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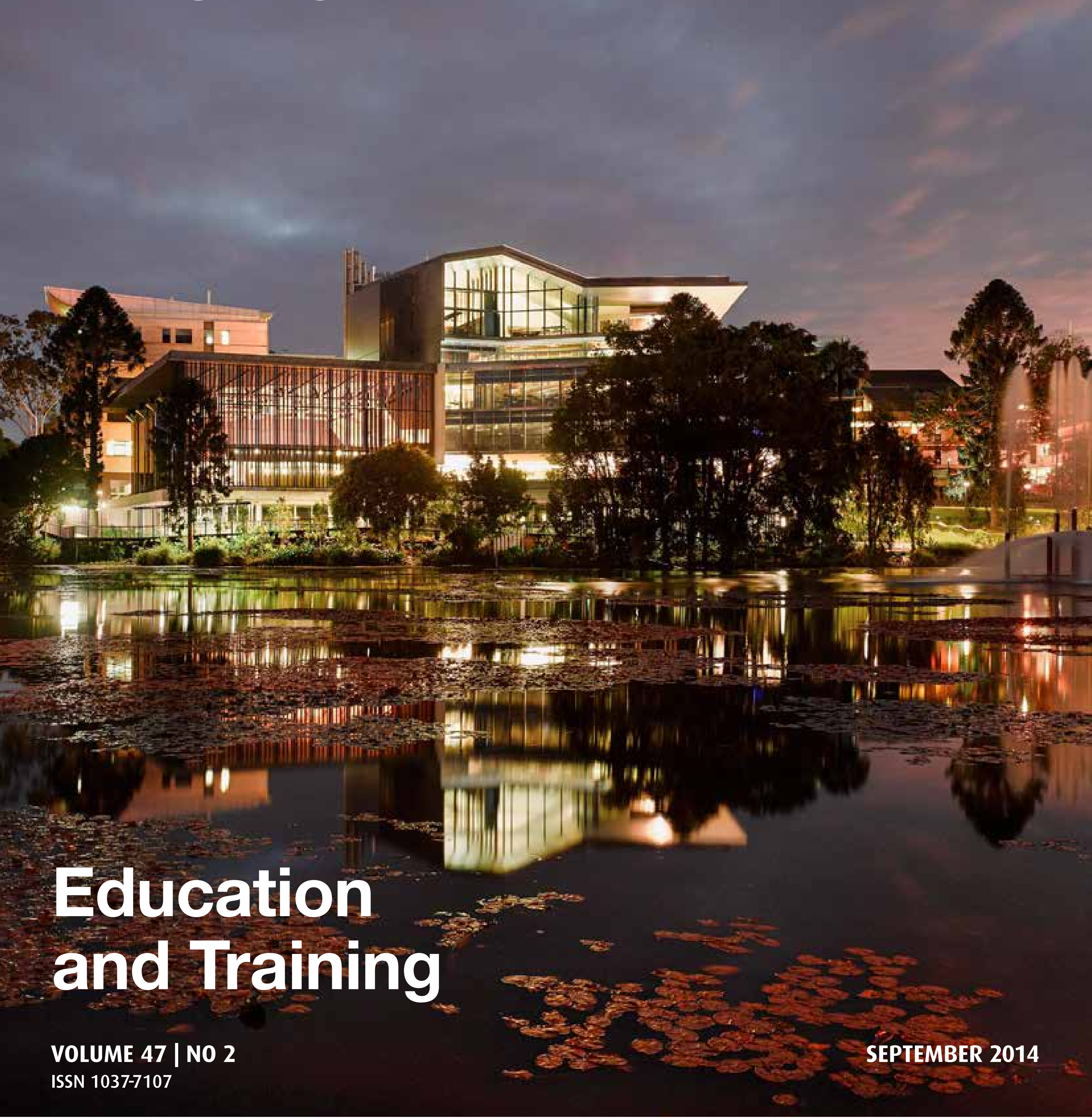

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Materials Australia

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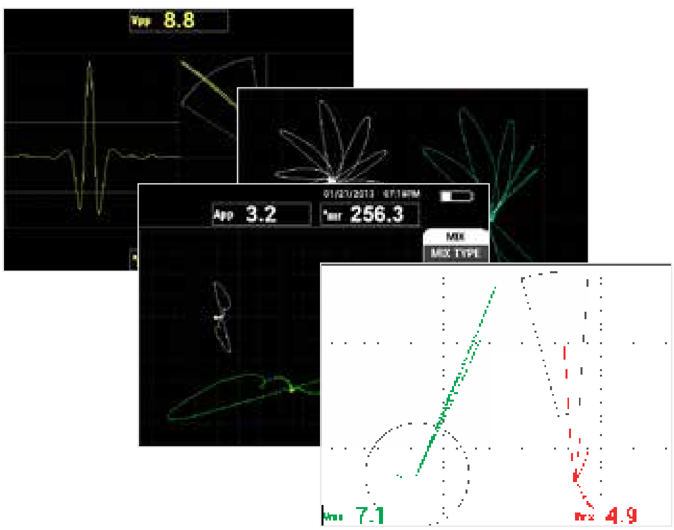


From the President

I hope this issue of Materials Australia Magazine finds you well. As I write this for the September issue of our magazine, I am amazed at how fast this year has flown by.

This issue of the magazine is focussed on Australian universities, particularly those that offer materials science and engineering related courses for undergraduate and postgraduate students. The courses available, and the subject matter, have certainly changed since I attended university.

The planning and organising for the upcoming CAMS2014 conference is progressing extremely well. This is the third biennial Combined Advanced Materials Societies conference, incorporating both Austceram and the Materials conferences. It will be held at the University of Sydney, NSW from the 26 to 28 November 2014. Further information is available later in this magazine (on pages 6 to 8) or via the website: www.cams2014.com.au. The conference committee is doing a sterling job and it is all coming together smoothly. The conference will only be as good as the support it gets from our members, so please, let's all assist the organising committee; get the word out to your networks about this conference and it should be a fantastic success. I look forward to seeing you there.

Further actions towards financial stability and membership growth remain high on Materials Australia's priority list. We are actively pursuing more consistent levels of activity across the branches and this will remain a core Materials Australia objective in the future. The Western Australia and Victorian branches continue to offer members in those regions a great program of events including technical presentations, dinners, training and seminar days. I am also pleased to announce that there is a new Materials Australia branch in the ACT. We welcome them on board and look forward to their events.

David Schonfeld recently organised the first Queensland branch meeting in quite a while. I flew up to attend the meeting and chat to members about what the institute is doing and planning. It was great to see some new faces in amongst the colleagues I already knew. The Queensland branch is planning for 2015 already – with some technical presentations in the pipeline.

Further actions towards financial stability and membership growth remain high on Materials Australia's priority list. We are actively pursuing more consistent levels of activity across the branches and this will remain a core Materials Australia objective in the future.

The website redevelopment team is up and running, led by our president elect Stuart Folkard. Any comments, or offers of help, can be directed to Stuart through Tanya at the Materials Australia Head Office. Let us know your opinion now before it's too late!

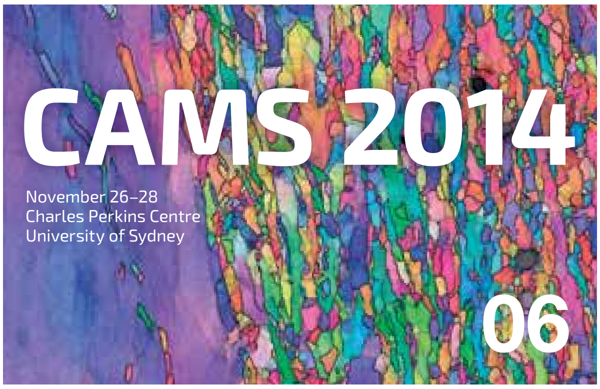
Those registered with the CMatP program have completed another full audit of professional development logs for assessment. In general, most members met all requirements for continued professional registration. It is great to see that many of the CMatPs are becoming more and more active. There is a CMatP LinkedIn page for dedicated questions and comments, which has been very well received. The CMatPs are also gathering momentum in their involvement with the institute as a whole.

Finally, and I know I write this every quarter, for Materials Australia to remain successful, to be viable, and to be relevant as an institute into the future, we NEED you, our members, to be involved. Please support your branch functions, seminars, and networking events. Without our member's interest, support, and assistance we will become unfeasible.

Cathy Hewett
National President

As always, any feedback, comments, questions, queries AND offers of help will all be accepted gratefully at chewett@bradken.com or via Tanya at tanya@materialsaustralia.com.au

CONTENTS



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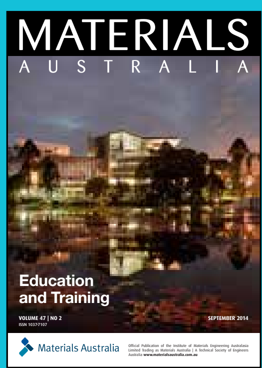

Cover Image
From feature article on page 30.
The Advanced Engineering Building (University of Queensland) at night.
Photo courtesy Peter Bennetts

Letters to the editor; magazine@materialsaustralia.com.au

CONTENTS

Industry News

Feature

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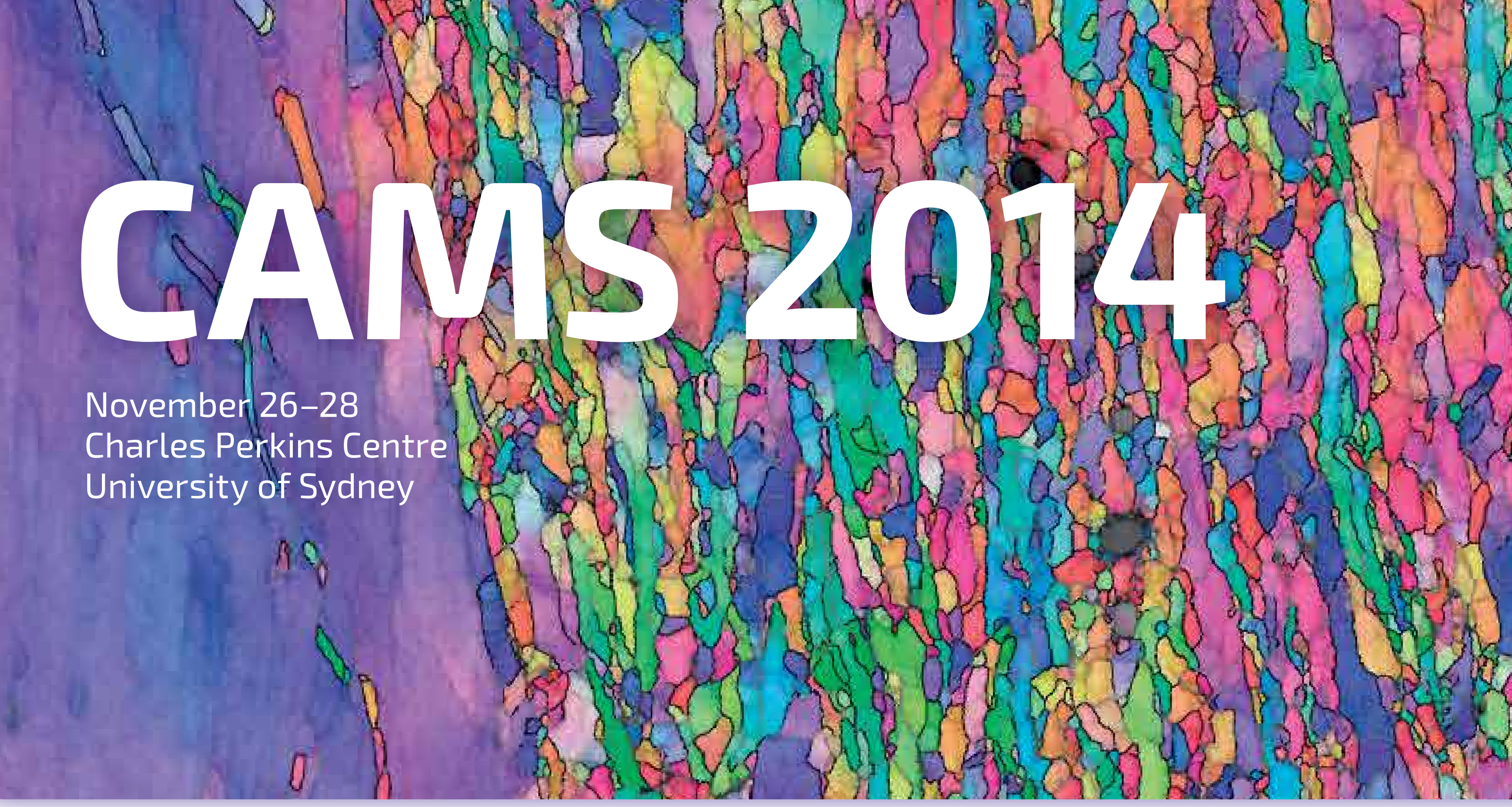

CAMS 2014

November 26–28
Charles Perkins Centre
University of Sydney

The Australian Ceramic Society, together with Materials Australia, is proud to present the third biennial conference of the Combined Australian Materials Societies.

International Perspectives

Although the meeting focusses on Australian progress in materials, there has been significant interest from research bodies in SE Asia, China, USA and Europe. The program has evolved to provide delegates with a diverse and global view on developments and research both here and around the world.

Fractography Short Course

CAMS 2014 presents unique opportunity to participate in this intensive pre-conference course, which is normally only available in the US. The two-day course titled *Fracture & Fractography of Ceramic Materials* will take place on 24–25 November. It will be facilitated by Richard Bradt and George Quinn, prominent US researchers & educators. Spaces are limited to 25.

Innovation Space

This will showcase the latest technology and equipment from materials & ceramics research instrument vendors. The focus is on providing our delegates with an opportunity to directly interact with industry.

Program Online now

A draft CAMS 2014 Program is now available online: with over 270 presentations, in six concurrent sessions, over three days.

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CAMS 2014

November 26–28
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Materials Australia

The Australian Ceramic Society

CAMS2014 is one of Australia's largest interdisciplinary technical meetings on the latest advances in materials science, engineering and technology. Including world-renowned invited speakers, an intensive scientific program featuring six concurrent streams, and exciting social events - this is the premium event of the Australian materials calendar.

Pre Conference Short Course: Fracture and Fractography of Ceramic Materials

Monday 24 & Tuesday 25 November 2014

CAMS 2014 presents unique opportunity to participate in this intensive pre-conference course, which is normally only available in the US. The two-day course will be facilitated by Richard Bradt and George Quinn, prominent US researchers & educators. *Spaces are limited to 25*

Innovation Space@CAMS

Delegates are being encouraged to bring along materials for testing at **Innovation Space@CAMS**. This is sponsorship in experiential form - it is a platform for industry partners and researchers to come together and learn from each other. Industry Partners include: ATA Scientific, AXT, C-therm, Nanovae, Netszch, Olympus, Scitech and Thermo Fisher.

Silent & Deadly!

CAMS2014 has commissioned and supports the screening of the original Players-Lasky silent movie featuring John Barrymore as **Dr Jekyll & Mr Hyde** with new soundtrack by Australian composer Karen Lemon, performed live by quartet of violin, cello, clarinet, and piano. Take this rare opportunity to view a classic silent film with live musical accompaniment in a theatre designed for chamber music. Seymour Centre - Wednesday 26 November. *Book now!*

If you are not attending CAMS, you can still buy your tickets at Seymour Centre on 02 9351 7940 or online: www.seymourcentre.com/events/event/ and click through to Dr Jekyll & Mr Hyde

Program now online: The program consists of more than 250 presentations under 25 Symposia themes over 3 days. You can read about our Invited Speakers, and click through to read the authors abstracts.

More information: **Caryn Morgan** CAMS2014 Conference Manager – info@cams2014.com.au OR p+61 2 9810 2701

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Victoria Branch Report

The Victorian branch, with support from Monash University Materials Engineering, hosted the annual Student Forum at Monash University. This event is designed to provide students studying a materials engineering or materials related course, with an appreciation of what a career in materials can involve. Several speakers highlighted their own experiences during their careers. They passed on important tips regarding what new graduates can expect from the workforce or a new employer; and how graduates can best prepare themselves to tackle employment challenges.

Speakers that offered students an insight into their own careers, as well as insights into the fields of research, industry and management included: Robert O'Donnell (a retired senior principle research scientist with a materials background); John Rea (a materials professional with business qualifications and General Manager of Inductabend); and Paul Plater (a metallurgical engineer and Director of RefMet).

Paul Plater (top) and John Rea (above) present to the students.

The Forum finished with the eagerly anticipated 'Show me the Money' presentation by Michael Lee (a Senior Expert – Metallurgy, with the Nexans Group). Michael explained to the students what they should expect from their employer, the sorts of questions they might be asked, and also the questions they might ask of their employer in return, when it comes to an interview and discussion of employment conditions and a remuneration package.

Michael Lee presenting the 'Show me the Money' talk to an eager audience.

The Branch also promoted Angels and Demons to its members, an interactive intellectual property workshop held on 7 August 2014 as part of Australian Engineering Week. The workshop illustrated the godly uses (and satanic misuses) of intellectual property regimes and discussed how to best make use of God's (or in this case, the Government's) gifts to mankind (trade marks, patents and design registrations).

The audience was treated to presentations from Andrew Towns (Director, Summit Strategy Pty Ltd), Nik Ramchand (Partner, Davies Collison Cave) and the secretary of the Victorian Branch, Edith Hamilton (who is also an Associate at Davies Collison Cave).

Andrew Towns founded Summit Strategy, a strategic management and marketing consultancy based in Hobart, in 1996. Andrew shared some of the insights he has gained while working with Savage Interactive. Savage Interactive won an Apple Design Award for the app Procreate in June 2013.

Edith's presentation provided an overview of how to protect the various aspects of your ideas, while Nik led the audience on an exploration of the intersection between app development and IP protection.

The workshop was very well attended, with over 70 people coming along to the event, and there was a great level of audience participation.

The event was hosted by Davies Collison Cave (www.davies.com.au).

The workshop presenters (from left to right): Edith Hamilton; the MC for the event, Justin Negler (Partner, Davies Collison Cave); Nik Ramchand; and Andrew Towns.

West Australian Branch Technical Meeting

14 July 2014 - C4M Modular Wall System

Source: Cliff Strahan, Lomwest Enterprises

Cliff Strahan is the inventor and developer of the C4M (pronounced see-form) modular wall system. At first sight, C4M blocks appear to be made of concrete, about 1m thick and 1780mm by 1500mm, (though they can be up to 2500mm high). Their main use to date has been in the property development sector, for retaining walls and noise abatement walls, at a cost of 30% less than commonly-used limestone block walls. Cliff sees this as only the first use, and is currently designing a C4M-walled house for himself, to be built in suburban Perth.

The novel feature of the C4M wall is that the concrete is only a 125mm skin on each main face of the block; the major component of each block is actually a dense mass of crushed used car tyres. Making each block starts with a structured mix of passenger car and 4-wheel-drive tyres, packed to minimise void space, forming a vertical stack of horizontally interlocking tyres. The stack is then compressed (about 5:1 compression ratio) and baled. The bale is then turned on its side and lowered into a mould filled with a 125mm bed of wet (mesh-reinforced) concrete, with an embedment depth of 50mm. When the concrete is sufficiently set, the bale (now with one concrete skin) is turned over and the second side is similarly embedded in concrete.

It might appear that a mere 50mm embedment seems insufficient, but the structure of the tyre mass means that the concrete is locked in place with many small compressively loaded ‘keys’, so that it neither separates, nor breaks off.

Walls are constructed rapidly (“four men can build 100 lineal metres of wall per day”), with the individual blocks being stacked using a mobile crane. The foundation can be concrete or compressed ground, depending on height and surcharge, and the blocks may be left free-standing, or locked together. Locking is achieved by filling a roughly 640mm by 250mm vertical channel at the edge of each block with reinforced concrete, to form cast-in-place pillars. The bulk density of the blocks is 0.9 tonnes per m^3, and if the piers are filled, the density of the wall is 1.1 tonnes per m^3 .

The elastic absorbing properties of the tyre bundle give the blocks extraordinary resilience; Cliff showed how a shaped explosive charge could not penetrate the wall, merely making a small hole in the front skin.

Cliff also showed videos of the manufacturing process. A standard module is made from 80 tyres (29 4WD and 51 car tyres), and the current factory, using machinery that he designed and constructed, can produce enough blocks, from 24 moulds, for 48m of wall per day. Dimensional tolerance is typically ±2mm. The tyres are baled for each of handling, but the compressed tyres are permanently deformed and the ties can be cut without effect on the integrity of the blocks. The moulds can be adjusted to make polygonal walls by making one side a little shorter than the other. For one current production run, patterns are placed in the moulds to produce embossed decorative designs for exposed faces.

Cliff gave a very interesting account of how he came to develop the product. He first started to use baled tyres while he was farming, and the evident potential led him to perfect the equipment for making blocks. Along the way he ran into trouble with the law against illegal dumping of tyres, and had to make the case to be granted a special licence. Some potential users have expressed concern about future liability, and to address this concern C4M can offer a stewardship arrangement. Cliff explained that because the tyres are virtually indestructible in this use, blocks can be recycled, or alternatively crushed to break off the concrete skins and re-manufactured.

During questions, Cliff explained his design for using C4M blocks to construct a solar-efficient house for the Pilbara region – “9 star rated for half the price of a 6.5 star house”. He also answered questions about the supply of tyres. Perth produces around 16m^3 of used tyres per day, but looking ahead, the total supply of used tyres in WA would be sufficient to make C4M blocks to build a only a small fraction of the retaining walls constructed annually in Perth. However, the company has its eye on the bigger picture: at bulk purchase prices, it would be economic to import tyres especially for block making. The Company has grown to have a turnover of $1.4 million in the past year, and a public float is now being planned.

West Australian Branch AINDT Joint Technical Meeting

Software Innovation for NDT Systems

Source: Phil Lewis, GE Inspection Technologies

Phil Lewis is Corporate Account Manager for GE Inspection Technologies, a position that draws not only on his prior experience as a manager of GE and as manager of a large engineering company in the UK, but also on his earlier hands-on experience as an X-ray NDT technician. Phil's presentation focused on the recent developments in software that are changing the way inspections are conducted.

L to R: Steve Algie, Bob Walker (AINDT), Stuart Folkard and Phil Lewis.

Phil explained that the market forces that had led to these developments included shortage of expertise available for on-site interpretation, greater demand for formal proof of compliance, demand for increased productivity, and greater market complexity, with an increasing need to apply a broad range of NDT technologies. Overcoming these challenges for NDT operators has also delivered a payoff for end-users of NDT services in greater plant uptime and improved safety.

Phil presented on two aspects of GE software technology. The first was the 'Rhythm' series ('Acquire', 'Review' and 'Archive') for NDT data management. The second was the 'Mentor Create' series for guided inspection and interpretation. The common factor of these technologies is the use of digital information that is now produced by most NDT inspection modalities.

Phil explained that the development of NDT software can be traced back to medical imaging software, which tends to be five to seven years ahead. Many of the problems are much the same, and indeed medical imaging can be regarded as NDT of the human body. As an example of the sorts of issues that are involved in data management, Phil referred to the development of DICOM (Digital Imaging and Communications in Medicine) as a standard for handling, storing, printing, and transmitting information in medical imaging. The use of this open-source standard means that an X-ray taken anywhere in the world can be accessed and examined anywhere else. This standard has now been developed into the ASTM DICONDE (Digital Imaging and Communication in Non-destructive Evaluation) standard for NDT data.

The great value of using the DICONDE standard is that it is compatible across platforms and systems, and allows image manipulation for viewing, correcting geometric distortions, and feature enhancement without ever altering the underlying raw source data – a vital factor for compliance requirements. A raw radiographic data file (DCM file) is typically around 10 Mb (similar to a digital photograph).

As an example of the scale of the storage issue in NDT, Phil cited the current Inpex LNG development which calls for around 1.5 million (physical) radiographs, to be retained (in climate-controlled secure storage) for at least 60 years. Digital data is potentially more 'durable', though its archiving brings its own issues with changing technology and formats. Phil also referred to a particular problem that is currently facing the industry in Australia where local standards demand physical X-ray images, while most international standards accept digital images. As a consequence, some new projects are being specified to these international, rather than Australian, standards.

The other GE software development is the 'Mentor Create' suite together with 'Visual IQ'. This software connects the detection instruments to the 'GE industrial intranet', which allows great flexibility in inspections and interpretation. In one mode of use, the inspection data can be viewed remotely and in real time by multiple users, allowing expert interpretation – this helps overcome the practical problem of a shortage of on-site 'Level 3' expertise. Another mode allows a remote expert to set the inspections parameters for a less-experienced on-site operator to use in a particular inspection task. The system also allows on-the-job operator competency testing.

Phil concluded his presentation with a hands-on demonstration of one of GE's Mentor units that could accept three different types of NDT probe (one at a time): eddy current, ultrasonic and phased array. He also showed a Mentor unit attached to a borescope. This allows both remote control, and recording of data and audio commentary for off-line evaluation, where previously on-the-spot decisions had to be made. Procedures can also be downloaded to the unit for customised 'menu-directed inspections', which remove the need to take documentation onto site.

West Australian Branch Seminar Report
30 July 2014 - Gears & Shafts 2014

Source: Paul Howard - CMatP

On 30 July, at the well-appointed Technology Park Function Centre, Materials Australia hosted a half-day seminar on the topic of Gears & Shafts. This seminar had been run successfully once before (in 2001) and was reactivated by the Western Australia Branch in 2014.

The seminar format consisted of an Industry breakfast (which delegates could choose to attend separately), a half-day seminar (which included four technical presentations) followed by a lunch, and then a plant visit to Hofmann Engineering in the afternoon.

The highlight of the industry breakfast was a Keynote Presentation from Erich Hofmann, the Managing Director of Hofmann Engineering. Hofmann presented an excellent overview of the strong interplay between materials and heat treatment methods, and the direct benefits for gearbox design. In one series of slides he clearly demonstrated how the advent of better steels and improved heat treatment processes, evolving from case hardening cast steels through to full heat treatment and chemically enhanced case hardening of forged steels, has allowed the size and weight of gearboxes for the same power rating to be dramatically reduced (from 8,000kg to just over 1,000kg).

Hofmann also described the various processes that have been undertaken in order to formulate a speciality forged gear grade (Hofalloy) that can be sourced outside of Germany. The Hofalloy is available in 220mm thick plates, which Hofmann Engineering is now using to manufacture the world's largest girth gears for mining industry SAG mills. The largest girth gear produced by Hofmann Engineering in their Perth facility is 13.2m in diameter, with Hofmann confirming that they have the capability for up to 15m in diameter. He showed a range of photos demonstrating the manufacturing steps, including large scale bending, flange fabrication and attachment, gear hobbing, final gear profile cutting, and then the final case hardening heat treatments.

The team at Hofmann Engineering was awarded the Claude A Stewart Award by Paul Howard, Materials Australia National Treasurer, in recognition of the significant contribution that Hofmann Engineering has made to the science and industry of metallurgy and heat treatment.

The opening presentation of the half-day seminar was given by Dr Ian Howard who

Dr Ian Howard (right) from Curtin University.

has worked at both DSTO and NASA in the area of gearbox vibration and modelling. He has been with Curtin University for 20 years and has extended his research into gearbox modelling through the advent of newer dynamic modelling software such as ANSYS, Matlab, Simulink and ADAMS. These dynamic simulations are then tested by true measurements using tachometers and accelerometers on real gearbox systems to validate the models.

Admire Kavayi (right), from Shell Technical Services.

Admire Kavayi, who works for Shell Technical Services and specialises in lubricants, gave the second presentation. The focus of his presentation was the benefits that have been derived in the mining sector by changing to more resilient

Erich Hofmann, the Managing Director of Hofmann Engineering with Paul Howard.

synthetic oils for gearbox lubrication. Despite increased up-front expenses, synthetic oils reduce power consumption by more than 4%, reduce gearbox running temperatures by more than 12%, extend the oil drain intervals by 100% and typically contribute to an overall service life extension of approximately 50%. These figures were verified in year-long field trials and have resulted in real dollar savings in excess of $150,000 per annum.

Justin Marwick from GearInspec presenting.

Justin Marwick gave the next presentation. Marwick spent many years working in the maintenance departments of several major mines, dealing with a range of gearbox and girth gear issues. The thrust of Justin's talk was on the advances of gear inspection, including how this technology can provide much better advice to mill owners, and assist mill owners in identifying, tracking and managing defects in very large gears (in some cases successfully over several years). Justin is now running a specialist consulting business where they

Phil Cornish (left) from ALF.

regularly apply this new Eddy Current Array technique. The technique uses heads that are specially moulded to the gear tooth profiles to ensure complete tooth and root coverage during the same inspection passes. This technique also creates a real-time database that can be re-visited and compared against future inspections.

Phil Cornish gave the final presentation on gear and shaft failures. Cornish presented a range of highly topical case studies on several significant industrial investigations with which he had been involved. Phil provided comprehensive reviews of the investigation techniques used to confirm the true root causes for failures to pinion gears, stub shafts (from poor repair methods), and several other shaft fatigue failures that were the result of some basic issues (such as misalignment and material defects in the source material).

Overall the seminar had approximately 40 delegates in attendance. All agreed that the program provided a very timely overview of the state-of-the-art in gear and shaft technologies and practice. The delegates came from a range of industries including manufacturers, consulting engineers, maintenance personnel from operating businesses and mining companies. Two delegates travelled from Melbourne to attend this event and we were also pleased to have delegates from the newest company member in Perth, Callidus Group.

The plant visit was also very well attended with just over 20 people hosted on a tour of the Hofmann Engineering facilities in Bassendean. The Managing Director, Erich Hofmann, started the afternoon visit with an overview of the company and the wide range of industry capability at the Bassendean plant, before breaking into small groups for plant tours. The tour took in the various areas of the Hofmann factories including the inspection and metrology area, the heat treatment shop, and the extensive machining and gear manufacturing operations. The plant tour was very well received by delegates and enabled everyone to appreciate the scale of the large gears manufactured in Western Australia for industry.

The Gears & Shafts event was also well supported by the IEAust, the Chamber of Minerals and Energy, the Asset Management Council, and Hofmann Engineering.

The Western Australia Branch organising committee consisted of Paul Howard, Jessica Down, and Michael Krachler. All committee members did an excellent job in pulling this event together, and working tirelessly to promote this event to the local industry.

CMatP Profile: Stuart Folkard

Where do you work? Describe your job.

I joined Wood Group Integrity Management (WGIM - formerly known as Ionik Consulting) in 2001 as principal materials engineer. WGIM is a global materials engineering and asset integrity management consultancy, which provides services primarily to the oil and gas industry, but also to other industrial sectors like mining. I am currently seconded to the Gorgon Stage 2 Project, managing a small team of materials and corrosion engineers in the upstream facilities group. The team is tasked with undertaking corrosion modelling, material selection, development of corrosion management strategies, drafting of linepipe and subsea equipment material specifications, and materials engineering support to other disciplines.

What inspired you to choose a career in materials science and engineering?

I started as a student in extractive metallurgy but after two years of being posted to remote mine sites, a colleague persuaded me to consider a career in physical metallurgy. This prospect was made more attractive by the offer of a study bursary. I soon realised that I enjoyed the diversity that materials engineering brings, not only the direct metallurgical aspects (like microstructure, mechanical properties and how they relate to application and design), but also the manufacturing influences, such as welding, forming, and heat treatment. My first job as a process control metallurgist (for a wire and wire rope manufacturer) gave me the opportunity to be involved in all of these aspects, and reinforced my decision to make a career in materials engineering.

Which has been the most challenging job or project you've worked on to date, and why?

I was given the opportunity to manage a project that we had won with a major oil and gas operator in Indonesia. The project involved the development of an asset integrity management system for their 250 offshore and overland pipelines. Technically, the project was relatively straightforward. The greatest difficulty was the cultural differences: the client was a European-based operator with many expat engineers working with local engineers. Although most were quite proficient in English, communication was not always effective. This resulted in a number of instances of miscommunication or misunderstanding.

What does being a CMatP mean to you?

Recognition amongst peers is important to most people, myself included. Being a CMatP is a way of gaining that recognition. Although, it is not just a case of filling in the form and paying the subscription fee! To be a registered professional in the materials engineering industry carries a responsibility; we must all ensure that we act with integrity, and in a professional manner that upholds the name of the institute, and maintains the credibility of such an industry accreditation.

Who or what has influenced you most professionally?

I have had the privilege of working with a number of very capable and competent metallurgists across a variety of industries; people who I have looked up to professionally, and whom I have looked to as role models for my own performance and development. In general, their attributes have been a solid, balanced knowledge of materials engineering, an ability to provide unbiased opinion, and an ability to remain calm under pressure. A common trait that I have admired of these role models is their ability to think and communicate clearly.

What gives you the most satisfaction at work?

Knowing that my team or I have done a good job, and that we have been fairly recognized for our efforts. I also enjoy working in the multidisciplinary environment that is the upstream oil and gas industry; this has given me the opportunity to broaden my knowledge beyond materials engineering. Working in such an environment allows me to understand issues or problems from a different perspective, gaining a perspective of what is important to others, so that chosen solutions are acceptable to everyone involved.

I enjoy the diversity that materials engineering brings, not only the direct metallurgical aspects (like microstructure, mechanical properties and how they relate to application and design), but also the manufacturing influences, such as welding, forming, and heat treatment.

CMatP Profile: Stuart Folkard

What is the best piece of advice you have ever received?

'Don't ask someone to do something that you would not be prepared to do yourself,' is something that I was taught by my father. It is a lesson that can be applied in many of life's situations. Not only does this show respect for others, but also touches on moral responsibility and ethics.

What are you optimistic about?

The CMatP program (or CMP, as it was originally named) had good momentum in the early days, but seemed to lose impetus after a few years. A committee was set up earlier this year, comprising a CMatP representative from each state, to look at how the program can be revitalised and improved. I am optimistic that, through the work of this committee and the support of the CMatP community, this program will gain strength as well as better, wider industry recognition.

What have been some of your notable professional and personal achievements?

Running my first marathon at the age of 40. Prior to this, from the comfort of my armchair, I enjoyed watching others run. I never considered myself to have the mental strength or physical stamina to run 10 kilometres, let alone an entire marathon. However, support (or should I say a little cajoling) from friends and a bit of training proved to me that I could. Sadly, the long distance running has come to an end these days and I again stand on the sideline watching others endure the aches, pains and the highs of marathon running.

A notable professional achievement was the successful development and implementation of an asset integrity management system for a major oil and gas operator. The system included the development of a software package that met the client's engineering needs and risk management processes, and was also transparent and configurable by the client's engineers. Development of the algorithms and the integrity management procedures and documentation involved a multi-disciplined approach with careful resource planning and deployment.

What are the top things on your 'bucket list'?

I would like to go back to South Africa to do a bush walk in the Kruger National Park where one can experience animals in their natural environment, rather than from the comfort of an air-conditioned vehicle. I would also like to visit the Chobe Game Lodge and Okavango Swamps in Botswana, and the Etosha Game Park in Namibia.

The history of the Incas has always been of interest to me and a visit to Machu Picchu in Peru would give me a chance to see first-hand the engineering skills of these great people. I believe, however, that the high number of tourists to the archaeological site is having a negative impact on the remaining structures...which raises the question of whether I want to contribute to this damage.

Our Certified Materials Professionals (CMatPs)

The following members of Materials Australia have been certified by the Certification Panel of Materials Australia as Certified Materials Professionals.

They can now use the post nominal 'CMatP' after their name. These individuals have demonstrated the required level of qualification and experience to obtain this status. They are also required to regularly maintain their professional standing through ongoing education and commitment to the materials community.

We now have over one hundred Certified Materials Professionals who are being called upon to lead activities within Materials Australia. These activities include heading special interest group networks, representation on Standards Australia Committees, and representing Materials Australia at international conferences and society meetings.

To become a CMatP visit our website:
www.materialsaustralia.com.au

Mr Benham Akhaban	CMatP	SA
Mr Ossama Badr	CMatP	VIC
Mr Ashley Bell	CMatP	WA
Mr Anthony Brooke	CMatP	WA
Mr Ian Brown	CMatP	SA
Mr Graham Robert Carlisle	CMatP	WA
Dr Carlos Caceres	CMatP	QLD
Dr Philip Carter	CMatP	NSW
Mr Ka Chan	CMatP	QLD
Mr Sridharan Chandran	CMatP	UK
Mr Ken Chau	CMatP	NSW
Ms Kerrie Christian	CMatP	NSW
Prof. Richard Clegg	CMatP	QLD
Mr Chris Cobain	CMatP	WA
Dr Ivan Cole	CMatP	VIC
Dr George Collins	CMatP	QLD
Dr John Cookson	CMatP	VIC
Dr Malcolm Couper	CMatP	VIC
Mr Peter Crick	CMatP	NSW
Mr Andrew Dark	CMatP	QLD
Mr. Warren Philip Dixon	CMatP	NSW
Dr Gilles Dour	CMatP	WA
Dr Ian Dover	CMatP	QLD
Ms Jessica Down	CMatP	WA
Mr Ronald Jeffrey Dunning	CMatP	WA
Dr Yvonne Durandet	CMatP	VIC
Mr Oscar Duyvestyn	CMatP	QLD
Mr Alexandre Dziouba	CMatP	QLD
Dr Mark Easton	CMatP	VIC
Dr Rajiv Edavan	CMatP	VIC
Mr John Edgley	CMatP	QLD
Mr Bernard Egan	CMatP	SA
Dr Jayantha Epaarachchi	CMatP	QLD
Mr Stuart Folkard	CMatP	WA
Dr Jeffrey Gates	CMatP	QLD
Dr Aziar Gazder	CMatP	NSW
Mr Noel Goldsmith	CMatP	VIC
Mrs Liz Goodall	CMatP	VIC
Mr Buluc Guner	CMatP	NSW
Ms Edith Hamilton	CMatP	VIC
Dr Alan Hellier	CMatP	NSW
Dr Greg Heness	CMatP	NSW
Dr Cathy Hewett	CMatP	NSW
Dr Tim Hilditch	CMatP	VIC
Mr Ryan Hilton	CMatP	NSW
Prof. Bruce Hinton	CMatP	VIC
Prof. Mark Hoffman	CMatP	NSW
Mr Paul Howard	CMatP	WA
Dr Paul Huggett	CMatP	WA
Mr Long Huynh	CMatP	VIC
Dr Amita Iyer	CMatP	VIC
Mr Russell Jackson	CMatP	VIC
Ms Mona Janbaz	CMatP	WA
Dr John Kariuki	CMatP	VIC
Dr Peter Kentish	CMatP	SA
Mr Robert Kilgour	CMatP	WLG
Prof Shailesh Kumar	CMatP	NSW
Mr Biju Kurian Pottayil	CMatP	WA
Mr Robert Le Hunt	CMatP	VIC
Mr Michael Lee	CMatP	VIC
Mr Kok Toong Leong	CMatP	SINGAPORE
Dr Dan Li	CMatP	WA
Mr Kevin Lim	CMatP	WA
Prof. Valerie Linton	CMatP	NSW
Prof Klaus-Dieter Liss	CMatP	NSW
Mr Michael Lison-Pick	CMatP	WA
Prof Yun Liu	CMatP	ACT
Dr Roger Lumley	CMatP	VIC
Mr Rodney Mackay-Sim	CMatP	NSW
Dr Matthew Mansell	CMatP	OMAN
Mr Michael Mansfield	CMatP	QLD
Dr Gary Martin	CMatP	VIC
Mr John McGrath	CMatP	SINGAPORE
Mr Andrew McGregor	CMatP	WA
Dr Alan McLeod	CMatP	QLD
Mr Greg Moore	CMatP	SA
Mr Peter Moore	CMatP	VIC
Dr Brian Mubaraki	CMatP	WA
Dr Jason Nairn	CMatP	QLD
Mr Deny Nugraha	CMatP	WA
Mr Michael O'Brien	CMatP	NSW
Mr Stephen Oswald	CMatP	WA
Mr Bhavin Panchal	CMatP	QLD
Dr Anna Paradowska	CMatP	NSW
Prof. Elena Pereloma	CMatP	NSW
Mr Paul Plater	CMatP	VIC
Dr Gwenaelle Proust	CMatP	NSW
Dr Dong Qiu	CMatP	QLD
Mr Geoffrey Randall	CMatP	QLD
Mr John Rea	CMatP	VIC
Mr Stephen Rennie	CMatP	WA
Dr M Akbar Rhamdhani	CMatP	VIC
Mrs Barbara Rinderer	CMatP	VIC
Prof. Simon Ringer	CMatP	NSW
Dr Richard Roest	CMatP	NSW
Mr Andrew Sales	CMatP	WA
Dr Christine Scala	CMatP	VIC
Mr David Schonfeld	CMatP	QLD
Dr Luming Shen	CMatP	NSW
Mr Hamish Sinclair	CMatP	VIC
Prof. David St John	CMatP	QLD
Mr Michael Stefulj	CMatP	NSW
Mr Mark Stephens	CMatP	VIC
Dr Graham Sussex	CMatP	VIC
Dr John Taylor	CMatP	QLD
Mr Alan Todhunter	CMatP	NSW
Dr Rowan Truss	CMatP	QLD
Dr Takuya Tsuzuki	CMatP	VIC
Mr. Jeremy Unsworth	CMatP	NSW
Dr Kishore Venkatesan	CMatP	VIC
Mr Pranay Wadyalkar	CMatP	VIC
Dr Philip Walls	CMatP	NSW
Dr. Laurence Walker	CMatP	WA
Ms Deborah Ward	CMatP	QLD
Mr John Watson	CMatP	VIC
Dr Philip Whitten	CMatP	NSW
Prof. James Williams	CMatP	ACT
Dr Xiaolin Wu	CMatP	VIC
Dr Richard Wuhrer	CMatP	NSW
Dr Wei Xu	CMatP	VIC
Dr Sam Yang	CMatP	VIC
Dr. Ji-Yong Yao	CMatP	QLD
Dr Shengjun Zhou	CMatP	QLD
Prof. Jin Zou	CMatP	QLD

Aluminium Extrusion Conference 2014 Wrap-up

Source: Barbara Rinderer

The fifth Australasian Aluminium Extrusion Conference was held in Surfers Paradise at the end of May, 2014. Materials Australia has long been associated with this conference, which was first held in 2001 in Sydney, and most recently in 2009 in Melbourne. While Swinburne University of Technology stepped in as the conference underwriters, Materials Australia maintained its involvement in 2014 as financial managers.

The conference, which was attended by over 100 delegates from Australia, New Zealand, and around the world, was a resounding success.

Xinquan Zhang from Rio Tinto Alcan said, "I believe this conference is truly the best one ever in this conference series." Marc Sibun from Lemarc Engineering noted that, "The conference had an impressive amount of personnel from industry," and described the conference as a "spectacular event".

Aside from the networking events with a welcome reception and conference dinner, the program included technical presentations and written papers on a range of topics relevant to the extrusion industry. The opening sessions discussed the economic climate for billet production and extrusion in Australia, and also in the Middle East. The session on equipment innovation provided an opportunity for the presentation of the most current developments in presses and preheating equipment, as well as control and management systems. Technical presentations were also given on billet production, extrusion processing, and problem solving. The entire conference had a very practical focus, which was complimented by a number of academics and consultants working to support the industry.

A technical workshop convened by Chris Jowett, a world expert in extrusion processing and consultant to Rio Tinto Alcan, was also offered. The comprehensive and well-received training workshop brought together experts from Australia and around the world. Through the generous support of Capral and INEX, a tour of their Brisbane site was also held following the conference. During the tour, visitors had an opportunity to view a high volume, complex production facility that had been through Lean Manufacturing implementation, as well as a new facility featuring some of the latest equipment innovation.

Given the success of the event and the considerable support from the industry, the organising committee are tentatively looking forward to another event in 2018.

Visitors enjoy viewing the press and induction preheating in action at the INEX, Loganlea facility.

Curtin University Orders AXT's TESCAN SEM-Based Minerals Analyser

Source: By Dr. Cameron Chai, AXT Marketing Communications Executive

AXT has been competitively selected to provide a TESCAN Integrated Minerals Analyser (TIMA) to the John de Laeter Centre at Curtin University in Western Australia.

This order marks the second TIMA that will be installed in Western Australia this year, and the second TESCAN electron microscope purchased by the John de Laeter Centre; in January AXT installed a TESCAN MIRA Schottky Field Emission Gun instrument for large area Energy Dispersive Spectroscopy (EDS) and Electron Backscatter Diffraction (EBSD) mapping of minerals.

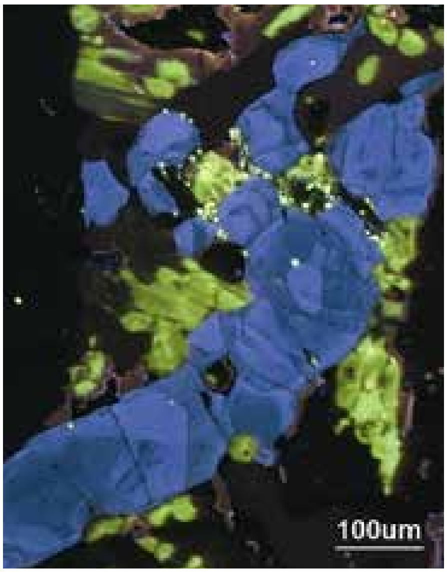
While the TIMA is available on two platforms, Curtin University has selected the more powerful FEG-SEM platform. The Curtin TIMA system features the larger GM fully analytical chamber which enables the loading of up to 15 x 30mm diameter samples and as many as 20 detectors and accessories.

The TIMA seamlessly integrates EDS detectors and software to rapidly and automatically analyse samples for mineralogy using three measurement modes (modal analysis, liberation analysis, and bright phase search). In addition, it will also incorporate TESCAN's unique compact Rainbow cathodoluminescence (CL) detector, which is ideally suited to the identification of different mineral phases, allowing simultaneous CL and Backscatter (BSE) imaging, a capability not available using conventional CL detectors.

Professor Brent McInnes, Director of the John de Laeter Centre commented, "The TIMA acquisition is jointly funded by a research consortium including Curtin University, the University of Western Australia, Murdoch University, the Geological Survey of Western Australia, the Australian Research Council and the WA Office of Science. We look forward to working with AXT and TESCAN to build a Digital Mineralogy Hub in Western Australia for minerals, energy, materials and environmental research. The TIMA will play a critical role in managing the microanalytical workflow of several JDLC facilities including over $20 million of ion, laser, electron and atom microprobe instrumentation".

AXT is Australia's leading supplier of analytical instruments and sample preparation equipment for the materials and life science industries as well as the mining and NDT industries. AXT's product range caters for academic and industrial clients. Established in 1991 as a manufacturer of x-ray tubes, AXT now has exclusive agencies for a range of international brands of high technology equipment. For more information about AXT, please visit www.axt.com.au or email info@axt.com.au.

If you would like to enquire about the Digital Mineralogy Hub Facility, or discover how the TIMA and MIRA can benefit your business, please contact Professor McInnes on: b.mcinnes_at_curtin.edu.au.



Cathodoluminescence image of an apatite and sodalite mineral taken with a TESCAN compact Rainbow CL detector.

Materials and Particle Characterisation Workshop

Source: ATA Scientific Pty Ltd

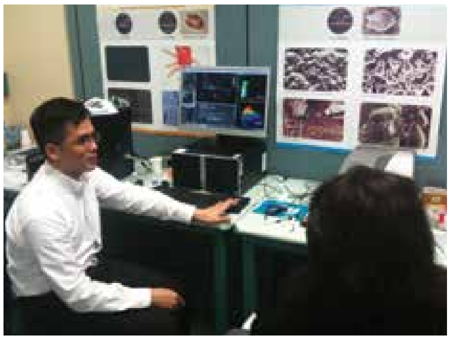
Specialists in analytical instrumentation for researchers and analysts, ATA Scientific hosted a three day workshop, from Tuesday 12 August to Thursday 14 August. The event was well attended by a stream of people from a wide range of scientific disciplines, including members of Materials Australia and the Australian Centre for Microscopy and Microanalysis (ACMM).

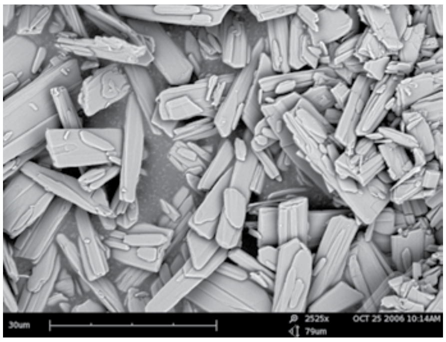
The workshop was designed to give scientists and their colleagues a unique opportunity to compare a range of different analytical techniques, all in one location. A series of demonstrations, together with valuable 'hands-on' time to experience the instruments, provided attendees with new insights into the wealth of information that is now readily available.

Four different instruments were setup for demonstration. All of these instruments were focused on the area of particle imaging and particle characterisation. The instruments on show for a test drive included:

- **Phenom Desktop Scanning Electron Microscope** (SEM) for high resolution imaging with X-ray analysis (EDS), for element identification. This desktop SEM eliminates the expense, delay (images are generated within 30 seconds) and complexity associated with operating a traditional SEM.
- **Malvern Nanosight** used to visualise and measure nanoparticle size and concentration, while a fluorescence mode provides differentiation of labelled or naturally fluorescing particles.
- **Malvern Morphologi G3** for automated particle imaging with optional Raman probe for chemical identification.
- **Malvern Zetasizer** to determine nanoparticle size, zetapotential, molecular weight and aggregation behaviour.
- **SEEC slides** from Nanolane that enable nanoscale imaging using a regular light microscope!

The event was delivered in a relaxed atmosphere, with all instruments available for viewing throughout the three days.

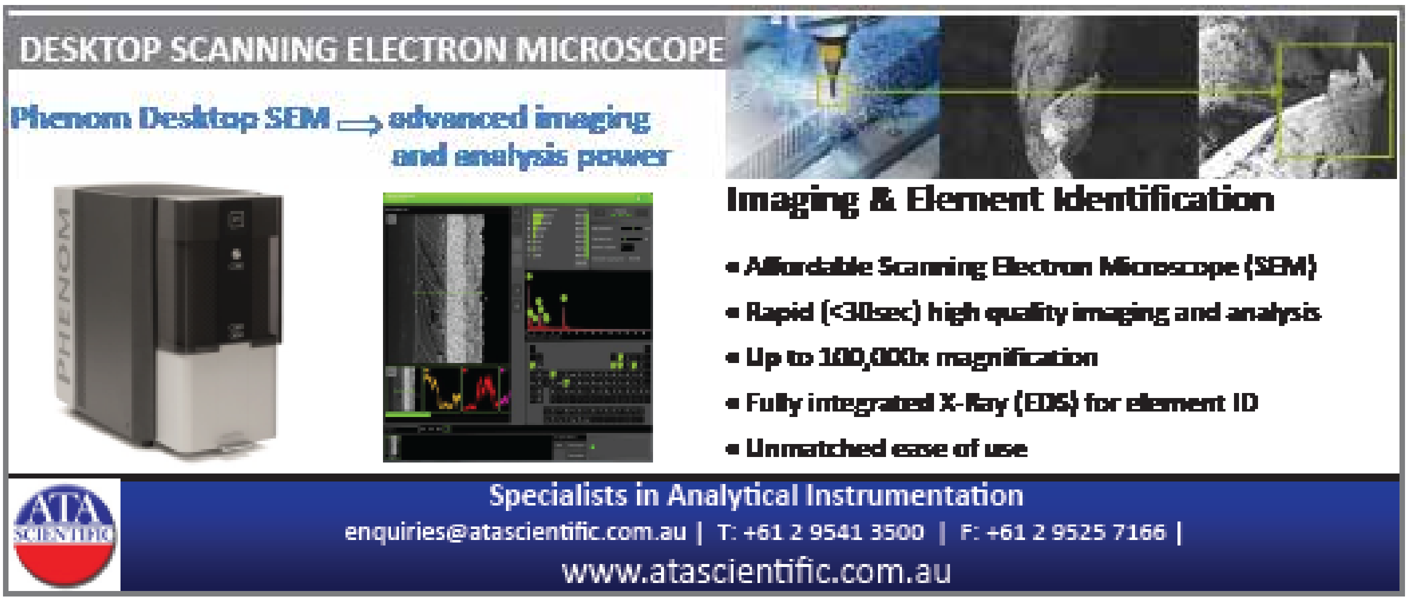




Attendees explored the technologies on show and were invited to bring in samples for analysis using the systems. A wide range of samples, including gold nanoparticles, pharmaceutical powders, polymer samples, filter membranes and metal powders, were analysed during the week, and the results were provided instantly. Having spoken to many attendees throughout the workshop, it was clear that they were fascinated and impressed by the speed and the quality of data obtained by the systems.

Overall, the event successfully demonstrated the capabilities of the systems. It helped to expose the true power of these technologies, which couple innovative engineering with intelligent software that helps drive them.

We plan to repeat the workshop in Melbourne from 29 October to 31 October 2014. For more information, or to register, visit our website: www.atascientific.com.au



Metal Manufacturing in Australia

Source: John R Worner. Bsc (Metallurgy), Managing Director – Pressform Engineering Group

From Federation, Australia has placed a significant halter around its neck by locating the seat of Federal Government in the new city of Canberra. Immediately, this caused a disconnect between industry, business and everyday city living. In the metals Industry, the perpetration of a monopoly steel supplier, has meant that the price of steel has remained at roughly $1000 per tonne for 40 years. It has only been in the last 15 years that true competition for steel sourcing has been in play. Featherbedded labour costs through all industries, made competition with international companies extremely difficult, and it is even harder today, exacerbated by politicians and media unfairly writing off manufacturing.

In our real world of making things that people use, the computer controlled machinery revolution that began over 20 years ago has meant that many businesses have survived and even prospered. Quality and consistency became expected from CNC machines. Innovation and astute thinking, some excellent suppliers constantly working to improve tooling and capacities, contribute to viable production of niche products and structures. It is now possible that one operator can effectively produce simultaneously from more than one machine at a time...a concept known as productivity improvement.

Sadly, a great opportunity was lost in the Oil, Gas and Mining Industries 20 years ago, when a duty free zone in Australia could have been created, in competition with international manufacturers. In such a zone, which other countries embrace, there are no taxes, duties or labour market restrictions.

This is impossible for Australian companies to compete with!

The innovation of the 457 Visa in Australia, has improved the availability of skilled labour, but has done the opposite to competitiveness because of minimum hourly rates that are applicable to such workers. The manufacturing work available in the project market now comes from the too hard basket, forgotten items, mistakes and the need for connecting structures, transition pieces and general assembly of the imported “meccano sets”. Significant man-hours are being spent in Australia in these areas, but sadly, in observing the magnificent structures arriving, one can only stand in awe, looking at them, and dream of what might have been.

The good news is, that these superb production facilities will have to be operated, maintained and repaired by Australian companies, and there are and will be, ongoing opportunities for Australian manufacturers for a long time to come. In companies such as mine, we do hold a wide and diverse range of tooling and capacities to make things for mining equipment, oil and gas fittings, piping structures, builders and constructors, train, car, truck and trailer parts, architectural screens, tiles furnace parts, and the list goes on.

There are new and exciting materials being developed, some in fact enhanced by Australia’s CSIRO. Nano-particle technology has great potential in cement reinforcing with metal powders, fibre composite building materials with potentially large increases in strength coupled with weight reduction, and increased densities. Powder metallurgy is making stronger, dense structural alloys. The discovery of the 1 molecule hexagonal Graphene sheets may create escalating demand for carbon and graphitic deposits. Enhancement and refining of smelting techniques now yield many new alloys in the stainless and nickel areas. All of these innovations give savvy Australian manufacturers the opportunity to keep up in the world market.

I would like to hear more politicians and media outlets repeat the phrase “Australia is open for business”. Take a leaf out of the American book, where both sides of politics embrace the concept that their country is a business, and must be run as such. Commence strong dialogue with employer and employee industry groups (bang heads together if you like), and let us go forward with some commonality of purpose, and work together as a team, developing an orientation towards cooperation that includes full bipartisan Government support.

John Worner established Pressform Engineering in 1976. Today, he heads the team at Pressform, as well as Pressurelube International, and Valve Sales Australia. With 40 years of experience, John has in depth knowledge of the fabrication and production of metal structures, components and parts; and a broad understanding of business in the manufacturing sector in Australia, and overseas.

Submit A Letter to the Editor

Materials Australia welcomes the views of its members, and the broader materials engineering industry. Please feel free to submit a Letter to the Editor via **magazine@materialsaustralia.com.au**

The New NETZSCH STA 449 *F5 Jupiter:* The No-Nonsense Model for Simultaneous Thermal Analysis

Source: NETZSCH Australia Pty Ltd

Designed in the well-established vertical instrument configuration, the new NETZSCH STA 449 *F5 Jupiter* provides ultimate ease of use. The instrument has been optimized to offer a broad variety of measurement tasks at an outstanding cost-to-performance ratio.

Many applications in the fields of ceramics, metals and composites require a temperature range up to 1600°C as well as a sensitive sensor for detecting small-scale effects. The STA 449 ***F5*** *Jupiter*, newly introduced to the NETZSCH product range alongside the modular STA instruments of the F1 and F3 series, meets these demands. Two instrument versions (with and without automatic sample changer), each including a TGA-DSC sensor, are available. In lieu of the TGA-DSC sensor, a pure TGA or a TGA-DTA can optionally be employed.

The core of the instrument is a top-loading highly sensitive low-drift micro-balance. The top-loading design, in combination with a rotating motorized furnace hoist, allows for the sample – and, if necessary, the sensor – to be changed easily and safely. In order to implement measurement routines quickly, the TGA-BeFlat® – a novel development for the F5 system – avoids carrying out baseline corrections.

The STA 449 ***F5*** *Jupiter* additionally comes standard-equipped with both AutoVac for automatic evacuation and refilling of the measurement system and mass flow controllers (MFCs) for precise control over purge and protective gases. This allows for the simultaneous determination of caloric effects and mass changes under both oxidizing and inert atmospheres.

When it comes to Thermal Analysis and the determination of Thermophysical Properties, NETZSCH Analyzing and Testing has it covered. Our 50 years of applications experience, broad state-of-the-art product line and comprehensive service offerings have made NETZSCH into a market leader, providing guaranteed reliability in their measuring instruments and comprehensive support.

Now with expert local service and support through its new Australian office, NETZSCH will not only meet your every requirement but also exceed your every expectation.

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PRODUCT LAUNCHES

Russell Fraser Sales Releases Next Generation of 3D Scanners

Russell Fraser Sales has launched the HandySCAN 300 and the HandySCAN 700 3D scanners. The HandySCAN 700 is 25 times faster than its former generation, is 40% more accurate and has a volumetric accuracy of 60 micrometers per meter. The TRUaccuracy™ feature ensures accurate measurements. It features a range of 3D scanning possibilities, regardless of the part size, complexity or material, the scanner operates in less than two minutes. For more information, visit: www.rfsales.com.au.

The HandySCAN 3D scanner from Russell Fraser Sales.

Applikon Biotechnology Launches micro-Matrix Microbioreactor

Applikon's micro-Matrix offers an integrated, easy-to-use, and cost-effective technology platform for the rapid handling and growth of large numbers of microbial strains, clone libraries, mutant banks, and cells. The system offers 24 independent bioreactors in a cost effective microtiter plate footprint. pH and dissolved oxygen can be controlled in each individual bioreactor via gas and liquid addition. For more information, visit: www.micro-matrix.com

Applikon Biotechno

Altium's newly released Tasking C compiler for the Renesas RH850 automotive microcontroller family.

Altium Launches A Variety of New Products

Altium, a global leader in Smart System Design Automation, 3D PCB design and embedded software development, has released a number of new products recently.

The Tasking C compiler for the Renesas RH850 automotive microcontroller family will offer high performance, balanced with very low power consumption over a wide and scalable range of products. This family provides rich functional safety and embedded security features needed for new and advanced automotive applications.

The WEBENCH® Altium Connector is a collaborative effort between Altium and Texas Instruments (TI) that blend TI's award-winning WEBENCH power design and simulation tools with Altium's leading EDA tool suite Altium Designer. This powerful platform provides design engineers with the first end-to-end analog circuit design and simulation environment, including everything from creating the power supply and simulating the complete circuit to creating the printed circuit board (PCB) layout.

The Next Generation Vault for Collaboration and ECAD Design Data Management is a centralized platform to support design teams and entire companies to easily manage and automate all the small yet crucial details to maintain focus on designing

For information on any of these products, visit: www.altium.com.au

Anomet Products Introduces Radiopaque Clad Wires

Anomet Products has introduced custom manufactured clad composite wire. An effective alternative to solid wires with marker bands, the new wire improves the visibility of implantable devices. The wire allows OEMs to specify the degree of visibility they desire under fluoroscopy by selecting the radiopaque alloys and cladding thickness best suited for their product. Easier to see than solid wires with marker bands, they are offered in sizes from 0.05mm to 1.52mm O.D. for use with stents, guide wires, and related devices. For more information, visit: www.anometproducts.com.

The SB-Series machines are standard equipped with eleven axes and thereby create a large bandwidth of bending contours.

Two New Bending Machines Launched by Schwarze-Robitec

Schwarze-Robitec has launched two new bending machine series, Platebender PB for plates and Sectionbender SB for sections. The bending specialist will present these new bending machines at the International Sheet Metal Working Technology Exhibition. The new plate bending machine series processes plates with a material thickness of only a few millimeters all the way to 125 millimeters.
For more information, visit: www.schwarze-robitec.com.

Morgan's New Material Keeps Pumps Running in Extreme Conditions

The new MAT-240 material developed by Morgan Advanced Materials is helping to keep pumps and seals running in challenging operating environments. Morgan's MAT-240 material is ideal for extreme conditions that are intolerable to other carbon graphite materials, due to the special formulation that allows for self-lubricating. MAT-240 transfers a lubricous film, which withstands dry conditions, steam and vacuum applications.
For more information, visit: www.morganadvancedmaterials.com

Victaulic Announces FireLock® Series 745 Fire-Pac Design Improvements

Victaulic, one of the world's leading manufacturers of mechanical pipe-joining and fire protection systems, has improved its FireLock® Series 745 Fire-Pac. The Victaulic Fire-Pac is a pre-assembled fire protection valve and trim that is pre-wired to a fire alarm control panel or junction box and enclosed inside a metal cabinet. The new FireLock Fire-Pac design relocates the electrical connection box from atop the cabinet to inside. As a result, it can be used in a much wider range of operating environments, including at temperatures as low as -6ºC.
For more information, visit: www.victaulicfire.com.

ZEISS Launches Photomask and Mineralogic Mining Solutions

German manufacturer of optical and industrial measurement systems, ZEISS has launched two new products: the next generation photomask qualification system, the AIMS™ 1x-193i that meets the requirements of advanced lithography like Source Mask Optimization; and the Mineralogic Mining Analysis Solution that combines a mineral analysis engine with a scanning electron microscope and spectrometers. For more information, visit: www.zeiss.com.

Zeiss' new Mineralogic Mining Analysis Solution combines a mineral analysis engine with a scanning electron microscope.

PANalytical's Epsilon 3X: Automation for Flexible and Safe Process Control

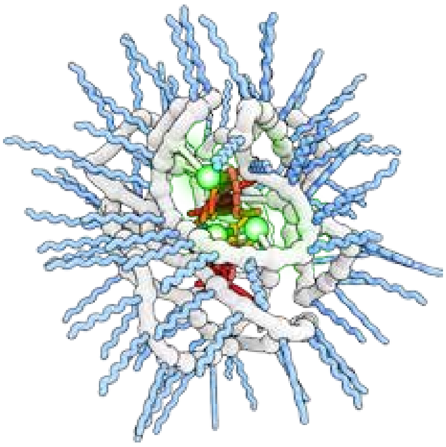
PANalytical has launched the Epsilon 3X automation option, combining the advantages of a benchtop X-ray fluorescence spectrometer with an automation environment. The Epsilon 3X automation instrument is enclosed in a sealed cabinet for safe operation and protection against dust, making it extremely robust. The system is designed to handle a variety of samples from a belt, robot or a manual input slide. For more information, visit www.panalytical.com.

With Epsilon 3X automation, the instrument is enclosed in a sealed cabinet for flexible sample introduction, safe operation and protection against dust.

GENERAL NEWS

Mimicking Enzyme Structures for Improved Organic Catalysis

According to Dutch researchers at the Eindhoven University of Technology, catalysts that mimic enzymes could revolutionise pharmaceutical manufacturing. Organic catalysts are essential for a number of industrial applications, but their inability to work within the same system or in water means that their efficiency is somewhat limited. Enzyme-like activity in a completely synthetic system could be used for reaction cascades in which multiple reactions occur at once.



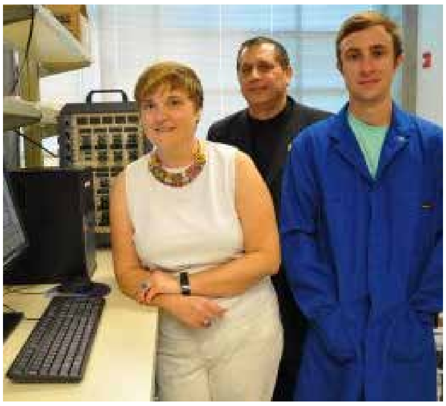
According to Dutch researchers, catalysts that mimic enzymes could revolutionise pharmaceutical manufacturing.

Interest in Cryogen Free, 7T Preclinical MRI Scanner Overwhelming

Delegates from academia and industry flocked to see the world's first commercial, cryogen free, 7.0T, preclinical MRI imaging system, which went on display for the first time at recent industry conferences. Manufactured by MR Solutions, the machine is capable of a variety of imaging techniques, including MRI, SPECT, and PET. The cryogen free technology provides a number of advantages. For more information, visit: www.mrsolutions.co.uk

Using Sand to Improve Battery Performance

Researchers at the University of California have developed a low cost, environmentally friendly way to produce sand-based lithium ion batteries that outperform standard batteries by three times. Graphite is used as the current standard material for battery anodes, but as electronics have become more powerful, graphite's ability to be improved has been virtually tapped out. Researchers are now focused on using silicon at the nanoscale, or billionths of a meter, level as a replacement for graphite. The problem with nanoscale silicon is that it degrades quickly and is hard to produce in large quantities. The California researchers solved both these problems.



(L to R): Mihrimah Ozkan, Cengiz Ozkan and Zachary Favors in the lab.

Research Highlights from the International Center for Materials Nanoarchitectonics

The simplest mechanical cleavage technique, using a primitive 'Scotch' tape, has resulted in the Nobel-awarded discovery of graphenes and is currently under worldwide use for assembling graphenes and other two-dimensional (2D) graphene-like structures toward their utilization in novel high-performance nanoelectronic devices. The simplicity of this method has initiated a booming research on 2D materials. However, the atomistic processes behind the micromechanical cleavage have still been poorly understood.

pitt&sherry to Provide Design Verification for Sydney Skytrain

Engineering consultancy pitt&sherry has been contracted to provide design verification services for internationally manufactured equipment used during construction of a 4km skytrain that will form part of the $340 million North West Rail Link (NWRL) in Sydney. The NWRL will be built as the first of Sydney's new rapid transit services, using fast, safe and efficient single-deck trains to service some 300,000 people in Sydney's north-west and the broader metropolitan area.

The 4km Skytrain will be an essential part of the North West Rail Link in Sydney.

Toyohashi Tech Develops Surface Plasmon Polaritons Solution

Researchers at Toyohashi University of Technology in Japan have developed a simple, low-loss waveguide for Surface Plasmon Polaritons (SPPs) that is applicable to nanoscale photonic integrated circuits on silicon. A thin metal film deposited on a silicon substrate was terminated with a diffraction structure (a multi-slit or a metal disk array) at the end to guide the SPPs transmitted on the surface (air-metal interface) to the opposite side of the metal (metal-silicon interface).

Kimberly-Clark Australia's $33 million cogeneration facility at Millicent Mill in South Australia.

Kimberly-Clark Australia wins Innovation and Technology Award

Kimberly-Clark Australia won both the Innovation and the Technology category at the 2014 Australian Business Awards. These awards acknowledge the company's commitment to driving sustainable solutions within the manufacturing industry after the installation of a $33 million cogeneration facility at Millicent Mill in South Australia. One of four cogeneration facilities for Kimberly-Clark globally, the reuse of waste heat sets a new benchmark for energy efficiency and is a technology first for the company globally.

Olympus Videoscope:
Solving Problems for Ford Performance Racing

Source: Relate Technical Communications Pty Ltd

An Olympus iPlex LX in the engine bay of an FPR V8.

When Mark "Frosty" Winterbottom lifted the winner's trophy at the 2013 Bathurst 1000 race, it was a tribute to the whole Ford Performance Racing (FPR) team. Among those celebrating behind the scenes were the engine technicians who had used an Olympus videoscope.

A vital piece of kit, the Olympus videoscope was used by FPR before the race to visually inspect the inside of the engine on Winterbottom's V8 Supercar to detect cracks, scoring, material transfer and any other flaws that could have potentially led to a catastrophic engine failure during the race.

Olympus—a world-leading manufacturer of optical, electronic and precision engineering products—has been at the forefront of videoscope development for many decades. The company has partnered with FPR since 2007, providing the latest technology to ensure that Ford's cars are tuned for success. "The level of support in terms of servicing the scopes we have, and upgrading equipment to the latest model, has been sensational," according to FPR's Chief Engine Builder, Ashley Campbell.

A videoscope is an inspection instrument that consists of a small camera mounted on a length of cable. An operator can control the camera remotely while it is inserted into the cavity under inspection.

"To us, the videoscope is absolutely essential and we are able to eliminate major failures because we are able to know the condition and viability of an engine throughout its life," stated Campbell. The latest model supplied to FPR is lighter, easier to use, and more conducive to how the team operates in the 'pressure cooker environment' on the Saturday night of a race meeting.

Informing the Future of Materials Science: A Focus on Australia's Universities

Author: Sally Wood

Materials scientists delve into all types of materials, determining their properties and performance from the atom up. A burgeoning, essential research area, materials science is an interdisciplinary approach that brings together the expertise of physics, chemistry, biology, biochemistry, and engineering.

It is no surprise then, that the educational pathways that students must take, and the in-depth research that is required for technology advancement, are vast and enormously varied.

It is this variation that makes materials science one of the most exciting career options within Australia's science industry. Career opportunities in materials science can be found in a myriad of places, in industry, research, universities, private corporations, and hospitals. Materials are being investigated and designed every day, for a huge variety of applications. After all, everything we touch is made out of some sort of material, whether it is man-made, naturally occurring or a combination of both.

The best foundation for a career in materials science is studying the basic sciences, through degrees such as physics, engineering, and chemistry. Once armed with a broad base of scientific knowledge, students are then able to focus on honing more specific skills that are in demand by their chosen industry niche.

In 2011, Australia was ranked fifteenth in the world in terms of national output of materials science and technology research papers (as determined by in Thomson Reuters Web of Science) for the preceding five years. This considerable strength in materials science in Australia for our relatively small population is remarkable. Australia was ranked ahead of a number of much more technically focused countries, including Singapore, Sweden, and Switzerland.

Australia is also home to some of the world's leading materials science and engineering universities and research centres, including the University of Queensland, the University of Technology, Sydney, and the University of South Australia.

The University of Queensland

The University of Queensland is pushing the boundaries of science and advanced technology, having a direct impact on the manufacturing, clean and renewable energy, biomedical devices, environmental, and electronics industries.

The University of Queensland currently has more than 115 full-time equivalent chemical sciences and materials engineering researchers, and more than 100 PhD and MPhil students. The industry leading university has received more than $80 million worth of funding, and published more than 1,600 resources since 2008. And, its Materials Sciences school was ranked 43rd in the world in QS World University Rankings by Subject in 2013.

In addition to collaboration with world-class universities, such as the University of Cambridge and MIT, University of Queensland researchers have an extensive network of industry partners including Rio Tinto, Boeing, Ford, GM, Baosteel, and the Dow Chemical Company. Successful commercialisation of research outputs – (including eight patents) – has also led to two spin-off companies, Hydrexia and TenasiTech.

Current research at the University of Queensland is tackling the development of new generation engineering materials, smart functional materials and advanced manufacturing technologies, including nanofabrication.

Research topics include design of advanced light alloys and processing, development of high-strength steels, and understanding the mechanisms of microstructural control, such as grain refinement, deformation, photocatalysis for solar-driven water pollutant removal, dye-sensitised solar cells, organic electronics, novel polymer materials, biodegradable scaffolds, biopolymer and biosurface engineering.

The state-of-the-art facilities at the University of Queensland support this Chemical Sciences and Materials Engineering research, including: the world class materials characterisation facilities in the Centre for Microscopy and Microanalysis; metallurgy and manufacturing facilities in the $130 million Advanced Engineering Building; and the newly established Australian National Fabrication Facility.

The University of Technology, Sydney

In New South Wales, the University of Technology, Sydney, is leading the way in the field of advanced materials. The University's School of Physics and Advanced Materials, undertakes innovative and industry-relevant research, expanding both the academic and professional knowledge of physics, nanotechnology, and advanced materials.

The majority of the research undertaken at the University of Technology, Sydney, is focused on optically-functional materials and structures for energy efficient applications using new experimental techniques and high performance computing.

Applications include: physics of light-emitting semiconductors; architectural physics and energy efficiency; optical properties of nanostructures and nanomaterials; computational modelling of nanomaterial systems; and material fabrication and characterisation by charged particle beams in reactive gaseous environments.

The School of Physics and Advanced Materials' research focal point is centred around two research strengths and one research facility. They are the UTS Institute for Nanoscale Technology, the Centre for Materials and Technology for Energy Efficiency, and the Micro-structural Analysis Unit.

The Institute for Nanoscale Technology brings together researchers from mathematics, physics, computational science, chemistry, microscopy, biology, materials science and engineering who are excited by the science and possibilities of materials and phenomena at the nanoscale (1 to 100 nm sizes). The interaction of light with nanoscale structures is an important theme, but other INT projects consider topics as diverse as photocatalysis, nanocomposite materials and biomedical implants.

The Microstructural Analysis Unit is a centralised modern, state-of-the-art facility that was established to facilitate high quality research and support a broad range of teaching programs. It is one of four Centres of Expertise within UTS Science and is the nexus of multi-disciplinary research at UTS.

The quest for sustainable energy enables the Centre for Materials and Technology for Energy Efficiency research team to

apply their extensive and complimentary expertise and capabilities in materials research for energy efficiency applications. The centre's core research areas include: solid state lighting, electro-chemical energy storage, photovoltaics, plasmonics, daylighting physics, and related computational modelling.

The University of South Australia

The University of South Australia, the largest university in the state, runs a future-focused science program, supported by high-calibre academics and research centres that are solving real world problems affecting everyday industry. The Bachelor of Science (Advanced Materials) offered at UniSA is industry informed and multidisciplinary in approach focused on Australia's primary industries of mining, energy, water and health.

The Ian Wark Research Institute is a centre of excellence for research into chemistry and physics and is the designated Australian Research Council (ARC) Special Research Centre for Particle and Material Interfaces. With an impressive list of research sponsors, collaborators and projects in areas such as bio and polymer interfaces, colloids and nanostructures and mineral processing, The Wark aims to both develop new technologies for use in industry and improve upon existing processes.

Named in recognition of eminent Australian scientist Sir Ian William Wark, the Institute has an international reputation for fundamental and applied research and postgraduate education. In 2012, it received a 5-star rating by the Excellence in Research for Australia (ERA) assessment for its research into Physical Chemistry, and in Resources Engineering and Extractive Metallurgy, indicating outstanding performance above world standards.

“We deliver products that have lots of good science behind them. They deliver benefit to the manufacturer in terms of jobs but also, are better for the environment or improve the quality of life for society. Building on the technology used in the car mirror context, we are exploring how this technology can be adapted for collecting solar energy and in energy-efficient lighting, both of which will reduce global greenhouse gas emissions.” Dr Drew Evans

Translating Research into Commercialisation Success

Source: Professor David St John


The Advanced Engineering Building (University of Queensland) at night. Photo courtesy Peter Bennetts

The University of Queensland attracts more than $80million in research funding from industry, and ranks first among Australian universities for licence income, value of equity holdings and invention disclosures, new Australian patents and active start-up companies. The University of Queensland is not only setting the benchmark for research and commercialisation success, with their buildings and facilities now attracting world-class status too.

The Advanced Engineering Building (AEB) has provided engineering students with a unique learning facility, allowing them to gain hands-on-experience through the monitoring of this world-class facility. Classed as a 'live' building – one that automatically adjusts air temperature for your comfort – the AEB self manages its energy output throughout the day. The designers and architects of the building have delivered on a challenging brief to create a building that embodies an interactive learning environment, and which offers the most advanced teaching methods for the engineers of tomorrow, while incorporating state-of-the-art green technology specifically suited to the unique Queensland climate.

Each day the AEB makes informed and calculated decisions to measure and monitor internal and external conditions – with this operational data available, the building provides students with best practice models in action to monitor the environmental performance as part of their curriculum. For example – students can assess elevator energy outputs, air conditioning levels and the building's structural performance, all in real time. With such learning opportunities at hand, the University has redesigned its curriculum around the building.

Physically, the AEB enhances our ability to transform engineering education with multi-purpose active learning spaces, where lectures are integrated with laboratories that can be used for design, build and test purposes. These learning spaces and research laboratories provide students with a powerful and active learning environment for improved teaching and learning – strengthening the undergraduate experience provided to students.

Industry-Based Research

The AEB has allowed for the construction of new laboratories and research facilities which have strengthened the expertise of existing centre, such as The Centre for Advanced Materials Processing and Manufacturing (AMPAM). AMPAM provides a focus for UQ's materials engineering and manufacturing activities, and those of its partners in major successful national collaborative ventures. The Centre's capabilities allow Queensland industry to capitalise on emerging trends in manufacturing research, where innovations in material developments are driving new combinations of metals, polymers, ceramics and composites that have not before been economically possible.

AMPAM is comprised of seven core partnerships, with extensive experience in a multitude of research sectors from defence to consumer products. Partnering with the ARC Centre of Excellence for Design in Light Metals, CRC for Advanced Composite Structures, CRC for Polymers, CRC for Rail Innovation, Defence Materials Technology Centre, QMI Solutions, and the Nihon Superior Centre for the Manufacture of Electronic Materials, AMPAM delivers unique opportunities for materials development, processing and manufacturing.

Composites Manufacturing and Evaluation

The UQ Composites group is renowned for its expertise in composites manufacturing, processing, testing and optimisation, in particular joining of dissimilar materials, thermoplastic matrix composites and bio-based and plant-fibre composites. The application of ultrasonic measurement and structural health monitoring techniques to characterise composite materials and evaluate the integrity of structural components, as well as numerical stress analysis and micromechanical damage evolution and manufacturing process simulations, are other areas of their expertise. Current research partners include the CRC for Advanced Composite Structures, Australian Aerospace, Airbus, and DSTO, while collaborative research is undertaken with colleagues from RMIT, the University of Bordeaux, Monash University, Griffith University and composite innovation centres and research groups in Malaysia, New Zealand, USA, Switzerland and Canada.

Metals Manufacturing and Solidification Technology

AMPAM is a world leading centre in solidification science and has extensive capability in metal fabrication technologies, medical device manufacturing and an emerging capability in additive manufacturing. The group's research activities in advanced titanium processing in partnership with Australian manufacturers was recognised in the 2012 ATN Go8 EIA Trial National Report as having "outstanding impacts in terms of reach and significance with the adoption of the research producing an outstanding social, economic, environmental and/or cultural benefit for the wider community, regionally within Australia, nationally and internationally." This research develops new manufacturing technologies, improves productivity and reduces costs when fabricating components from titanium and other difficult-to-machine materials. In the area of solidification, the group is working on the modelling of grain refinement and the application of these models to commercial casting alloy systems, solders, brazing alloys and Zn-Al steel coatings. The group also has expertise in alloy design for magnesium alloys.

Medical Device Development

AMPAM also works closely with Australian medical device manufacturers at all stages of production to develop prototype devices. The group's capability includes alloy development and characterisation, melting and investment casting, heat treatment and microstructural control, processing methods such as swaging and wire drawing, forming techniques and laser welding.

Polymer Processing

The polymer processing facilities at UQ are internationally renowned both in breadth of scale (from small, to pilot and large scale equipment). Because of our links to fundamental processing understanding (links to polymer characterization, rheology

Synchrotron real-time soldering observations for electronic interconnects.

(flow behaviour) and polymer performance resources), the research being undertaken into polymer processing has attracted a number of industry partners including Integrated Packaging, Plantic Technology Ltd, Rheology Solutions, AnoxKaldnes, Veolia, RSL Care, Norske Skog and many consulting partners. AMPAM's polymer research covers areas such as polymer formulation and blending, rheology, flow simulation, polymer properties and lifetime modelling. Collaborative research is currently underway with partners from QUT, CSIRO, ANSTO and UNSW, examining areas such as bio-based polymers, natural composites, degradable polyehthylene, nanocomposites, thermoset coatings and supercritical polymer processing for aerospace, agricultural, biomedical and high value industrial plastics applications.

Joining

Joining processes are important in the production of many components and are also commonly used in the repair and maintenance of plant and equipment.

At the University of Queensland, there are several projects that interface with both national and international industrial partners to provide support and make advances in joining technology. The range of processes which are of interest to the program partners are diverse and include adhesive bonding, self-piercing riveting, soldering, aluminium brazing, diffusion bonding and laser and conventional welding.

These processes are used to join a range of metallic, non-metallic, composite and dissimilar materials for a variety of applications including biomedical, electrical, structural and functional. Current partners include Nihon Superior, Cook Medical and Henrob. As part of this program, research is also conducted with other research institutions including Osaka, Kyushu universities and the Australian Universities within the CRCs and the Defence Materials Technology Centre.

AMPAM researchers are also very involved in the engineering education programs at UQ providing a solid framework for materials education into the future. The modern research facilities of the AEB, coupled with AMPAM's research expertise, has ensured that The University of Queensland's licensing and commercialisation success remains strong. For further information on AMPAM and the Centre's research capabilities, please visit: http://ampam.mechmining.uq.edu.au/

AMPAM - Translating Research into Commercialisation Success

Source: Professor Peter Halley, Associate Professor Kazuhiro Nogita

The University Of Queensland
AUSTRALIA

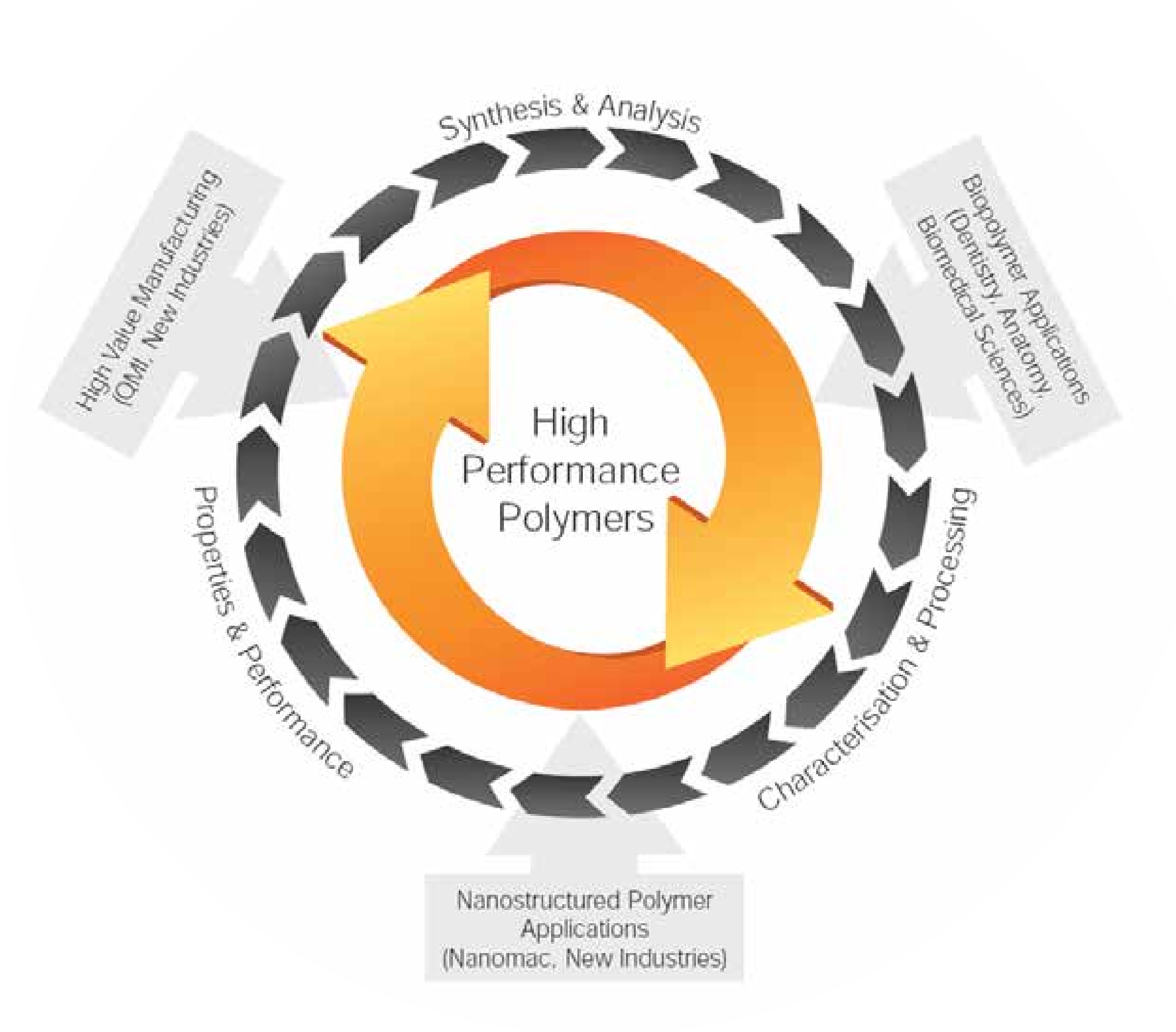
Case Studies

Biodegradable Plastics

The development of Australia's first Biodegradable Plastics Packaging products was an outstanding achievement from UQ's AMPAM team, via the CRC for International Food Manufacturing and Packaging Science (1995-2002), a collaboration between The University of Queensland, CSIRO and Swinburne University of Technology.

The CRC researchers identified that a range of corn starch based formulations could be used to manufacture a flat sheet bioplastic, which could then be thermoformed to produce biodegradable trays. This discovery generated valuable intellectual property (3 patents) and a spin-off company in 2002 (Plantic Technologies), which produced Australia's first biodegradable packaging products in October 2003. The company officially launched its Plantic® material and its presence to the packaging industry in August 2003.

Plantic has been supported by substantial venture finance interest and was successfully launched on the London Stock Exchange –AIM market in May 2007 generating a further $20M GBP ($50M) for expansion into European markets. In November 2010, Plantic Technologies Ltd went from being a public listed company to being privately owned by Mr. Gordon Merchant (founder and owner of Billabong). UQ's AMPAM team continues to work with Plantic in all aspects of fundamental research, product design and development of new generation of biopolymers.



Development of Lead-Free Solders

The recent boost in the popularity of portable microelectronic devices means that solder joints are regularly loaded at strain rates higher than those previously encountered. However, lead-free solders are generally more brittle than the older generation lead solders. Therefore, joints made from the newer generation of lead-free solders have lower resistance to shock loading caused, for example, by the accidental dropping of the portable device.

The soldered joints commonly found in mobile phones and e-tablets have a microstructure consisting of tin primary crystals and other more complex intermetallic phases. The cross section of the intermetallic compound (IMC) layer between the solder and copper substrate contains more crystals that contain a number of cracks and voids. These cracks and voids are generated during solidification and cooling to room temperature. These cracks compromise the reliability and diminish the shock resistance of the final microelectronic devices.

During research and production of the alloys, it became clear that the 'anatomy' of a soldered electrical connection in modern electronic devices plays a key role in its properties and functions. For this reason, it is most important to understand the morphology, crystal orientation and mechanical properties of intermetallics and the impact they have on the integrity of solder joints for micro-electronics applications.

Despite the identified limitations of the lead-free solders, the uptake of new solder alloys in response to legal mandates has arguably occurred without significant opportunity for detailed research. Most of the research for the last decade has been heavily oriented toward 'mechanical testing' and solder designs.

Associate Professor Nogita has collaborated with Nihon Superior Co. Ltd. Japan since 2003 to develop a lead free solder that overcomes some of the limitations of other lead-free solders. His innovative research into the use of nickel to stabilise the crystallography and morphology of the alloys led not only to a superior product for the company, but through his research, Nihon Superior were able to uphold their patent application in the Supreme Court of Japan in 2011. With the assistance of the research and innovation from Associate Professor Nogita, Nihon Superiors lead-free solder has now been incorporated into more than 5 billion circuit boards since its development in 1999. Commercially, this alloy has become one of the most popular lead-free solder products worldwide.

Profile: Mark Easton

Mark Easton has more than 19 years of experience within the materials and engineering industry. He is current the Deputy Head of School (Manufacturing and Materials), within the School of Aerospace, Mechanical and Manufacturing Engineering, at RMIT University.

Mark has undertaken a number of extensive material research programs throughout the course of his career, including investigating: powertrain alloy development with advanced magnesium technologies which led to the development of a castable creep resistant magnesium alloys with Magontec; alloying variables that affect grain refinement and hot tearing in Al alloys with Rio Tinto Alcan; a new generation of alloys for sacrificial coating of steel with Bluescope; the effect of impurity element creep on properties in Al-based alloys; and a variety of approaches for improving the properties of gravity cast Mg alloys through microstructural control using chemical and mechanical means.

Mark holds a Bachelor of Science (with majors in Applied Mathematics and Materials Science), a Bachelor of Engineering (First Class Honours) in Materials Engineering, and a Doctor of Philosophy. The title of his thesis was Grain Refinement Mechanisms in Aluminium and its Alloys and the Effect of Grain Refinement on Castability.

He is a Certified Materials Professional (CMatP) with Materials Australia, a Member of The Minerals, Metals and Materials Society (TMS), and an Associate of the Australian Institute of Company Directors (AAICD).

Q&A

Tell us about your current role.

I am currently the Deputy Head of School for Manufacturing and Materials at RMIT University within the School of Aerospace, Mechanical and Manufacturing Engineering. This involves oversight of the teaching and research activities across this area. It is quite a diverse group, with activities ranging from molecular dynamic modelling of soft materials, to light alloys and additive manufacturing, through robotics and mechatronics to systems engineering. So the materials engineering activities are part of a broader engineering context, which definitely has its advantages.

What study have you undertaken to prepare you for a career in materials engineering?

At undergraduate level I did a combined Bachelor of Science and Bachelor of Engineering (Hons.) at Monash University. The Bachelor of Science included majors in Applied Maths and Materials Science, and the Bachelor of Engineering included Materials Engineering. I then undertook a PhD at the University of Queensland in materials engineering, focused on the grain refinement of aluminium alloys.

In what way is ongoing education and training important to a career in materials engineering?

I think that we undertake further education and training either to deepen our knowledge or to broaden it. In the first part of my career, through to the completion of a PhD and the first few years after, it was definitely about deepening my knowledge of materials engineering, particularly in the area of metals processing, particularly solidification. Since then, it has been mainly about broadening my knowledge base, in particular project management, commercialization, and governance.

What project have you most enjoyed working on? Why?

I really enjoyed my time with the CAST Co-operative Research Centre and there were really two areas that I enjoyed greatly. One was working on magnesium alloy development with Advanced Magnesium/Magontec. The other was on grain refinement/hot tearing, microstructure development with Comalco and Rio Tinto Alcan. Both of these projects had a great relationship with the industry partner, a commercial driver for the project, and also the chance to do some really good science with really good teams of researchers, who were generally from a range of Universities and the CSIRO, as well as the industry partner.

Profile: Mark Easton

What aspect of your career do you most enjoy? Why?

I enjoy getting involved in research projects and putting good teams together. I also enjoy getting up in front of a group of students, lecturing and discussing problems and issues.

What are some of the common challenges that you face?

It is a challenging and exciting time for the manufacturing industry, which affects both the teaching programs that we have, and the research activities. At the moment, we are repositioning teaching and research programs to respond to both today's and tomorrow's society and associated manufacturing industry. This always takes some guesswork, or hypothesis building as we would say in research, but it makes it very interesting.

What is the most innovative advancement that you have seen in materials engineering?

There are new technologies being launched all the time, whether it be light-weight structures or flexible solar cells, or 3D printing of novel structures of the novel biomaterials now being designed and implanted. It is hard to say what the most innovative is, but I am currently fascinated by the opportunities in the additive manufacturing space through the integration of mechanical design, innovative process technology, and materials development. It is clear that working in cross-disciplinary teams is providing the greatest scope for innovation.

How can RMIT assist young engineers?

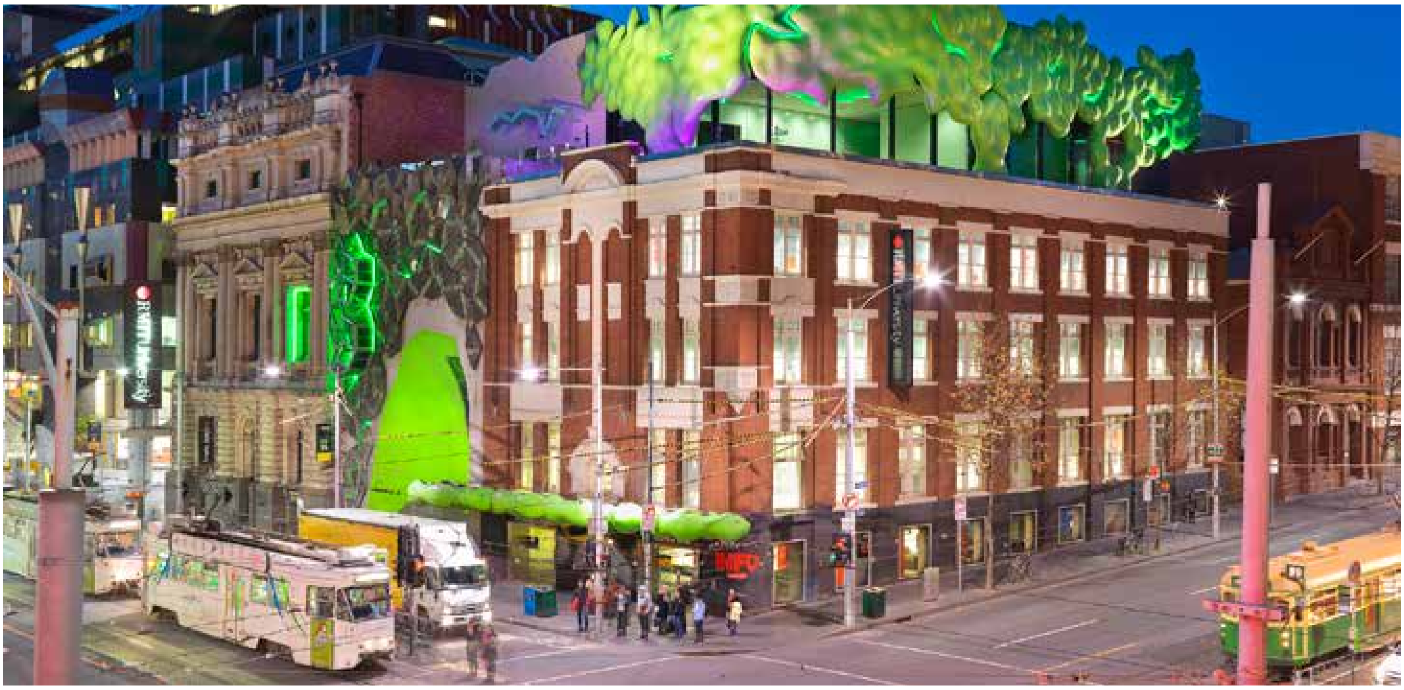
In pure numbers terms, RMIT is the biggest engineering educator in Australia. As such, it integrates the complete educational supply chain, from vocational education through to masters by course work and higher degree research students. There are a multitude of programs that can help engineers hone their technical skills or develop management capabilities. One of the great things about RMIT is the commitment to innovative teaching, whether it be problem based or work integrated learning, producing work ready graduates. RMIT makes nearly 200 placements in industry all over the world each year as part of its vision to be a global and connected university.

What piece of career advice would you give to today's engineering graduates?

Engineering is a good choice because in many ways engineers are key to the economic productivity of society; they solve real technical problems. Part of this is driving change and improvement. So, be prepared to be flexible, as you will find that things will change, even drastically, but your skills will enable you to solve the next problem, or take hold of the next opportunity. My skills developed in casting are perfect for additive manufacturing where issues like porosity formation, differential shrinkage, and microstructure control are critical, and of course project management skills are generic. So, my advice is that you have a great set of skills, just be willing to use them in creative ways.

What does the future hold for your industry?

The materials and manufacturing industries are currently going through a time of transition. Whilst there has been some lamenting about the demise of some of the traditional manufacturing industries in Australia, it is better to look on it as a time of transition. Everything is becoming more international, so we can no longer be competitive as mass-market manufacturers for the Australian market. But instead, there are many new technologies gaining acceptance, such as additive manufacturing, or in applications such as implants and scaffolds for biological materials. All these require the skills of materials engineers.



RMIT University, Building 22 (aka 'Green Brain').

University of Technology Sydney (UTS) UTS Science

Source: Lisa Aloisio - UTS Sydney

UTS Science is a world-class research intensive faculty with a growing reputation for its research quality and impact across a wide range of disciplines. This is supported by vibrant, high impact research in an inclusive environment, with world class facilities and active interactions with the scientific professions and the community.

As a leading provider in science research and education, UTS Science contributes about 40 percent of the total research activities and outputs at UTS. Recently, UTS Science was one of only two institutions rated 'better than world standard' in the 2012 Excellence in Research for Australia (ERA) report.

UTS Science conducts highly competitive, focussed research through its research intensive centres and institutes in environmental sciences, infectious disease, forensics, nanoscale technology, clean energy, medical and health sciences including the fundamental and theoretical aspects of mathematics, physics, chemistry, biology and geosciences.

With a strong record and commitment to research and development, UTS Science strives to facilitate quality postgraduate research and valuable experience. Our academics are active researchers who are world-renowned international experts in their fields.

UTS has invested $1 billion to fundamentally change the way teaching, learning and research is delivered. Our new science building will be complete in 2015, increasing our research and teaching capabilities by adding more exciting opportunities for discovery and enhanced learning.

UTS Science prides itself on research that engages with industry and the community, and produces outcomes of social and economic benefits.

WORLD CLASS FACILITIES

UTS is one of the best science facilities in Australia. With state-of-the-art equipment and instrumentation, our facilities are modern and comparable to those in advanced commercial laboratories.

UTS Science has invested extensively in its research facilities with advanced specialised scientific laboratories, instruments and expertise that are readily available to researchers, students and industry for research, learning and collaborations.

Our teaching, learning and advanced research facilities include, a Super Lab, proteomics, forensic and analytical chemistry, microbial imaging, elemental bio-imaging, environmental sciences, microstructural analysis, surgical and anatomical science, insect research and a Chinese medicine outpatient clinic.

MICROBIAL IMAGING FACILITY

The Microbial Imaging Facility (MIF) provides high-resolution imaging of microorganisms and biological processes within larger eukaryotic cells, and equipment for flow cytometry and biological specimen preparation for optical and electron microscopy.

The facility's specialist expertise lies in bacteria, parasites and viruses and the imaging of individual organisms as well as how they interact with their hosts.

The MIF is comprehensively equipped with sophisticated and state-of-the-art optical microscopes for epifluorescence, deconvolution, confocal and live-cell imaging microscopy.

One of the strengths of the imaging facility is the suite of instruments available for use by both internal and external research collaborators. A four-laser confocal microscope is set up with live-cell imaging equipment to do fluorescence activation or resonance energy transfer experiments as well as a wide field live-cell imaging system to do long-term live-cell imaging, both with bacteria, viruses, parasites or eukaryotic cells.

The hero equipment in this facility is the DeltaVision OMX Blaze imaging system. UTS was the first commercial installation site in the world for this exciting new technology which incorporates an ultra-fast structured illumination module and the latest advanced high speed scientific CMOS cameras, enabling live-cell, multi-colour super-resolution 3D-SIM imaging.

The MIF has strong strategic research links and collaborative research programs with a number of international universities and laboratories. Staff provide expertise in teaching instrumentation use, sample preparation, and demonstrating best practice and results in experimentation. Industry interactions can be short and long term research projects, custom technique development, problem-solving and fee-for-service analysis.

MICROSTRUCTURAL ANALYSIS UNIT

Established in 1993, the Microstructural Analysis Unit (MAU) is a centralised large equipment facility underpinning high quality research and support to a broad range of postgraduate and undergraduate teaching programs.

This MAU provides researchers in both the physical and biological sciences with access to a comprehensive array of state-of-the-art analytical microscopy tools as well as materials analysis and fabrication equipment.

Research expertise and advanced training are provided in advanced microscopy and materials characterisation techniques by a highly experienced team of five resident professional staff. Staff are active researchers with wide research interests, particularly in technique development.

The MAU has strong, collaborative research links and programs with a number of international universities and laboratories, such as the Technical University of Berlin, University of Sherbrooke (Quebec), Polish Institute of Physics, as well as a number of Australian Universities including the Australian National University, Macquarie University and University of New South Wales.

The MAU is a hub for multi-disciplinary research within UTS Science. It has several characterisation and fabrication facilities which include:

- Electron microscopy and microanalysis
- Scanning probe microscopy
- X-ray characterisation
- Optical characterisation
- Electron beam chemistry lab
- Nanophotonics lab
- Cathodoluminescence microanalysis lab
- Thin film vacuum deposition lab

Industry engagement is a key function of the MAU with a large, diverse industry user base with over 100 companies having used the facility since it opened in 1993. The MAU collaboratively partners with American based nanotech equipment manufacturer FEI Company in research and support of new energy efficient materials research at UTS.

ELEMENTAL BIO-IMAGING FACILITY

The Elemental Bio-Imaging Facility is a world-class multi-disciplinary facility, unique in Australia. It is the only dedicated facility in the world for imaging of trace elements by laser ablation inductively coupled plasma mass spectrometry.

The facility combines research expertise in analytical chemistry, physics and clinical and biological sciences to establish state of the art bio-imaging solutions for solving complex analytical and biological research problems.

Research is strongly focused on applying cutting edge techniques to research problems that include understanding metal metabolism, disease biomarker discovery, spatial localisation and quantitation of proteins, sugars, prosthetic groups, drugs or nanoparticles, environmental contaminants and 3D mapping of the brain and sites of inflammation in tissues.

In purpose built laboratories with state of the art equipment provided by Agilent Technologies, this facility houses the following instrumentation:

- Three elemental bio-imaging systems
- Ultra high performance liquid chromatographs coupled to various molecular mass spectrometers
- Lab on chip devices
- Capillary electrophoresis instruments
- Gas chromatographs and a new 500 Mhz nuclear magnetic resonance system

Partnerships and global collaborative projects are a key function for the Elemental Bio-Imaging Facility. Strong, long term, collaborative research synergies have been established with a number of major Australian universities and affiliated institutes including Macquarie University, University of Sydney, University of Adelaide, Melbourne University and the Howard Florey Institute.

The global reputation of the facility continues to grow, with senior staff providing expert consultancy and participating in collaborative research with universities in the Asia Pacific Region, the United States and Europe including National University of Singapore, University of Sao Paulo, Harvard School of Public Health, UC Berkley, Mt Sinai School of Medicine New York and Munster University.

UTS Science works closely with major industry partner, Agilent Technologies, to assist them with providing products that will define the future of elemental analysis and applications to the life sciences, pharmacological breakthroughs and understanding of disease processes.

CHEMICAL TECHNOLOGIES

The Chemical Technologies research facility pulls together the resources of several well equipped laboratories specialising in chemistry and materials science. The laboratories carry out services to both academics and commercial clients in research, training and the development of chemical technologies.

Specialties of the facility include the physical and mechanical characterisation of engineering materials, and the chemical and physical characterisation of forensic and pharmaceutical samples. Backed by a team of experienced researchers, the facility is equipped to produce and characterise a diverse range of organic and inorganic materials.

Our research laboratories consist of three suites:

- Analytical
- Forensic
- Materials

These facilities support key research in the areas of chemical analysis, detection and analysis, material and properties, forensic analysis, biochemical analysis and safety environment.

The Chemical Technologies research facility provides research laboratories for high quality research, training, education and consultancy services. These research laboratories assists in a variety of corporate, government and community organisations in chemistry, forensic science, nanotechnology and material science.

The facility is equipped with advanced technology and equipment including an Agilent 500 MHz Nuclear Magnetic Resonance (NMR). The NMR is used in the analysis of chemicals (organic and inorganic), monomers, polymers, resins, illicit drugs, pharmaceuticals, petroleum products, hazardous waste and natural products and food. It also has the potential to analyse compounds associated with melanoma to understand disease states such as cancer.

The Chemical Technologies research facility works in close collaboration with Agilent Technologies on a national and international basis. Agilent Technologies supports UTS research by providing instrument access, technical support, research funding, scholarships and internship opportunities.

RESEARCH WITH US

For further information contact www.science.uts.edu.au

Materials Engineering at Monash University

Source: Department of Materials Engineering, Faculty of Engineering.

Based in Melbourne, Monash University has a strong global reputation supported by impressive credentials. It is rated as one of the best universities in Australia, ranked within the top 50 universities in the world for engineering (Academic Ranking of World Universities 2013), and its Faculty of Engineering is recognised for producing research that is well above world standard (Excellence in Research for Australia 2012).

The Department of Materials Engineering at Monash University is an international, research-active department with modern facilities and a broad education offering in materials science and engineering.

While Monash University's work spans the entire materials field, their team of materials engineers specialise in the cutting-edge and fundamentals of metals and alloys, biomaterials and tissue engineering, nanomaterials, polymers, composites, corrosion, and advanced materials characterisation.

Biomaterials

The intersection of biomedical science and materials engineering is an exciting one, and largely falls in the province of biomaterials and tissue engineering. Many of the advances being made at the interface of these two disciplines are at the centre of new medical and health-based technologies and are changing the way we live and treat illness. Some recent examples of Monash University research projects are outlined below.

Engineering Smart Nanomaterials to Repair Neural Pathways

Neural tissue engineering (NTE) is a method of regeneration of damaged neurons providing cellular niches, which promote attachment, growth, proliferation and migration. Electrospun scaffolds are ideal for NTE, as nano-scale architectures can be fabricated that have dimensional similarities to the native basement membrane.

Neural stem cells' differentiation is dependant on the physical and chemical properties of the scaffold. The physical environment provides cues that can be exploited to enhance and direct differentiation. Furthermore, electrospun scaffolds can be easily functionalised to promote adherence. The longer-term goal of this research is to utilise cell-scaffold constructs that will assist in functional recovery of the damaged spinal cord in vivo.

Source: Monash University

New Materials for Implants

Heart disease is the leading cause of death and disability worldwide, accounting for 30% to 40% of all human mortality. Currently two strategies, (embryonic) stem cell-based therapy and left ventricle restraint are under intensive investigation for the treatment of the devastating disease. A combinatorial approach of stem cell therapy and mechanical passive restraint represents a novel approach. A heart patch serves two purposes: to deliver functional cardiomyocytes to the infarct heart muscle and provide mechanical restrain to the weak left ventricle.

The essential requirements on a heart patch material include long-term elasticity, cell deliverability and degradability. The most important challenge that materials scientist currently encounter in the field of cardiac tissue engineering is to make a nonlinear elastic polymer that is similar to that of the myocardium. Such nonlinear elasticity would ensure that the heart patch can 'beat' together with the recipient heart, thus providing appropriate restraints to the left ventricle throughout the beating process. New biocompatible rubbers, including crosslinked and thermoplastic elastomers, are under development in our research.

Other work involves the development of materials, which would be suitable for temporary implants. The need for such materials is particularly great in vascular surgery where a temporary, bioresorbable stent could provide support to the walls of a blood vessel when it is required and dissolve when its mission is fulfilled – without a further invasion of the surgeon.

Nanomaterials

Researchers at Monash University are utilising nanobiotechnology approaches to repair damaged neural pathways in the brain and spinal cord. Biomimetic and nanostructured scaffolds are being used to deploy neural stem cells, improving the efficiency of cell replacement therapies. Nano-structured scaffolds include nanofibres engineered from 'topdown' approaches such as electrospinning as well as 'bottom-up' techniques of self-assembling peptides and proteins.

Monash University has expertise in nano-fabrication, biofunctionalisation of nanofibres (using patented technology), imaging, stem cell culture, and animal models for neurological diseases and injury.

Nanograined Functional Alloys

Monash University is currently researching the functional properties of nanostructured materials for clean and efficient energy technologies.

Research programs include:

- The efficient magnetic core materials and rare-earth free permanent magnets for electric motors in cars; a vital element to an environmentally-friendly automobile industry
- Economically viable palladium-free alloy membranes with excellent hydrogen permeation characteristics; a key technology in maintaining a low greenhouse gas emission while using coal for energy generation.

Nanostructures and Advanced Light Alloys

Monash's light alloys group is focused upon magnesium, aluminium and titanium alloys. Major aims are to produce light-weight, high performance light alloy products for applications in the automotive, aircraft and aerospace industries, via the manipulation of nanoscale aggregates of alloying elements or grains in the final products.

Monash University has advanced casting and thermomechanical processing facilities to manufacture the nanostructures designed for better performance, and it also has world-class facilities to reveal the structure, chemistry and distribution of nanoscale aggregates that ultimately control the mechanical properties of the light alloy products.

Ongoing projects include development of high-strength, creep-resistant magnesium casting alloys, texture control of magnesium sheets and extrudates, multistage thermal processing under isothermal and non-isothermal conditions, the effect of microalloying additions on precipitation behaviour in magnesium and aluminium alloys, machining of titanium, and processing-nanostructure-property relationships.

Bulk Nanostructured Materials

In a quest for advanced structural materials, researchers at Monash University have turned their attention to bulk nanomaterials for large-scale structural applications. They are developing processing techniques by which the microstructure of metals and alloys can be broken down to nanoscale. This extreme grain refinement is achieved by severe plastic deformation of a material.

The processes employed make it possible to produce nanomaterials in large quantities while avoiding any health hazards that may be associated with handling of nanoparticles. Light metals, steels and other structural materials with extraordinary mechanical strength and attractive functional properties can be produced in this way.

Nanostructured Photovoltaic Systems

Reducing the cost of converting solar energy into electricity is a global endeavour that is attracting the attention of researchers worldwide. Research activities at Monash University have been focused on the development of low cost and lightweight dye sensitised solar cells (DSCs), a new type of solar energy devices that is now recognised as one of the most significant alternative photovoltaic technologies to silicon wafer-based solar cells.

Through collaborations in the Victorian Organic Solar Cell Consortium (VICOSC),

The New Horizons Building at Monash University. Source: Monash University

Monash researchers have been actively involved in the development of flexible DSCs on plastic substrates by printing technology.

Activities include development of nano semiconductor materials and conducting polymers for working and counter electrodes, stable ionic liquids and noncorrosive redox couples for electrolytes, new DSC device structures and device fabrication technologies.

Green Materials Engineering

Natural resources are becoming scarce, and the fragility of the environment, including the earth's climate, is rapidly becoming apparent. That is why there has been an increasing emphasis on renewable technologies, and on industries and processes that produce less waste – waste that is not only treated appropriately but also re-used. It is also why Monash University's materials engineers are undertaking a range of research projects in this area.

New Methods of Hydrogen Storage

Hydrogen is one of the cleanest sources of renewable energy—the development of advanced materials for the generation and storage of hydrogen is a key to achieving low greenhouse gas emissions.

Monash University is conducting extensive research into these materials, particularly into novel niobium-based hydrogen permeation membranes and nanostructured magnesium based hydrogen storage alloys. As a result, Monash researchers have recently discovered that by using nonequilibrium material processing, the microstructure of niobium-based hydrogen permeation alloys can be reduced to as small as 10 nanometres.

Since both the solubility and the diffusivity of hydrogen in alloys are enhanced by nanoscale grain refinement, this nonequilibrium processing is expected to lead to novel nanostructured membrane alloys with exceptional hydrogen purification capability.

Biodegradable Starch-Based Plastics

Most plastics are derived from non-renewable resources, such as oil and gas. But new research from Monash University shows that plastics can now be made from renewable materials, like starch, plants and farmed crops. Recent breakthroughs mean that conventional plastics-processing equipment can process such materials into a variety of shapes and objects.

New Types of High-Efficiency Batteries

Monash researchers are examining the use of new ion and electron-conducting materials to improve electrolytes and electrodes in solar cells, fuel cells, capacitors and lightweight batteries.

When looking at ways of powering everything from cars to miniature devices that may be used to help power biomedical devices, the ability to store more energy in smaller or lighter devices is not only advantageous but also crucial.

The materials development plays a crucial role in achieving the higher efficiencies and greater reliability required in such devices to help them reach the market.

Profile: Alan Todhunter

Alan Todhunter has over 30 years experience as a senior materials scientist, working predominantly in infrastructure and built environment projects in the building, transport, and mining industries across Australia and Asia.

Alan has balanced a career in industry with a career in academia. He has actively lectured in materials science in various roles in built environment degrees since 1996, and is currently a lecturer at the University of Western Sydney, in Construction Management.

Prior to this, he was Senior Materials Science Engineer at Aurecon, a high-end engineering consultancy within the Australian construction, mining and transport industries.

As a highly experienced materials and durability technologist, Alan has extensive experience in construction and infrastructure industries in materials, degradation, corrosion and material failure diagnostics.

Alan holds a Bachelor of Applied Science (Hon.) in Materials Science and a Master of Science, from the University of Technology, Sydney. He is a member of the Royal Australian Chemical Institute, Affiliate Member of the Australian Institute of Building and a Certified Materials Professional (CMatP) with Materials Australia.

Tell us about your current role.

I lecture in Construction Management at the School of Computing, Engineering and Mathematics at the University of Western Sydney (UWS). In this role, I am responsible for the delivery and unit coordination of subjects in the second and fourth years of the Construction Management Degree program, integrating face-to-face and online learning for content delivery and assessment. Subjects include:

- Materials Science in Construction: properties and durability of construction materials.
- Major Project in Construction: a research based methodology subject that facilitates individual learning in a construction-based topic.
- Construction in Practice Three: a capstone group project for final semester students, aimed at developing a hypothetical construction project in an established commercial or residential area, which complies with both Local and State Government regulations.

What study have you undertaken to prepare yourself for a career in materials science?

My studies have been in materials science, completing both an Honours and a Master's degree from the University of Technology, Sydney. My Master's thesis in the 1990s was on the use of finite element analysis as a tool to investigate the properties of ceramic materials.

In what way is ongoing education and training important to a career in materials science and engineering?

When it comes to ongoing training, the most important factor is that the education should be within the chosen discipline. For me, as a materials scientist in construction, it is essential to not only be aware of the materials used, but also to understand the significance of material performance, durability and specification. This is something that cannot be learnt in a classroom environment. It can only be learnt within the construction profession, participating in projects and tenders. It is this industry experience that is incorporated within the lecture material that I present. Working as a consultant has given me exposure to a diverse range of materials in service. In doing so, I am able to keep up my reading on new materials technology as well as what is happening in materials durability and remediation.

After a 20-year break from study, I recently commenced research to complete a Ph.D. at the University of Western Sydney.

Profile: Alan Todhunter

What projects have you most enjoyed working on? Why?

My career as a materials scientist has seen me move from the coatings industry to dental and biomedical composites and into construction materials. A great advantage of a sound undergraduate degree is the ability to diversify into many industries. The experience within industry, in senior materials science and engineering roles, has challenged me to go back to the fundamental sciences of materials and incorporate that into large infrastructure projects.

For me, the challenge of being part of a team looking at coating failures, corrosion and concrete degradation at the Olympic Dam site, reviewing concrete durability in major coal port facilities, and preparing durability tender reports for North West Rail Link have been the highlights of my career.

There is also a fondness in my heart for a coatings project that I completed several years ago in Shenzhen, China. There, I was able to review the performance of coating materials in an environment quite different to Australia. Looking at coating failures on the 40th floor of a building during a typhoon is an experience that is hard to forget.

Back in the 1990s, I was part of an industry based research team to develop tough, light cured dental composite materials that lead to a two-year research assistant position at the Centre for Advanced Materials Technology at Sydney University. This gave my first experience in an academic environment and fostered interest in teaching. A professor in engineering asked me to give his lectures while he was attending a conference. All of a sudden, I found myself in the midst of academic life. It was a very humbling experience, realising that what I was teaching would contribute to the materials education of so many bright minds.

What aspect of your career do you most enjoy? Why?

It is easy for me to be passionate when I am working on the construction of large infrastructure projects. On these large-scale projects, all components are made of materials, and it is fantastic to see the diversity and application of materials in the built environment. The diversity of employment and consulting in my industry career, leading to an academic career, has opened up many opportunities for me. I have been able to pass on not only my experience in the performance of materials in the built environment, but also the processes associated with research and project management.

Over the last few months, I have been fortunate to be part of a team in the University of Western Sydney Construction Management Program, which is looking into the education process that prepares students for a career in the built environment.

What are some of the common challenges that you face?

The biggest challenge for me is ensuring that my knowledge of the built environment is current, and appreciating the significance of the built environment. It is important to be passionate and experienced within any chosen profession. A major challenge is accountability. In industry, a decision on the durability of a material, such as concrete, can have a profound impact on the long-term performance of a built asset, such as a tunnel, and also on the cost of a project. Similarly, as an educator, it is essential to impart knowledge to students that helps them develop their interest and stimulates thought on the 'what ifs' of construction.

What is the most innovative advancement that you have seen in materials science engineering?

My observations of innovative advancement have been focused on the increasing awareness and significance of sustainability, and the impact of the use of resources and energy. This is not so much innovative in terms of materials, but innovative in terms of how people think. The development of clean energy, such as solar power, is an area into which materials scientist can contribute.

How can the University of Western Sydney assist young graduates?

The University of Western Sydney can help young graduates by ensuring that the curriculum is focussed on the needs of the broader industry. A stand-alone degree in materials science is not offered at the University of Western Sydney, but materials science is a core subject within the Construction Management degree. This subject focuses on construction materials, so the content is less about the fundamental properties of materials, and more about the performance, specification and durability of materials such as concrete, steel and coatings. The challenge is to impart sufficient knowledge to students about how these materials behave in the built environment.

Construction Management is a degree that was developed to facilitate project management in construction. It combines management, law, business, engineering technology, and material science. I believe that education is a discipline that needs to be grounded in the passing on of knowledge, and that also creates a mindset for innovating and problem solving.

What piece of career advice would you give to today's materials graduates?

I would suggest that they keep an open mind on where they take their career. If I had been told, 25 years ago, that I would be on a construction site, solving problems associated with the curing temperature of concrete, or finding the cause of corrosion in high-tension cables, I would have been puzzled. The transition from a lab coat to a safety helmet and high visibility vest is not a great leap, but it does require a sound, solid undergraduate education.

What does the future hold for your industry?

There are fewer opportunities in manufacturing industries than when I was a student in the 1980s and 1990s. This is an economic reality within Australia. From my observations, research into clean energy and sustainable materials is most likely the future of the industry. Research into the science and engineering of materials will remain strong, so long as there is progress. Personally, I believe that the construction industry offers incredible career potential for materials scientists and engineers.

The University of Western Australia: Taking on Projects of Global Significance

THE UNIVERSITY OF WESTERN AUSTRALIA
Achieving International Excellence

Source: Sally Wood

The University of Western Australia (UWA) offers education and research across a number of different engineering disciplines, including materials, mechanical, chemical, mechatronics, petroleum, oil and gas, and asset management.

UWA is one of Australia's elite Group of Eight research-intensive universities. It's research teams have established global partnerships with leading industry players and attract a research income of more than $27 million per annum. It is no surprise that UWA takes on projects of global significance, from inventing a needle mocroscope to pinpoint cancer cells, to creating safer designs for oil and gas pipelines.

Not only does UWA have a distinguished 100 year history, and has been ranked as one of the world's top 100 universities, it is also well underway with a $250 million investment program that includes a revolutionary new Engineering Zone. Once complete, this will reinforce the University's reputation as an international engineering centre of excellence.

UWA has close relationships with a variety of industry partners including Apache, BHP Billiton, Chevron, Clough, Lycopodium, Monadelphous and Rio Tinto. These industry links provide a range of employment and research opportunities.

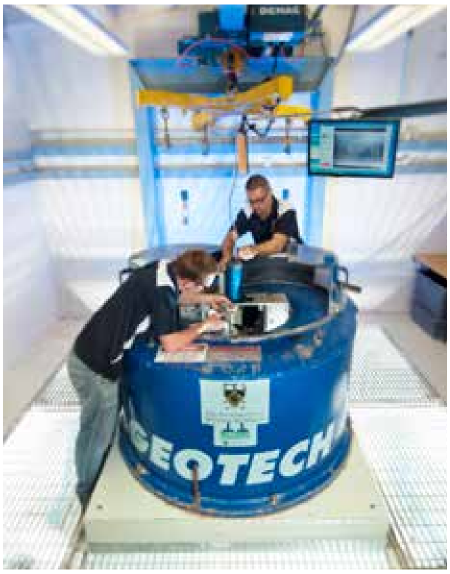
Materials Research

UWA is currently undertaking a wide variety of materials research, covering the design of sensor and actuator systems, friction, and wear. Current research areas include:

- Hardware and software for active noise and vibration control systems
- Adaptive signal processing, control, and filtering
- Acoustic and vibration transducers and instrumentation
- Room acoustics for improving sound quality
- Optimising techniques for sensor and actuator placement

Functional Materials Research

Functional materials are also known as intelligent or smart metals. Research at UWA is currently focused on shape memory alloys, and magnetoelastic materials. These materials are used in a wide spectrum of applications with innovative designs in the fields of medical technology, car manufacturing, space and aeronautical engineering, sports products and robots.



Super Nanowire Composite Solves 'Valley of Death' Riddle

Materials research facilities at UWA recently led to a world first; a team of researchers from Australia, China and the US created a super strong metallic composite by harnessing the extraordinary mechanical properties of nanowires.

Co-author and Head of the School of Mechanical and Chemical Engineering at UWA, Winthrop Professor Yinong Liu, said the work has effectively overcome a challenge that has frustrated the world's top scientists and engineers for more than three decades, nicknamed the 'valley of death' in nanocomposite design.

"We know that nanowires exhibit extraordinary mechanical properties, in particular ultrahigh strengths in the order of several gigapascal, approaching the theoretical limits. With the fast development of our capability to produce more in variety, more in quantity and better in shape and size of nanowires, the chance of creating bulk engineering composite materials reinforced by these nanowires has become high," Professor Liu said. However, all the attempts to date have failed to realise the extraordinary properties of the nanowires in bulk materials.

Professor Liu says the problem is with the matrix: "In a normal metal matrix-nanowire composite, when we pull the composite to a very high stress, the nanowires will experience a large elastic deformation of several per cent. That is OK for the nanowires, but the normal metals that form the matrix cannot. They can stretch elastically to no more than 1 per cent. Beyond that, the matrix deforms plastically," he said.

Plastic deformation damages the crystal structure at the interface between the nanowires and the matrix. In this regard, the properties of the composite are limited by the properties of the ordinary matrix, and not determined by the extraordinary properties of the nanowires.

"The trick is with the NiTi matrix," Professor Liu said. "NiTi is a shape memory alloy, a fancy name but not totally new. It is no stronger than other common metals but it has one special property that is its martensitic transformation. The transformation can produce a deformation compatible to the elastic deformation of the nanowires without plastic damage to the structure of the composite. This effectively gives the nanowires a chance to do their job, that is, to bear the high load and to be super strong. With this we have crossed the 'valley of death'!" Professor Liu said.

Using this idea, the researchers have created composite materials that are twice as strong as high strength steels, that have elastic strain limits up to six per cent - which is 5-10 times greater than the elastic strains of the best spring steels currently available - and a Young's modulus of ~30 GPa, which is unmatched by any engineering materials so far.

The breakthrough opens the door for a range of new and innovative applications. The very low Young's modulus matches that of human bone, making it a much better material for medical applications such as implants, for example. The ability to produce and maintain extremely large elastic strains also provides an unprecedented

opportunity for 'elastic strain engineering', which could lead to improvements in many functional properties of solid materials, such as electronic, optoelectronic, piezoelectric, piezomagnetic, photocatalytic and chemical sensing properties.

Inspiring High-Impact Science

UWA's $40 million world-class Centre for Microscopy Characterisation and Analysis (CMCA) is an inspiring collaborative research facility with 13 core co-located capabilities. Supported by an intellectual hub of expert scientists, the CMCA is a unique analytical facility that supports cutting-edge research in biological, biomedical, geo-environmental and physical sciences, with strong relevance to the energy and minerals sector.

The Centre's application in earth and environmental sciences focuses on analysing and characterising minerals, rocks and soils. Its high-impact capability supports Australian industry in a broad range of areas. Among its achievements, it has conducted atomic-level analysis to understand new generation steels, contributed to alumina-based R&D projects, helped identify and validate new mining exploration methods, and assisted in 'cracking' methane gas.

The facilities that the CMCA offers include:

- Ion Probe Facility
- Scanning Electron Microscopy
- Electron Probe Micro-Analysis with Spectroscopic
- Cathodluminescence
- Flow Cytometry
- Transmission Electron
- Microscopy
- Optical and Confocal Microscopy
- Scanned Probe Microscopy
- Bioimaging Facility
- Visualisation
- Specimen Preparation
- Mass Spectrometry
- Nuclear Magnetic
- Resonance Spectroscopy
- X-ray Diffractometre

The Energy and Minerals Institute

The UWA Energy and Minerals Institute (EMI) is the gateway for industry to engage with UWA's world-class research and facilities. Through engagement and collaboration, EMI facilitates the University's energy and minerals research partnerships – addressing industry needs by bringing together the right expertise.

Deep Water Engineering

Capable of reproducing the behaviour of complex seabed sediments, UWA's world-class centrifuge facilities support industry with geotechnical design for structures such as pipelines, anchors, foundations and jacket foundations.

The facility supports leading research into offshore foundation systems, including the mechanics of seabed sediments, geo-hazards and seabed mobility, and pipeline and deep water offshore engineering.

"In the past decade, the facility has deepened our understanding of the North West Shelf seabed and we are developing new benchmarks for deep-water engineering and exploration in the region," says Professor Christophe Gaudin at the Centre for Offshore Foundation Systems.

COFS was established in 1997 by Professor Mark Randolph to better understand Australian subsea soils and develop adequate foundation solutions. Backed by internationally recognised academics and strong technical expertise, the Centre is the only one of its kind in Australia and the only testing and modelling facility in the southern hemisphere to have both a beam and drum centrifuge.

The Centre has developed extensive links with industry and provides technical capability to exploration and petroleum companies around the world in all aspects of safe and economic foundation design and operation.

Exploration Technology Breakthrough

Persistence and collaboration, combined with world-leading science, has helped UWA and Rio Tinto develop the VK1 airborne gravity gradiometer – an advanced piece of exploration technology designed to detect otherwise invisible, buried ore bodies

Operating from an aeroplane, VK1 is a next-generation airborne survey system. The technology measures subtle changes in the Earth's gravity field, from which it produces a density map that identifies the presence of ore bodies.

Some 30 years in the making, two VK1 systems have undertaken initial flight trials near Perth, and more comprehensive trials are planned this year. VK1 components are built within UWA's Physics Workshop. VK1 is named after UWA Physicist Dr Frank Van Kann, who invented the technology.

Advanced functional materials at the University of Tasmania:

Source: Faculty of Science, Engineering and Technology (SET)

A Faculty where world leading research comes naturally

Within the University of Tasmania, Faculty of Science, Engineering and Technology (SET), we are committed to research and innovation, and to providing our students with access to world-class facilities and an exceptional educational experience. A focus on transformative research encourages our staff and students to see beyond the laboratory and maximise the future societal benefits of their work. The School of Physical Sciences within the Faculty of SET is home to the Disciplines of Maths, Physics, Earth Sciences and Chemistry, together with two internationally renowned research centres, the ARC Centre of Excellence in Ore Deposits (CODES), and the Australian Centre for Research on Separation Science (ACROSS).

Materials Science

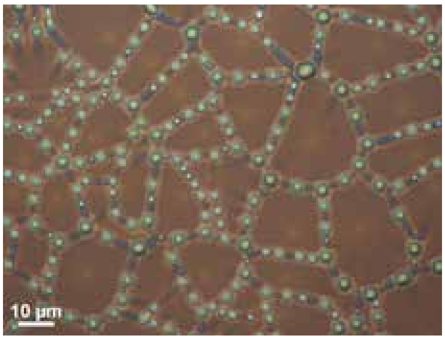
Materials science is the study of the design, synthesis, production and characterisation of new materials. As such, materials science underpins a vast diversity of society's needs, from the medicines we take, to the cars we drive, or the houses we live in. Within the Faculty of SET at the University of Tasmania, research into the production and characterisation of advanced functional materials covers a wide range of current and future applications, with projects ranging from synthetic chemistry of new polymers, fuels and pharmaceuticals, to the extraction and characterisation of natural products, or the patterning of nano-structured surfaces, and production of composite nano-carbons.

Porous Organic Polymers

Research into the development and characterisation of organic porous polymers, and their subsequent application in analytical science, is a particular strength within the Faculty. Examples include polymer monoliths and functional polymer nanoparticles, designed using a range of synthetic strategies, such as bulk polymerisation, high-internal phase emulsion polymerisation and cryopolymerisation techniques. These polymers have applications as scaffolds for sample enrichment and stationary phases within areas of separation science. In-house facilities for characterisation of such materials include size exclusion chromatography, mercury intrusion porosimetry, thermal gravimetric analysis and BET nitrogen adsorption (for further information contact Professor Emily Hilder).

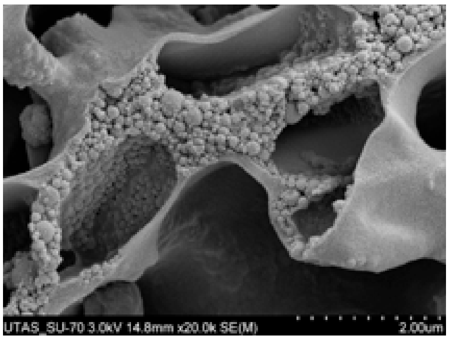
Nano-structured Surfaces

Patterned surface coatings have a number of potential industrial, medical and environmental applications. One such example is the ability to use such patterned surfaces to collect water directly from the atmosphere via the condensation of humidity. In this project, materials are being developed that are synthetic replicas of the surface of the Stenocara beetle, which possesses a patterned exoskeleton that enables it to collect drinking water from the atmosphere in environments



Patterned surfaces.

where there is minimal groundwater. The creation of a patterned surface is achieved by the use of two incompatible polymers (one highly water repellent, the other water loving or hydrophilic) that phase separate when prepared as a surface coating, yielding a material that consists of a random array of bumps across the surface. These materials could be used as a method of localised water collection in urban environments, and are currently being investigated for optimisation of performance, as well as scale-up and manufacture considerations (for further information contact Dr Stuart Thickett).



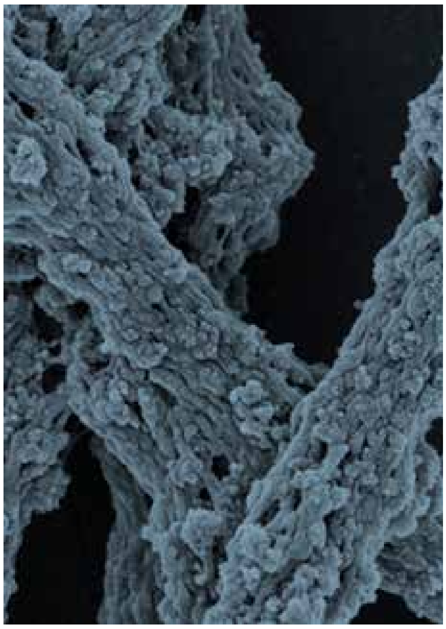
Porous polymers.

Nano-Carbon and Carbon Composites
Detonation nano-diamond is a nano-carbon material with excellent mechanical and optical characteristics. It has numerous potential applications. The material exhibits excellent thermal conductivity and an absence of cytotoxicity, hence the potential application of this material in nano-medicine, nano-photonics, and nano-bionics is generating considerable interest. Recent work within the Australian Centre for Research on Separation Science has focussed upon nano-diamond production and purity, including development of new microwave assisted purification technology, and investigations into precise elemental composition of detonation nano-diamond using inductively coupled plasma (ICP) mass spectrometry. Carbon composite materials are also under development, incorporating nano-carbons of various kinds. Carbon and nano-carbon porous monoliths have been developed incorporating fullerenes, nano-diamonds, or nano-onions (for further information contact Professor Pavel Nesterenko).

Synthetic Materials for Everyday Living
Research into synthetic chemistry-based materials is focussed on a range of topical, fundamental and applied projects, including the development of catalysts or processes for the functionalisation or synthesis of organic frameworks. These span many applications, such as the synthesis of complex molecular scaffolds, novel surface-based and bulk polymeric materials to the selective oligomerisation of ethylene to upgraded petrochemicals. Computational chemistry makes a strong, parallel contribution to the design of new catalysts and understanding catalyst function and structure-activity relationships of the organic targets in an efficient manner. These projects draw heavily on expert usage of advanced spectroscopic, diffraction and computational facilities at the University of Tasmania and regular access to national infrastructure facilities (for further information contact Associate Professor Michael Gardiner).

Australian Centre for Research on Separation Science (ACROSS)
Research within ACROSS involves the study of fundamental processes and materials for the separation, isolation and quantitation of individual chemical species, or classes of chemical and biochemical compounds, from within multi-component mixtures and/or complex matrices. As such, it finds application in almost all of the chemical and biological (life) sciences, and in many areas of chemical engineering, and indeed industrial manufacturing. Separation science spans the spectrum between nanoscale technology and exploration, and macroscale materials and application, with common elements of theory and implementation. Further and greater advances in separation science are seen as an important driver behind a broad spectrum of Australian science for the foreseeable future, ranging from new developments in nanotechnology, to novel biomaterials, to improved manufacturing processes (for further information contact Professor Brett Paull).

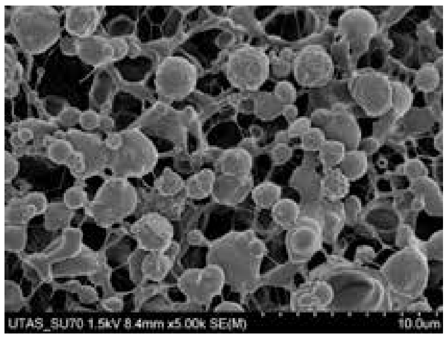
Central Science Laboratory (CSL) - Pioneers in centralised analytical facilities
The Central Science Laboratory provides research level analyses of materials across a wide range of disciplines. The centralised



Nano-diamond/PAN polymer composite fibres.

facility is staffed by application experts, most of whom are research fellows, and houses an array of atomic, molecular and microscopy analytical instruments and techniques, including FT-vibrational spectroscopy (NIR, Mid -IR and Raman with confocal microscope capability), ICP mass spectrometry, organic mass spectrometry, isotope ratio mass spectrometry, elemental analysis, high resolution scanning electron microscopy, electron microprobe X-Ray analysis and 600 MHz nuclear magnetic resonance spectroscopy (for further information contact Dr Evan Peacock).

The majority of the research undertaken at the University of Tasmania is supported by the Australian Research Council. The University of Tasmania is a research node of the ARC Centre for Excellence in Electromaterials Science (ACES). The School of Physical Sciences is based within the Faculty of Science, Engineering and Technology, upon the Sandy Bay Campus of the University of Tasmania, in Hobart. For Further information, visit www.utas.edu.au/science-engineering-technology.



Nano-particles for drug encapsulation – Courtesy of CSL.

MATERIALS
AUSTRALIA

Materials Australia Magazine's 2014 Features List and Deadlines

Materials Australia has planned the following features for 2014, designed to highlight different disciplines and sectors of the Materials Community.

Our aim is to publish a relevant, interesting and current magazine for those involved in all aspects of Materials. These features attract attention from the right audience and if your business is active in one of these areas, then you will want to be involved.

We offer your company the opportunity to promote your business directly to decision makers in the Materials Community.

Materials Australia also encourages members to contribute to our magazine and we will consider all editorial contributions.

December 2014

Power Generation. Materials for Energy: Solar, Wind & Wave Energy.

Content Deadline: Friday 21st November 2014

Advertising Deadline: Friday 21st November 2014

With the next edition of Materials Australia magazine currently in production, now is the time to consider advertising with us.

For further details, please contact: Gloss Creative Media Pty Ltd
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1
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