is being formed, a certain amount of stress is loaded into the glass structure. This usually increases as the glass cools, usually at different rates in different parts of the object. This tension can be viewed in a polarising viewer which shows the tension in the glass as a range of colours. In most simple objects the tension probably won't cause any operational problems later in life however in complex and intricate works it can lead to fractures in the glass as soon as it experiences a significant temperature change.

▲▲ Items produced during the day are heated in an annealing oven overnight.

Consequently, whatever is produced in the work shop during the day, gets placed in the workshop's annealing oven overnight. This heats glass objects up to 565 degrees C and then slowly cools. This process, known as annealing, allows any stored tension in the molecular framework of the glass to equalise across the glass.

Working with glass

Glass is an amazing materials to work with. Chris says anything you can do with metal or wood, you can do with glass.

"However," he cautions, "you always need to take care with glass because it jumps up and bites you from time to time."

▲▲ Fine work if you know how.

Which may be why attaining a qualification in scientific glass blowing can take over 6years. In 2001 an assessor came out to Australia from New Zealand to assess Paul and awarded him the British Society of Scientific Glassblowers Certificate of Competence.

Thankfully, therefore, the long and distinguished tradition of scientific glassblowing will still be available at ANU - at least for the foreseeable future.

More info: Christopher.Tomkins@anu.edu.au

CSEM Prize in 2003

There are two prizes to be won. One is for 'science of materials', the other is for 'application of materials'. In 2002, the science category was won by Sachin Doshi (Bachelor of Engineering Honours) for trialling a novel doping technique in the fabrication of quantum well lasers. The application category was taken out by Alan Swanson (Bachelor of Arts Honours) for developing an innovative new form of furniture (called air furniture). (See our December, 2002 issue for details. It can be downloaded at http://www.anu.edu.au/CSEM/newsletter.htm)

Award Conditions

1. There shall be two prizes for award by Council each year which shall be known as the Centre for Science & Engineering of Materials Prizes.

2. Each prize shall be valued at $2,000.

3. The prizes shall not be shared.

4. The prizes shall be awarded for:
   (i) The final year thesis in the field of **Science of Materials** (judged as best by the Panel); and
   (ii) The final year thesis in the field of **Application of Materials**

5. Assessment of the theses will be made by the Panel which will be a group appointed by the Director, Centre for Science & Engineering of Materials.

6. It is expected that the theses submitted for the award of the prizes will be retained by CSEM for record and display purposes. The Intellectual Property rights will remain with the individual students.

7. In order to be eligible for the prizes students must:
   (i) have been enrolled in a program leading to the award of a degree of Bachelor offered by the University; in the year of the award of the prize, have submitted for examination the final year (Honours) thesis; and
   (ii) have submitted a copy of the thesis to the Director, CSEM, Department of Engineering, FEIT, by **30 November in that year**.

8. The prize winners shall receive a certificate and a cheque.

9. If, in any year, submitted theses are, in the opinion of the Council on the advice of the CSEM Panel, deemed inappropriate and do not justify awarding the prizes, the prizes shall not be awarded in that year.

the backpage

MM webspotting

Glassblowing & glass

- **Glassblowing basics (East Carolina Uni)**
  http://www.ecu.edu/chem/glassblowing/gb.htm
- **The American Scientific Glassblowing Society**
  http://www.asgs-glass.org/
- **Internet resources for glass**
  http://www.library.unisa.edu.au/internet/pathfind/glass.htm
- **ANU NITA School of Art Glass Workshop**
  http://www.anu.edu.au/ITA/CSA/glass/index.html
- **Glassworks recycling**
  http://www.glassworks.org/
- **Glass Australia**
  http://www.anu.edu.au/ITA/CSA/Glass/Glass.Canberra/
- **Corning Museum of Glass**
  http://www.cmog.org/

CSEM

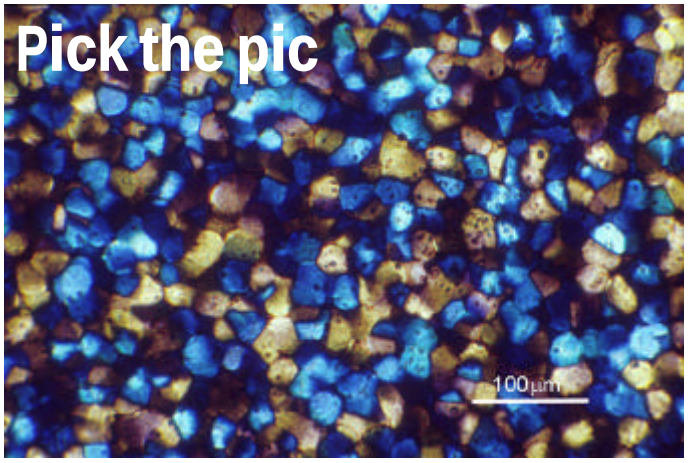
ANU Centre for Science & Engineering of Materials

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

Faculties
Department of Chemistry (Faculty of Science)
Depart of Engineering (Faculty of Engineering and Information Technology)
Department of Geology (Faculty of Science)
Department of Physics (Faculty of Science)

National Institute of the Arts
Materials Workshops

Pick the pic



▲▲ This is a thin section through a LAS glass ceramic.

Glass ceramics are materials that are cooled from the melt in the form of a glass, and then heat treated to induce controlled crystallisation of the glass. Heterogeneous nucleation is carried out at a temperature to maximise the nucleation rate (common nucleating agents include TiO_2 and ZrO_2), and the temperature is then raised sufficiently to cause the nuclei formed to grow rapidly.

Glass ceramics are strong, reasonably tough, transparent to IR radiation, have a low coefficient of thermal expansion, a high resistance to thermal shock and a low thermal conductivity, which makes them very useful in domestic applications such as cookware and cooker hobs.

The most common glass ceramic system is LAS (Li_2O-Al_2O_3-SiO_2), but others include MgO-Al_2O_3-SiO_2, Na_2O-BaO-Al_2O_3-SiO_2, and Li_2O-MgO-Al_2O_3-SiO_2.

LAS glass ceramics are principally used for domestic cooker hobs and cookware. LAS and other glass ceramics can also be used for microwave radomes, vacuum and laser envelopes, telescope mirrors, and in bioceramic applications.

This specimen was heat treated at 840ºC for 3 hours. The image was captured using transmitted polarised light microscope, with sensitive tint plate.

It was taken by Dr K Knowles from the Department of Materials Science and Metallurgy, University of Cambridge.

[The above images, and many more stunning cross sections of glass ceramics, can be found in the DoITPoMS Micrograph Library run by the University of Cambridge.

See http://www.msm.cam.ac.uk/doitpoms/miclib/index.php

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Please let us know if you wish to be added to our electronic or postal mailing lists.
Electronic copies of *Materials Monthly*, useful links and additional information about CSEM can be found at our website.

www.anu.edu.au/CSEM