NEWSBULLETIN

OF THE AUSTRALASIAN CERAMIC SOCIETY

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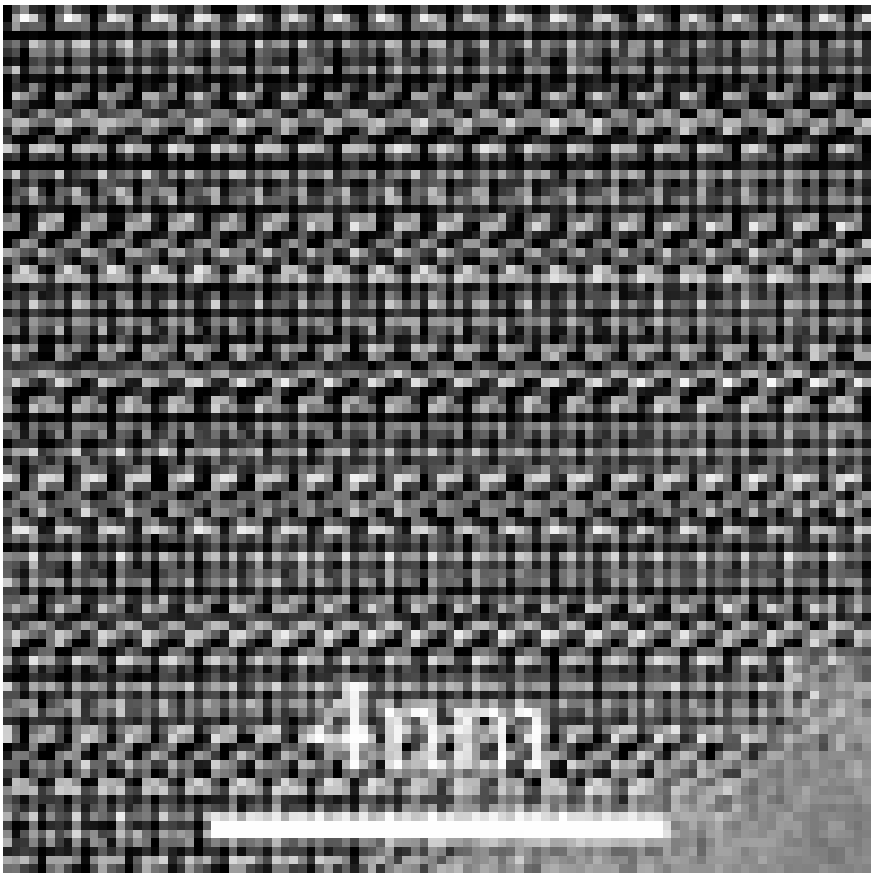

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COVER PHOTO
$Nd_4SrTi_5O_{17}$ Oxide sample viewed along the [100] direction.
System: Nd-Sr-Ti, Composition: $Nd_4SrTi_5O_{17}$
High resolution electron microscopy (HREM)
4 nm
Courtesy DoITPoMs Cambridge University

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PRESIDENT'S ADDRESS
NOVEMBER 2005

Following on from the previous visit of a Chinese Ceramic Society delegation to Austceram 2004, it was my pleasure recently to present an invited talk entitled "Overview of Ceramic Manufacturing and Research Activities in Australia" on the occasion of the 60th anniversary of the Chinese Ceramic Society in Beijing, China. The occasion was very auspicious not only in regards to the 600 plus delegates but also in the kindred society support offered through presentations from Dr Warren Wolf, American Ceramic Society President and Dr. Eiichi Yasuda, Deputy President of the Ceramic Society of Japan. As the conference was primarily presented in Chinese (the slides of my own presentation being translated prior to the event), an understanding and appreciation of the talks given by eminent members of the Chinese Academy of Science and other notable Chinese ceramicists was not without problems however the event was extremely well organised. Hopefully this interaction between our two societies will grow even stronger and possibly lead to the initiation of a joint award for talented ceramicists and continued exchange of both technical and business opportunities. I would also like to take this opportunity to personally thank the Chinese Ceramic Society for their excellent hospitality and well wishes for our society.

During my visit to China the opportunity was taken to discuss recent developments in the global ceramic scene as regards the efforts to revitalise the International Ceramic Federation, the synergistic activities of the Asia-Oceanic Ceramic Federation, both of which your society is an active member of, and of course the role of individual societies. In addition, changing attitudes to society membership, participation support of domestic and international events and ultimately, retention of existing members and growth strategies.

During a rather pleasant pre-conference banquet, the question was asked as to the size of our society membership. To put this into context, the Ceramic Society of Japan has ~4500 members, the American Ceramic Society, ~8000 and the Chinese Ceramic Society, a massive 30,000. It is disappointing to have to report that the current membership of the Australasian Ceramic Society is of the order of only 160 financial members. A size that Warren Wolf pointed out was similar to some of their sections and certainly a size for concern. To further underline this point, a meeting was recently held in Melbourne where a young enthusiastic ceramic engineer, David Menzies, the recipient of the joint ACS/CSJ award, presented an excellent talk on his research activities and experiences in Japan. The talk was topical but undoubtedly fairly specific covering aspects of developments in solar cell research including photo-catalyst materials which exhibit excellent self cleaning properties. Including I might add, when applied to bricks and tiles. The talk attracted only five society members a number nearly matched by David's own family and friends. To say I was disappointed would be an understatement but it is indicative of a longer term trend. Members are aware of the push for greater collaboration with kindred societies at both the technical and social levels. Plans are currently underway to hold Austceram 2007 jointly with Materials Australasia (IMEA) in the first quarter of 2007 at a venue in NSW yet to be confirmed. In addition State branches are holding joint meetings in an attempt to make the talks more attractive and applicable to areas of ceramics and materials science. Other strategies

are being explored to both retain, and preferably increase our membership; but quite simply, the society *needs your participation* if we are to survive and prosper! Please feel free to contact myself or any other committee member at both the Federal and state level with your views on this issue.

As the calendar year rapidly draws to a close, I would like to take this opportunity of wishing you all compliments of the season and for those of you going on vacation, have a good but safe holiday.

Nigel Stone
President Australasian Ceramic Society.

Nigel Stone, Dr Eiichi Yasuda, Dr Warren Wolf

Nigel Stone presenting talk

Nigel Stone inspecting masonry on Great Wall

Warren and Linda Wolf with Nigel Stone at a tea ceremony

LETTER TO THE EDITOR
FROM DAVID MENZIES
JOINT ACS/CSJ AWARD RECIPIENT 2005

My name is David Menzies and I am a final year PhD student working on dye-sensitised nanocrystalline solar cells based on titanium dioxide at the Department of Materials Engineering, Monash University. My supervisors are Dr Yi-Bing Cheng and Prof George Simon from the Department of Materials Engineering and Dr Leone Spiccia from the School of Chemistry at Monash University. I would like to take this opportunity to thank the Australasian Ceramic Society and the Ceramic Society of Japan for the 2005 ACS/CSJ Award. This award allowed my recent visit to a number of ceramic institutes (four) in Japan, as well as attending two conferences.

My first visit was to Toin University of Yokohama where I did some collaborative work on flexible titanium dioxide-based solar cells (see Figure 1). The titanium dioxide films are coated onto a flexible PET substrate that is coated with a conductive film (indium tin oxide). These solar cells are of recent research and commercial interest as the potential application base is greater than those that are on rigid glass substrates, and they can likely be used in modular fashion. In addition, the cost for manufacture is greatly reduced as PET is a cheaper material to purchase and to handle than glass. The downside of dye-sensitised solar cell technology is that commonly used electrolytes are organic solvent-based, and thus will evaporate over time due to the worse gas barrier properties of plastic materials in comparison to glass. Thus, the work that I carried out in the laboratory at Toin University of Yokohama was the application of non-volatile electrolytes to these flexible solar cells. The initial tests that were carried during my visit produced greater than 1% light to electricity conversion efficiency, in comparison to about 4% for the organic solvent-based electrolytes. Thus, with further improvements these solar cells may have a slightly lower efficiency than cells containing organic solvent-based electrolytes, but have much increased lifetime which is very important for commercial applications.

Figure 1. David Menzies holding a flexible Dye-Sensitised Solar Cell

AUSTRALASIAN CERAMIC SOCIETY ANNUAL GENERAL MEETING. PRESIDENTS REPORT.

Wednesday 24 August 2005

Since taking office in August 2004 there have been a number of interesting developments, not least of which was the successful AUSTCERAM 2004 event held alongside Materials Engineers Australasia (IMEA) ICAMP3 in Melbourne last November. The event was attended by over 350 delegates from 26 countries and offered all the delegates the possibility of attending a number of technical streams relevant to both ceramicists and materials engineers alike. It was also successful from the financial perspective raising in excess of $25k. At this event David Phillips was recognised for his years of service to the society and was awarded a life membership. In addition Eric (Lou) Vance was given the Biennial Ceramic Society award for his work on development of a wide range of Synroc derivatives for immobilising high level radioactive waste.

At this event we received a formal delegation of nine individuals from the Chinese Ceramic Society including their Executive Deputy Secretary-General, Prof Pan Donghui. Following on from this, both Richard Bowman and I have accepted an invitation to attend the 60th anniversary of the Chinese Ceramic Society to be held in October in Beijing.

As you are all aware, attracting and even retaining society members is not easy and I must unfortunately report that the downward trend has continued with our membership declining to just over 150 financial members. Richard Bowman recently attended a seminar dealing with just this topic and as a result has been formulating some ideas and plans on how to address this.

In the issue of the January NewsBulletin I indicated that one path to explore involved the society's relationship with other kindred societies. To this end a memorandum of understanding (MOU) was signed in late May 2005 by Prof. Barry Muddle, the then President of Materials Australasia and myself. Through this avenue I am hoping that members of both societies receive greater exposure to one another's events and I look forward to greater cooperation at both the state and Federal levels. Opportunities have also been identified with the Australian Branch of the UK based Institute of Refractory Engineers which I intend to pursue.

The declining membership trend is of course not just a problem specific to the Australasian Ceramic Society but is a trend experienced globally. Certainly the much larger American Ceramic Society is also grappling with this and recently it has been announced that the International Ceramic Federation (ICF), of whom we are a founding member, are to relaunch themselves in an attempt to counteract this global trend. Dan Perera is very active in this and representing our interests on the Exploratory Committee for Ceramic Alliances. As a member of the Asia-Oceanic Ceramic Federation (AOCF), Dan is also actively involved in promoting the ACS with the Japanese, Korean and Chinese Ceramic Societies. Although I understand no members of the Federal Council will be attending the first AOCF meeting to be held in Osaka later this year, Dr. Yi-Bing Cheng will be representing our Society. We will also be officially represented at PACRIM 6 in September by Dan and Phil Walls.

The revamped ICF will also be holding an International Congress on Ceramics in June 2006 in Canada, which will be designed in the form of workshops rather than traditional technical presentations, formulating a road map for future ceramic developments. I would certainly encourage all members to participate if they can or at least provide input via Dan or any other member of the Federal Council.

It is also my pleasure to inform the members that after a number of barren years mainly through the lack of applicants, the joint Japanese /ACS ceramic award was given to a young and enthusiastic ceramic engineer, David Menzies from Monash University. I know he has recently returned from Japan and visited a number of universities and Institutions and look forward to seeing his report published in the NewsBulletin in a short while. He will be also giving a talk on his experiences, at least to the Victorian Branch.

As regards, our next major conference event, this is provisionally scheduled for the first quarter of 2007 in Sydney and will be chaired by Lou Vance from ANSTO. Once again we will be holding this event jointly with Materials Australasia who will be running their annual materials conference. More information on this will be published as it becomes available.

Hopefully you will have also noted that the society web page has been improved thanks to the sterling efforts of Ian Davies. Like all websites however, it is only as of value if both members and councillors provide up to date relevant information for dissemination to our membership.

On the Journal front, two professional publications have been produced of a very high standard and I would like to thank the editorial committee and especially Besim Ben-Nissan and Lou Vance for their continued support and enthusiasm. In addition Cathy Inglis and colleagues have done a great job in producing the less formal Society NewsBulletin with the latest edition due out within a few days.

At the Federal level, I would like to thank all councillors for their ongoing support and enthusiasm especially at a time when work demands are forever increasing. The success of your society often comes down to the efforts of individuals and there is no doubt that the committee is determined to ensure the survival if not growth of the society. The same of course clearly applies to the state branches.

N.A.Stone
President Australasian Ceramic Society.

GEOPOLYMERS: FROM PYRAMIDS TO THE SEWER

Dan Perera (Ansto, Sydney, Australia, E-Mail: Dsp@Ansto.Gov.Au)

A summary of the presentation Dan made to the NSW Branch after the AGM in August 2005.

The term geopolymer was coined by Prof Joseph Davidovits in the 1970s to define inorganic polymers formed using aluminosilicate minerals. These materials date back to the 1950s in Ukraine. Geopolymers are made by mixing reactive aluminosilicate precursors, such as calcined clay (metakaolinite - MK) or fly ash with strongly caustic alkali silicate solutions, with minimum water addition to make a stiff paste. The mixtures polymerise and solidify upon curing at 20-90^{o}C, preferably in high humidity and sealed conditions. They are X-ray amorphous and are composed of cross-linked AlO_4^- and SiO_4^- tetrahedra, with charge balancing Na or K ions. Their structure has not been determined with any precision. Two useful tools that are used to study these materials are infra red spectroscopy (IR) and solid state magic angle spinning nuclear magnetic resonance (MAS NMR). Their hypothetical structure based on MAS NMR and proposed by Davidovits [1] is shown in Figure 1. It is known that Ca can also be incorporated in the structure; however its precise position within the structure is not known and it is currently under investigation.

Using IR it is possible to distinguish between MK- and fly ash- based geopolymers as shown Figure 2. The intense absorption at 1020 cm^{-1}, which corresponds to an antisymmetric stretch of the tetrahedral Si-O unit, is normally observed at 1100 cm^{-1} in silica. Substitution of Al in the tetrahedral site results in a decrease in wavenumber of this band, which becomes, essentially, a Si-O-Al stretch. The Si-O-Al stretch for fly ash-based geopolymer is shifted to 990 cm,$^{-1}$ indicating more Al substitution than for a MK-based geopolymer. Scanning electron micrographs (SEM) also clearly show the difference as shown in Figure 3. From the SEM images it will of course not be able to clearly distinguish the amorphous phase. This is possible by using transmission electron microscopy (TEM) as shown in Figure 4. Some of the typical physical properties of an MK-based geopolymer is listed in Table 1. It should be noted that there will be variations in these properties depending on the composition and curing regime.

Table 1. Physical Properties of a typical MK-geopolymer*

Open porosity	16%
Bulk density	1.61 g/cm^3
Air permeability**	(300 kPa) $< \sim 10^{-10}$ m^2
Water permeability#	$< \sim 3x10^{-4}$mm/min
Cold crushing strength	90 MPa

*(Si/Al=2; K/Al=1, molar ratio)
**ASTM C-577 (99) # NZ/Austr. Std. AS/NZ 4566.16 (1977)

Some of the current applications include building products, concrete paths, fire resistance boards, acid resistance panels, airport runways, exhaust systems of racing cars, toxic and radioactive waste encapsulation/immobilisation, and sewer pipes. Geopolymers have to be ‘tailor’ made for different applications. Their production will generate ~ 80% less carbon dioxide per unit mass than ordinary Portland cement (OPC). Several Australasian companies are interested in geopolymers for various

applications, e.g. Boral Ltd, James Hardie Pty Ltd, Fletcher Building Products Ltd, Golden Bay Cement Co., Siloxo Ltd., Orica Ltd. and Rocla Pipes Ltd. ANSTO has researched geopolymers with the potential for immobilisation of intermediate level radioactive nuclear waste, heavy metals such as Pb, refractory heat insulating castables and for bonding steel to glass. ANSTO is also trying to understand the kinetics of the curing process by using impedance and ultra sound spectroscopies.

By heating geopolymers it is possible to make ceramics, glass ceramics and glasses. Some of the specific areas mentioned in the literature are in producing pollucite ($CsAlSi_2O_6$) containing ceramics, leucite-based glass ceramics, ceramic foam and glass coatings.

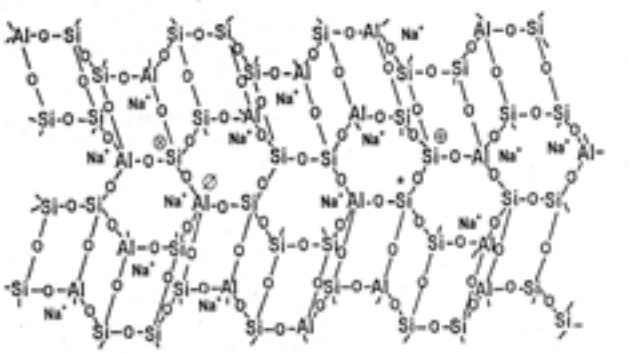

Fig.1. Hypothetical geopolymer structure based on MAS NMR (after Davidovits [1]).

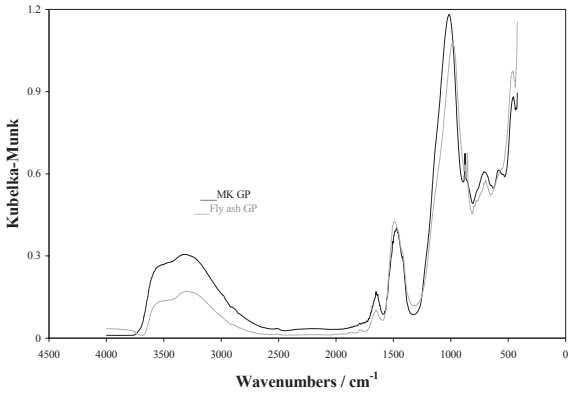

Fig.2. DRIFT IR absorption spectra of MK-based and fly ash-based geopolymers at ambient.

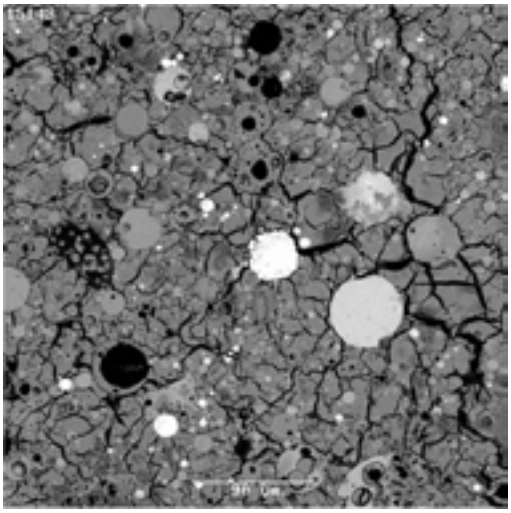

Fig. 3.Backscattered SEM images from polished surfaces of a fly ash-based geopolymer (left; M=mullite, H=hematite, I=iron aluminium silicate))

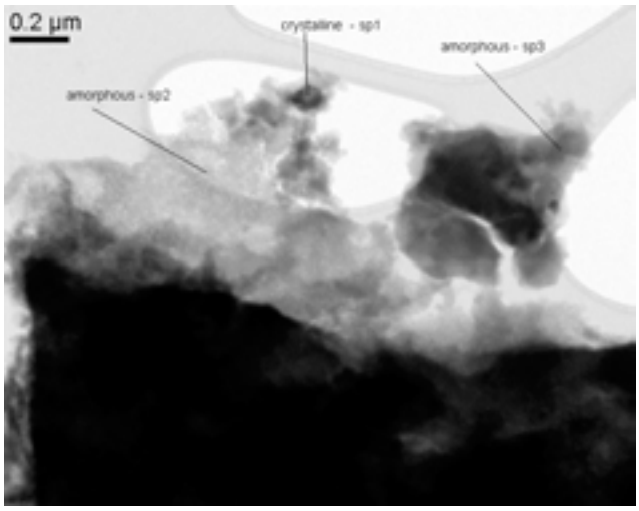

Fig.4. TEM image of a 5 wt% Cs – containing geopolymer. Most of the Cs is in the amorphous phase and the crystalline phase is hematite which originated from the clay.

Some of the barriers to widespread use of geopolymers are 1) most of the building codes are written specifically for OPC and b) durability. Although buildings made from geopolymers in the Ukraine have lasted for over 50 years, this is minuscule compared to OPC containing buildings which have lasted for over 150 years. Prof Davidovits counters this by claiming that some of the pyramids built (3000-1800 BC) have lasted 1000s of years are essentially made by using cast geopolymer stones (for details see: www.geopolymer.org**).** According to the literature current geopolymer research is directed towards durability and understanding the science.

The geopolymer community has had difficulty in defining exactly what geopolymers are. If the definition of ceramics according to Prof. Kingery is considered: "Art and science of making and using solid articles which have as their essential component, and are composed in large part of, inorganic nonmetallic materials," then geopolymers fit this definition.

Acknowledgements

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NEWS IN BRIEF

EUROPEAN UNION HAS RESEARCH EDGE

The EU has passed the USA in total share of world publications by 5%. The strongest growth is in the Asia Pacific where China in particularly is ramping up its science capability.

The decline in the US does not appear to be explained by a shortage of scientists in the US but increased internationalisation of research and increasing capability elsewhere.

PROFESSOR BARLOW, PRESIDENT OF FASTS, TALKS NUCLEAR SENSE

Professor Barlow, President of FASTS declares that the nuclear debate must focus on Waste.

Nuclear energy has recently entered the national political debate as an option to reduce Australia's greenhouse gas emissions.

The range of claims and counterclaims about nuclear energy and its efficacy and safety in climate change scenarios has demonstrated an urgent need for comprehensive studies of Australia's energy futures.

These studies must include a detailed analysis of the economic, environmental and social costs and benefits of all energy sources, including, for instance, the substantial costs of decommissioning nuclear reactors and safely disposing of the waste.

But what chance a sensible and well-informed debate on nuclear energy when dealing with Australia's existing nuclear waste has been so fraught?

Radioactive materials have been routinely used for the last 50 years in Australia for a wide variety of industrial, medical and research purposes.

In that period, about 3700 cubic metres (4,000 – 5,000 tonnes) of low and short lived intermediate level waste and 500m3 of long-lived intermediate waste has been accumulated (there is no high level waste in Australia).

The prime responsibility for managing radioactive waste lies with the Commonwealth as about 95% of existing and future waste is generated by Commonwealth agencies, primarily ANSTO at its Lucas Heights facility but also small amounts at CSIRO and the Department of Defence.

While the amount of waste generated under State and Territory licences is small, this waste is currently stored in over 100 locations around the country in metropolitan and regional sites.

Dispersed storage of radioactive waste is not a viable long-term strategy and is potentially hazardous, inefficient and impossible to completely secure. That is why the States and Territories must demonstrate political leadership and join with the Commonwealth to ensure the proposed site is a comprehensive national facility that is state of the art in terms of environmental safety, efficiency and security.

The Commonwealth Government recently announced plans to investigate three possible sites in the Northern Territory for a national storage facility when a proposal for a South Australian site was abandoned last year after a sustained political campaign.

The science, engineering and technology of safely storing, transporting and disposing of low and intermediate level waste is well understood and can be achieved safely and efficiently if done properly.

Much of the political debate has focused on site selection for storing radioactive waste. But storage is only one part of the equation. Australia must aim for safe and efficient disposal.

Given rising concerns over security of radioactive waste and possible 'dirty bomb' scenarios, it is surprising that safe disposal has not received the focus it warrants.

The key object of safe disposal is to sufficiently dilute radioactive materials so that its radioactivity is comparable to naturally occurring background radiation. In the case of long-lived radioactive waste (materials with a half life of more than 30 years), radioactive waste needs proper shielding from the biosphere in a geologically stable site.

Australia has the relevant scientific and engineering expertise to design , build and manage disposal of such waste.

Radioactive waste that has been properly disposed of has no value whatsoever for would be terrorists. Stored intermediate level waste represents a greater security risk.

Quite apart from security concerns there is a real intergenerational equity issue at stake – it is irresponsible to leave our waste to our children.

There are about 30 radioactive materials routinely used in Australia including a wide variety of industrial applications such as smoke detectors (americium246), sterilisation (cobalt60) or equipment to check the integrity of welding (caesium137).

Each year more than 500,000 Australians undergo diagnosis or treatment procedures using a variety of nuclear sources. Technecium99m is used in about 80% of diagnostic procedures and iodine131 for thyroid treatments.

Some of the radioactive materials used in Australia are produced at ANSTO's Lucas Heights reactor. Others, including cobalt and caesium are imported.

But these imported radioactive materials no longer add to Australia's long-term waste because for the past decade or so, the industry standard is suppliers of products such as cobalt, must take waste back for reprocessing or recycling after use.

Will Australia adopt a similarly responsible attitude to waste generated from our exports of uranium? If we are to seriously ramp up our participation in the nuclear industry then the option of being a full service provider must be considered including accepting the waste as part of the deal.

Professor Snow Barlow
President Federation of Australian Scientific and Technological Societies

IR LEGISLATION AND UNIVERSITY/ARC/PFRA INDEXATION

Bradley Smith, President of FASTS is concerned that the new industrial relations system introduced into Parliament by the Government last week, may contain a 'sleeper' with long term implications for Government funding of universities, ARC, NHMRC, CSIRO and a raft of industry R&D programs. In short, my concern is indexation arrangements for grants may result in further erosion of the real value of Commonwealth funding over time.

Currently university and ARC grants are indexed using the Cost Adjustment Factor (CAF). This is a formula comprising 75% safety net adjustment for the minimum wage and 25% non-wage component (essentially based on movements in CPI). I am not up to date with the exact figures but a couple of years ago the indexation was 2.1% - at the same time CSIRO was a bit more, about 2.3% but I can't remember the formula basis for CSIRO, other PFRAs, or industry R&D programs. The basis for working out the safety net is determinations of the Industrial Relations Commission.

However, in the legislation before Parliament, the IRC will be scrapped and replaced with a new entity called the 'Fair Pay Commission'. The Fair Pay Commission will have responsibility for setting minimum wages. However, this needs to be understood in relation to the general thrust of the legislation to increase employer's powers, erode union power, reduce/relax conditions for the unemployed and current employees once their current entitlements expire and so forth. It is possible that in a period of recession and/or surplus labour, there will be significant pressure to reduce the minimum wage if not in nominal terms but, over time, in real terms (relative to CPI).

In that scenario a potential flow on will be reduction of university/ARC indexation relative to CPI let alone real costs. Given current indexation levels are not adequate to maintain the value of grants this situation may accelerate the loss of value.

Some years ago Phillips Curran did an analysis of this for MCEETYA and for memory they estimated that the shortfall in Commonwealth funds due to the inadequate indexation methodology blew out to about $500million pa between 1996 – 2001 for the higher education sector.

University salaries, as with all professionals, has increased far higher than the safety net adjustment in the past decade or so. A Go8 paper on indexation published last year, for instance, showed average weekly earnings, full time ordinary increased by 25% between 1997 – 2002, a basket of education industry salaries increased by 19% but the safety net adjustment was 8% for the same period.

The notion that the new IR system constitutes a 'sleeper' is, of course, based on pure speculation that the safety net adjustment to the minimum wage will not keep up with CPI or at any rate be adjusted differently than otherwise would have been the case under the IRC.

We will need to keep a watching brief on this and encourage AVCC, GO8, ARC, CSIRO to look very closely at it too.

Bradley Smith
Executive Director
Federation of Australian Scientific and Technological Societies
www.fasts.org

NEW TECHNOLOGY

MOLECULAR BUILDING BLOCKS TO CONTROL THE PROPERTIES OF MATERIALS

A young research chemist from the University of Sydney is building a range of revolutionary new materials based on molecular frameworks that promise to reshape the world; and the world is starting to take note.

Associate Professor Cameron Kepert is based in the University of Sydney's School of Chemistry. He is only 34 and yet he has already attracted more than $8 million in funding since 2000, has over 50 published papers, 4 patents, is cited in more than 1,500 publications and has just been appointed Director of the ARC Molecular and Materials Structure Network*. Earlier this year he scored a prestigious Federation Fellowship and, at the beginning of October, was awarded the 2005 Malcolm McIntosh Prize for Physical Scientist of the Year†. The award was presented to him by Prime Minister John Howard at a gala event in Canberra and carries with it a cash prize of $50,000. Not bad for someone still in the early years of their career.

So, what's all the fuss about? Cameron is a molecular engineer, and his efforts in constructing new molecules and materials have him at the forefront of a chemical revolution.

"We're taking molecular building blocks, and building them up into larger molecules and structures or materials, and trying to control the properties of these new structures," says Cameron.

His first major breakthrough was to create 'switchable porous materials'. These materials are crystals with nanopores of just the right size and structure to only fit a target small molecule. These materials can grab these small target molecules, and, when their pores are filled, the material switches its properties. For example, it might change its shape, its colour or its magnetism, thereby signalling that it has come in contact with the target molecule. Published in Science in 2002, the discovery has opened the way to molecular electronics, and to new ways of making highly sensitive chemical sensors.

The pore structures can even be designed to distinguish between right- and left-handed molecules (a property known as chirality) and potentially separate the two. Some pairs of molecules have the same chemical composition but one molecule is the mirror image of the other, leading each to take on different properties. Being able to distinguish the chirality of molecules is a critical issue in the pharmaceutical industry where more than half of the top drugs sold are either right- or left-handed. Separating the mirror images, however, has proved fiendishly difficult.

Another of the 'nanoporous' materials being developed by Cameron and his team could be used to create a safe, compact storage medium for hydrogen gas - urgently needed if hydrogen is to become the preferred fuel for cars.

In 2002 Cameron and his colleagues created another unique material - solids that contract upon warming; a behaviour known as negative thermal expansion. Most materials that we are familiar with, by contrast, usually expand on heating (referred to as positive thermal expansion).

A common form of failure in electronic components is thermal stress. As the electronics heat up they expand and break but the new materials that Cameron is working on have the potential to fix the problem. They could be designed to shrink and compensate for the expansion. Or, composite materials could be fabricated that contain a mix of negative and positive thermal expansion that neither expand nor contract (a behaviour called zero thermal expansion), and these could be used to replace existing components. In addition to electronics, materials that display zero thermal expansion would be invaluable in mechanical componentry used in high precision instruments. Cameron already holds two patents for this technology and is launching a start-up company to commercialise the invention.

Among his other patented inventions are modified clay nanotubes. These tubes can store and release bio-active chemicals. Cameron is working with a leading agrochemical company to develop this technology for the controlled release of herbicides and pesticides.

These revolutionary new materials are expected to find application in many fields including electronics, photonics, sensing, agriculture, and energy storage.

"It took millions of years for nature to evolve and build complicated molecular structures that perform very specific functions," says Cameron. "We're beginning to mimic some of those systems and build similar complexity into our chemistry. And in the next decade or two, the fundamental discoveries that we're making will transform the use of chemistry across society."

More info:
https://sciencegrants.dest.gov.au/SciencePrize/Pages/Home.aspx

*The ARC Molecular and Materials Structure Network links scientists, technicians and students engaged in the determination and analysis of atomic structures of any kind; biological molecules, chemical molecules or solid state materials - and unites them with Grid computing, visualisation, database, informatics and applied mathematics researchers. For more info see:
http://mmsn.chem.usyd.edu.au/mmsn_intro_right.htm
†The Malcolm McIntosh Prize for Physical Scientist of the Year is one of the Prime Minister's Science Prizes awarded each year.

MACHINEABLE POLYCRYSTALLINE DIAMOND HITS MARKET

A small company based in Canberra is now manufacturing what it claims is the thickest machineable polycrystalline diamond (PCD) compact cylinder available anywhere-measuring 32mm in diameter and 40mm in height. The large cylindrical PCD material is electrically conductive so it can be easily cut into more complex 3-dimensional shapes using conventional Electrical Discharge Machining (EDM) equipment.

The company is Ringwood Diamond Material Technologies and the ultra hard material it produces is called DiaCom®. The material is composed of approximately 70% diamond with the balance made up of a silicon carbide binder. Sintered under a special set of pressure and temperature conditions, it is biocompatible due to the 'Cobalt free' manufacturing process and customers have reported the PCD material to be thermally stable to 1400° Celsius.

"Our unique patented sintering process enables DiaCom® to be cut and shaped into virtually any design our customers require," said Len Kosharek, CEO, Ringwood Diamond Material Technologies. "This new degree of freedom will enable engineers, requiring a material with diamond like properties, the opportunity to develop application solutions, that up until now were unavailable due to size limitations of existing PCD material and its inability to be easily shaped".

DiaCom® is already being used or tested in traditional PCD applications such as cutting tools, wear and bearing parts, oil and rock excavation and high pressure/high temperature research experiment apparatus.

CSIRO tested the performance of DiaCom® against three other PCD manufacturers in wear rate, wear resistance and length of cut trials. The results showed DiaCom® outperformed its nearest competitor in all tests.

"In wear rate tests, DiaCom® performed 3 times better than its nearest competitor," said Dr Jim Boland, Research Group Manager, Rock Cutting and Drilling Technologies, CSIRO. "In the wear resistance tests we conducted, DiaCom® achieved at least 50% greater wear resistance and a greater length of cut".

Ringwood Diamond Material Technologies is a division of Ringwood Superabrasives Pty Ltd. In early 2002, a group of investors, including a major international investment bank, a business development fund, the Australian National University and a number of entrepreneurial investors, bought from the ANU the technology and intellectual property for the manufacture of a range of superhard materials and the necessary assets to start Ringwood Superabrasives Pty Ltd.

More info: www.ringwood-dmt.com

CORPORATE MEMBERSHIP

Is your company interested in becoming a Corporate Member?

Corporate Members may nominate two representatives of their organisation as members and receive free advertising space in a Society publication on one occasion.

A membership form is a available on the *Australasian Ceramic Society* website at the following address:

http://www. Ausceram.com

MEASURING HARDNESS

Knowing the hardness of materials has been important since ancient times. Stone and rock, for example, were the first building materials and it was important to know which stone (mineral) could be used to cut and break other materials.

In 1822, Mohs published a scale of hardness based on what material could scratch another material. On Mohs scale the softest mineral talc was given a score of 1 and diamond, the hardest, given a score of ten. Although it refers to hardness, the test that it is based on is essentially that of resistance to scratching and cutting of one brittle material by another. To a construction engineer, the term hardness means resistance to indentation (plastic deformation) not scratching.

Putting dents into materials to test their properties of strength and hardness is as old as materials testing itself. However, it became a bit of a quantitative science in the late 19th Century when steel making became a widespread industrial process and the market began producing a large number of grades and types of steel. Suddenly it became very important to know exactly how hard a steel was to ensure the right grade was selected for different applications. For example, using steel train wheels that were significantly harder than the steel rails on which they ran was a recipe for trouble.

The solution was a method for measuring hardness based on pushing a hard metal ball (or diamond-tipped cone) into the steel being tested with a known force. The size (depth) of the resulting indentation was measured against the force being applied. Sometimes known as the Rockwell Hardness Test, this technique is still in use today to measure hardness.

A Rockwell Hardness Tester has the capacity to apply a load of up to 103 Newtons (or 100 kg of force). One hundred kilograms may not sound much (it's the weight of a large adult male) but when focused on a single point it's enough to put a sizeable dent in most metals.

The subsequent evolution in hardness testing used more sophisticated equipment but applied the same basic technique of pushing a probe with known force into the material being tested and measuring the resulting deformation. The main difference was one of sensitivity.

The next step forward came about in the 1950s when there was an increasing number of alloys and specialty metals being used in a diverse range of applications. Now it was possible to understand the functionality of metals down at the level of its grain size on a scale of micrometres and there was a corresponding need to measure hardness on a similar level. Using microscopes to position a fine diamond-tipped probe, hardness testers could now apply forces of the order of a single Newton to the boundaries, peripheries and central regions of individual metal grains. This was known as micro-hardness testing.

In the 1980s the need for even more sensitive hardness testing arose with the advent of technologies capable of hardening surfaces using ion implantation. With the implanted region being only 100-200 nm deep, there was a need for indentation techniques that could operate at this scale. Australia has played a major role in development of this science with Dr Ron Hutchings from ANSTO being a co-author of the original nanoindentation patent, and Professor Mike Swain having developed one of the first instruments in the field while working with CSIRO. That instrument is the

UMIS (Ultra Micro Indentation System) 2000 and operates in the milli-Newton range (10-3 Newtons). Applications include the assessment of high tech surface coatings on cutting tools, dies, bearings, integrated circuits and artificial human joints.

However, now with the rapid evolution of nanotechnology even milli-Newtons of force is simply too much and in recent years there has been the development of nanoindenters capable of delivering loads in micro-Newtons (10-6 Newtons).

In summary, if you're measuring the hardness of the bulk properties of metals you're talking about indenting force = thousands of Newtons; the microscopic grain structure of metals, the indenting force = Newtons; the surface layers of materials, indenting force = milli Newtons; and loading forces onto nanoscale structures, indenting force = micro Newtons

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www.azom.com

AZoM's Mission
The aim of AZoM is to become the primary materials information source for the engineering and design community worldwide. It also aims to be the primary publicist of news, views and developments within the materials science community. However, unlike many other materials related organisations AZoM is totally focussed on the needs of the end users of materials. To achieve this aim, all of the educational, informative and news content on AZoM is easy to access and search and is provided on a free of charge, no subscription, no charge per article, totally free basis.

30TH ANNUAL CONDENSED MATTER AND MATERIALS MEETING

7 - 10 FEBRUARY, 2006
CHARLES STURT UNIVERSITY, WAGGA WAGGA, NSW

Wagga 2006 will be held at the Convention Centre at Charles Sturt University, Wagga Wagga, NSW. Arrival formalities will commence from 4.00pm on Tuesday 7 February 2006, with scientific sessions commencing 8.50am Wednesday, 8 and concluding with lunch on Friday, 10 February 2006. Accommodation will be available on the University Campus near the Convention Centre. This meeting is an opportunity for all Condensed Materialists, be they physicists, chemists, engineers, materials or earth scientists to meet in an informal atmosphere to discuss their current research, future direction and other matters of importance in the field. The usual Wagga format will apply with emphasis on contributed poster papers plus a number of invited oral papers and selected contributed oral papers. A mini symposium on surface science and nanostructure will be integrated in the meeting. Students are particularly encouraged to give oral presentation.

Abstracts: Contributed papers are requested in all areas of condensed matter study. Further details of abstract format together with template files will be available at the wagga2006 website.

Conference Proceedings: Participants are invited to submit a manuscript for publication in the conference proceedings which will be peer-reviewed and published electronically on the website of the Australian Institute of Physics.

Registration Deadline: 9 December, 2005
Abstract Deadline: 9 December, 2005
Formal notification of registration and paper oral/ poster allocations 6 January, 2006

Further information:
http://www.ansto.gov.au/bragg/wagga06/
Or contact: Cherylie Thorn, B58, PMB 1, Menai, 2234, NSW, Australia
Phone : (02) 97179039 *Fax :* (02) 97173606
email: cxt@ansto.gov.au

CIMTEC 2006

JUNE 4-9, 2006,
ACIREALE, SICILY, ITALY

The 2006 International Conferences on Modern Materials Science and Technology (CIMTEC 2006) will be held in Acireale, Sicily, Italy on June 4 to 9, 2006. As a major long standing event for the international materials community CIMTEC 2006 will gather together a large number of world-class experts within an interdisciplinary context covering a wide range of most demanding areas for materials research and application, from information technology to biological systems.

CIMTEC 2006, whose major endorsing bodies are the International Union of Materials Research Societies (IUMRS), the World Academy of Ceramics (WAC) and the International Ceramic Federation (ICF) will feature the 4th FORUM ON NEW MATERIALS (4th FNM) and the 11th INTERNATIONAL CERAMICS CONGRESS (11th ICC), each of them hosting a number of Sections, Specials Sessions, Symposia and Conferences.

For more information, please visit CIMTEC 2006 website: http://www.cimtec-congress.org

The American Ceramic Society, in collaboration with the Ceramic Society of Japan and the European Ceramic Society, has initiated a new series of biennial meetings. Join us for the 1st **International Congress on Ceramics** on **25-29 June 2006** in Toronto, Canada at the Westin Harbour Castle Hotel.

This is a global event designed to facilitate discussion and planning concerning major issues that face the ceramic and glass industry, culminating in the development of a global roadmap for ceramics. Download the global roadmap matrix.

This is your opportunity to get involved and shape the future of the ceramics and glass industry. Here is how you can participate in this global exchange and roadmap development:

- Submit your abstract for a poster presentation on one of the application areas or cross-cutting technologies/issues as outlined in the roadmap matrix. **Deadline for submission is 19 December 2005.**
- Be sure that your company is part of the event by becoming a Congress sponsor or exhibitor. Contact Mark Mecklenborg for more details.
- And, most important of all, register for the Congress, and be an active participant in ceramic history in the making.

Visit www.ceramics.org/meetings/icc for more details on this inaugural event.

CERAMITEC 2006

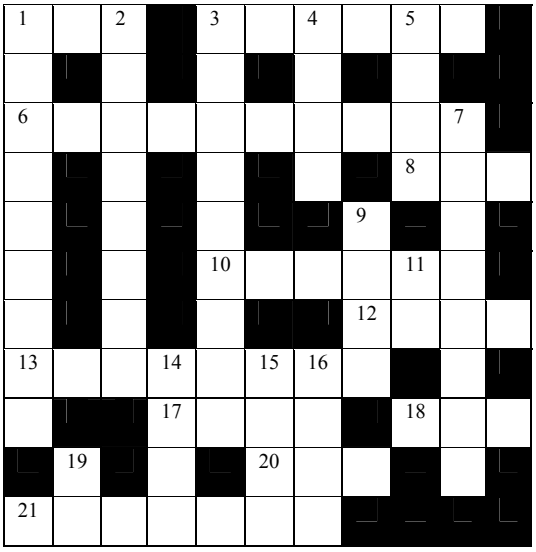
10th International Trade Fair for Machinery, Equipment, Plant, Processes and Raw Materials for CERAMICS and POWDER METALLURGY

16 - 19 May

NEW MUNICH TRADE FAIR CENTRE

Never before has CERAMITEC been as international as it is today. Messe München aims to build on this success and develop it still further. The key facts and innovations can be seen here at a glance. CERAMITEC can justifiably claim to be the world's leading trade fair in its field. The figures speak for themselves.

CRYPTIC CROSSWORD



ACROSS
1 Number one back for a charge (3)
3 Small piece in beer makes a feldspar(6)
6 Thor a close feldspar (10)
8 Fortune holds a cask of fun (3)
9 Laugh at smallgoods shop for group VII 1 across (6)
12 Fifty officers commanding hospital maybe in Scotland (4)
13 Strike a light , one noting one in a mix up.(8)
17 Heavy metal go first(4)
18 Cool joint makes a ceramic (3)
20 This paper proves ‘e is green (1,1,1)
21 Down the pub, the Chinese detective saw the sand dune (7)

DOWN
1 I toss one cat into equal pressure vessel (9)
2 One string loses south gas (8)
3 Feldspar makes it another (9)
4 Basaltic clay put a Spanish exclamation on Boron (4)
5 Badger’s home mixed up in exam (4)
7 Eastern work vehicle has hundred twitches for a fusible.
9 Link a cooker (4)
11 Action for party (2)
14 Cali is the UN’s lab watchdog (I,1,1,1)
15 Triple one in east for UN’s nuclear watchdog (1,1,1,1)
16 O noisy god (4)
19 Thank you to all that responded (2)

First correct entry opened receives a $20 book token.
Address entries to:
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Congratulations to Lou Vance, last edition’s winner.

Answer to last edition

O	R	P	I	M	E	N	T	■	A
■	E	■	L	■	I	■	E	R	G
K	A	O	L	I	N	I	T	E	■
■	L	■	I	■	S	■	R	■	P
■	G	■	T	■	T	H	A	N	E
G	A	M	E	T	E	■	G	■	R
O	R	E	■	■	I	■	O	■	I
D	■	N	O	O	N	■	N	■	D
E	■	■	■	T	■	N	A	N	O
T	R	I	G	O	N	A	L	■	T

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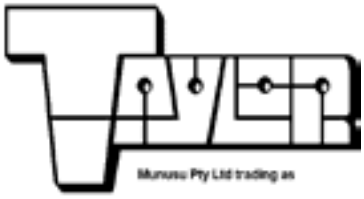

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THE AUSTRALASIAN CERAMIC SOCIETY

THE SOCIETY

The Australasian Ceramic Society is an organisation that works towards furthering all aspects of ceramics - science, industry, research, trade and in art. The society aims to bring together all those interested and involved in ceramics for mutual cooperation and the exchange of knowledge and ideas.

FEDERAL COUNCIL OFFICERS

The Society has a Federal Council comprised of representatives from the member branches. These are in New South Wales, Victoria and Western Australia and each operates autonomously with its own Committee. There are corresponding Secretaries in Queensland, South Australia and New Zealand.

ACTIVITIES

Meetings

Regular meetings are held by the member branches. The meetings are usually comprised of informal social gatherings and lectures by invited speakers. Occasionally, there are joint meetings with kindred societies.

Conferences

The Society holds its AUSTCERAM conferences every two years. Since 1988, the AUSTCERAM conferences have become events on the international conference agenda. The conferences cover all aspects of the ceramic area and present both new work and reviews.

Scholarships & Prizes

Several Society scholarships and prizes are given to students undertaking courses in ceramics at tertiary level.

Awards

The Australasian Ceramic Society Award is given every two years to a person who has made a major contribution to ceramics in Australasia. The award encompasses all fields of ceramics. Eligibility is not restricted to Society members. There are also other awards, as determined by the Council.

Excursions

Visits are regularly organised to ceramic research establishments, manufacturing plants, raw material deposits and so on, often in conjunction with Technical Meetings.

PUBLICATIONS

Journal

The Journal of the Society is circulated internationally with a particular concentration in the Australasian region. It contains papers on original ceramic research and industrial development as well as review articles. It is published twice annually and is sent free to members. The Journal may be subscribed to independently of Society membership.

Newsbulletin

The Newsbulletin is the Society's vehicle for news, information and comment. It contains notices, reports of Society activities and other events, letters, articles, opinions, news of members, industry news and other items of interest and concern. It is published four times a year and is sent free to members. Advertising in the Newsbulletin is available to members and others.

Conference Proceedings

Conference proceedings contain the papers presented at the AUSTCERAM conferences and are a comprehensive record of progress and developments in ceramics both in the Australasian region and internationally.

FASTS

The Australasian Ceramic Society is a member of The Federation of Australian and Technological Societies (FASTS). FASTS represent the interests of some 60,000 scientists and technologists in Australia.

FASTS works to influence the formulation of science and technology policy to the economic, environmental and social benefit of our nation.

MEMBERSHIP INFORMATION

Membership is open to all individuals, companies and associations. There are five categories of membership.

Member
Benefits of Membership include automatic subscription to the Journal, receipt of the Newsbulletin, and notices of Society activities.

Corporate Member
Corporate Members may nominate two representatives as members and receive free advertising space in a Society publication on one occasion.

Honorary Life Member
This is an honour awarded by the Federal Council to members who have given long and distinguished service to the Society.

Retired Member
Persons who have retired from their profession may apply for Retired Membership at a reduced fee. Retired members receive all the benefits of members.

Student Member
Full time students are entitled to Student membership at a reduced membership fee. Student members receive all the benefits of Membership.

CURRENT ANNUAL MEMBERSHIP FEES

	Cost	GST	Total
One time joining fee	$10.00	$1.00	$11.00
MEMBER	$80.00	$8.00	$88.00
CORPORATE MEMBER	$200.00	$20.00	$220.00
RETIRED MEMBER	$40.00	$4.00	$44.00
STUDENT(no journal)	$15.00	$1.50	$16.50
STUDENT (inc. journal)	$25.00	$2.50	$27.50

*No GST for overseas members

NEWSBULLETIN ADVERTISING CHARGES

The costs for 1/4, 1/2 and full page advertisements in the *Newsbulletin* are $400, $600 and $940 respectively. In addition to this full page colour advertisements cost $1400. Advertisements are published in the *Newsbulletin* for one year (4 issues).

Companies which advertise in the *Newsbulletin* receive an automatic link to their homepage in the website of the Australasian Ceramic Society.

Please contact the Editor of the News Bulletin if you are interested in advertising in the *Newsbulletin* and receiving a link to your website.

Australasian Ceramic Society

ABN 81 000 468 708

C/o ANSTO, PMB 1 Menai, NSW 2234, Australia

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**(Member, retired member, corporate member, student member)*

For Corporate Members Only, Please State Company Nominees

1. Title		**Name**	
2. Title		**Name**	

Cost for Membership

One-time Joining Fee:	AUD $11.00
Membership Fee (Including GST):	AUD $
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NEWSBULLETIN
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THE AUSTRALASIAN CERAMIC SOCIETY