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AUSTRALIA AND CHINA:
SCIENCE AND TECHNOLOGY WEEK
中澳科技周

The artwork on the cover of this commemorative book and throughout *Partners for a Better Future – Australia and China: Science and Technology Week* depicts strong symbols of both Australian and Chinese culture. The colours and images reflect upon each country's traditions and folklore, and have been brought together in a contemporary way, signifying movement and change. The red background symbolises success and prosperity, while the yellow and ochre dots are indicative of indigenous Australian art and the Aboriginal culture. The dragon and the kangaroo are both powerful icons within their respective countries. They symbolise strength, power and protection. The two creatures are shown to be travelling side by side across the page, as if on a journey together. This represents the collaborative journey that Australia and China are undertaking within the fields of science and technology; moving forward, working together towards a better future.

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SHANGHAI WORLD EXPO 2010

This publication celebrates thirty years of Australia-China scientific cooperation catalysed by Australian and Chinese government investment.

Thirty stories for thirty years

This book is a snapshot that demonstrates the extent and nature of Australia China collaborations which range from keyhole heart surgery saving young lives in Guangzhou, to satellites monitoring Australian bushfires; from tracking pre-dynastic trade to exploiting new coal reserves with zero emissions; from light weight alloys for cars to improved rice crops.

These are just a sample of the many successful partnerships between Australian and Chinese researchers over the past thirty years for the mutual benefit of our two nations and the world.

For further information on these stories visit **http://www.innovation.gov.au/Section/science/Pages/CollaborationwithChina.aspx**

Partners for a better future

Australia and China Science and Technology Week
Shanghai World Expo 2010

Australia and China share a strong, longstanding, and productive science and research relationship. Each country brings world-class scientific strengths and complementary intellectual traditions to this relationship.

China is one of Australia's key research partners. We have made significant investments in joint research over many years. This has nourished the relationship and given rise to many exciting new discoveries.

This year is the thirtieth anniversary of formal government-to-government collaboration on science and technology between Australia and China. Agencies in both countries have joined forces to celebrate the occasion, including Australia's Department of Innovation, Industry, Science and Research, and China's Ministry of Science and Technology.

This publication provides a snapshot of the benefits that have come from this partnership, capturing and celebrating the strength and breadth of the Australia-China bilateral relationship over time.

Partners for a Better Future – Australia and China: Science and Technology Week at the Shanghai World Expo 2010 brings together eminent scientists from both countries.

The program covers topics of critical importance to China, Australia and the world, including astronomy, climate change science, biotechnology and nanotechnology. Participants will be able to discuss their research activities, exchange information, and explore new opportunities for cooperation.

China and Australia are partners for a better future, dedicated to generating and applying knowledge that will deliver improved economic, social and environmental outcomes for all. Together, Australian and Chinese researchers are helping to address the global challenges of climate change, food and resource security, environmental sustainability, and health and wellbeing.

This is just the beginning. We look forward to many more decades of scientific cooperation and engagement.

Senator Kim Carr

Australian Minister for Innovation, Industry, Science and Research

贺信

值此中国与澳大利亚科技合作协定签署30周年之际，我谨代表中国科技部向中澳两国广大科技人员表示热烈的祝贺和诚挚的问候。

随着世界科技发展步伐日益加快，科技合作已经成为各国经济、社会和科技发展的重要引擎。中国政府与澳大利亚政府早在上世纪80年代就签署了科技合作协定，30年来两国科技人员、研究院所、高校和企业之间建立了深厚的友谊和良好的合作关系。两国政府高度重视科技合作与交流，不断增加科技合作支持力度，创新合作机制和模式。科技合作与交流为两国关系、人文交流和经贸合作发挥了不可替代的作用。 同时，为两国与世界各国开展更广泛的合作奠定了坚实的基础。

我相信，在两国政府更加有力的支持下，通过广大科技人员和企业家的积极参与，中澳科技合作将会迎来成果更加丰硕的未来。

祝2010年在上海世博园举办的“中澳科技周”圆满成功！

万钢
中华人民共和国科技部长

On the occasion of the 30th Anniversary of the China-Australia Agreement on S&T Cooperation, I would like to give my warmest congratulations and regards to our scientists.

As the pace of S&T development accelerates, cooperation in science and technology has become the driver of economic, social and scientific development. Early in the 1980s, the Chinese and Australian Governments concluded this important agreement on Scientific and Technological Cooperation.

The foregoing three decades witnessed the deepening friendship and sound collaborative relationship among our scientists, academies, universities and enterprises. The two Governments attached great importance to this relationship by constantly increasing input and innovating the mechanism and modes of cooperation. This cooperation has played an irreplaceable role in promoting the bilateral relations, people to people exchange and economic & trade cooperation. Meanwhile, this cooperation has laid a solid foundation for our two countries to engage more widely with other countries in science and technology cooperation.

It is believed, with the increasing support of our governments, and more active participation of the science, academia and business communities, China and Australia will embrace a more fruitful cooperation in the future.

I wish the Australian Science Week in Shanghai Expo 2010 a complete success.

WAN Gang

Minister
Ministry of Science and Technology
The People's Republic of China

Contents

Thirty stories for thirty years

Keyhole surgery reduces sudden death in children

Chinese and Australian medical researchers are collaborating to find better solutions to the problems of heart disease for the developing world.

Professor Lexin Wang from Charles Sturt University (CSU) in regional New South Wales is working with his colleagues at Liaocheng People's Hospital in Shandong Province and Guangzhou Red Cross Hospital in Guangdong Province to reduce child mortality and recovery times.

In the past decade, international teams managed by Professor Wang, who leads the Cardiovascular Research Group at CSU, have developed innovative keyhole surgery solutions to two congenital heart problems—hole in the heart and long QT syndrome, a nerve condition that leads to an irregular heartbeat. The new surgical intervention has reduced the death rate in children with these conditions by 95 per cent, and more than halved the post-surgical recovery times.

"The work has application across the world because of the huge cost savings that keyhole surgery can bring. The operation is cheaper and simpler than conventional techniques and reduces hospital stays and recovery times. The greatest benefit is in patients from developing countries such as China, as it makes surgery affordable."

"As chief investigator, I bring the team together. We do the clinical trials on patients in hospitals in China, analyse the data and then publish them. We have also had input from thoracic surgeons from Taiwan, Italy and the United States," says Professor Wang, who trained as a cardiologist at Peking University and Royal Perth Hospital.

Dr Zengshan Ma leads a surgical team at Liaocheng People's Hospital watched by three Australian students (CSU)

Born in crisis, now delivering global dividends

When a massive earthquake hit China's Sichuan Province in 2008, Australian remote sensing expert Associate Professor Linlin Ge from the University of New South Wales (UNSW) activated his own emergency response. He sought help from the Japanese Earth Remote Sensing Data Analysis Center.

The Japanese responded by offering immediate access to their Advanced Land Observation Satellite, downloading images of Sichuan's quake-ravaged terrain day and night. Coordinated by Dr Ge, teams from Australia, Japan and China worked 24 hours a day capturing and interpreting the satellite data, and guiding Chinese rescue and reconstruction teams to the worst-affected areas.

When Australia's Victorian bushfires struck in 2009, China reciprocated, offering two satellites with optical and infrared sensors to monitor fire behaviour on the ground. Dr Ge again led the effort providing information to Australian response agencies around-the-clock.

This combination of UNSW's fast-response Interferometric Synthetic Aperture Radar technology and crisis-monitoring on the ground from China's remote sensing satellites quickly captured international interest.

By the time massive floods hit Queensland and New South Wales in 2010, the UNSW team had a galaxy of satellites on offer—from space agencies in China, Italy, Germany, Canada, the United States, Japan and Europe. What had begun between Australia and China as a spontaneous partnership born in crisis is delivering global dividends.

A formal partnership has now been signed between the China Earthquake Administration, the National Research Centre of the Chinese State Administration of Work Safety, the Australian Cooperative Research Centre for Spatial Information, the New South Wales Land and Property Management Authority, and UNSW allowing ongoing Australian access to Chinese satellites.

Chinese satellites monitored fire behaviour during Australia's Black Saturday fires

Launching millions of insects into cyber-space

Two of the world's largest insect collections are now in cyber-space boosting knowledge of insect species and their contribution to global biodiversity.

More than 12 million specimens of Australia's National Insect Collection at the CSIRO in Canberra, and a further 3.6 million in China's national collection at the Institute of Zoology in the Chinese Academy of Sciences, Beijing, are now available through the Australia-China Virtual Taxonomic Laboratory.

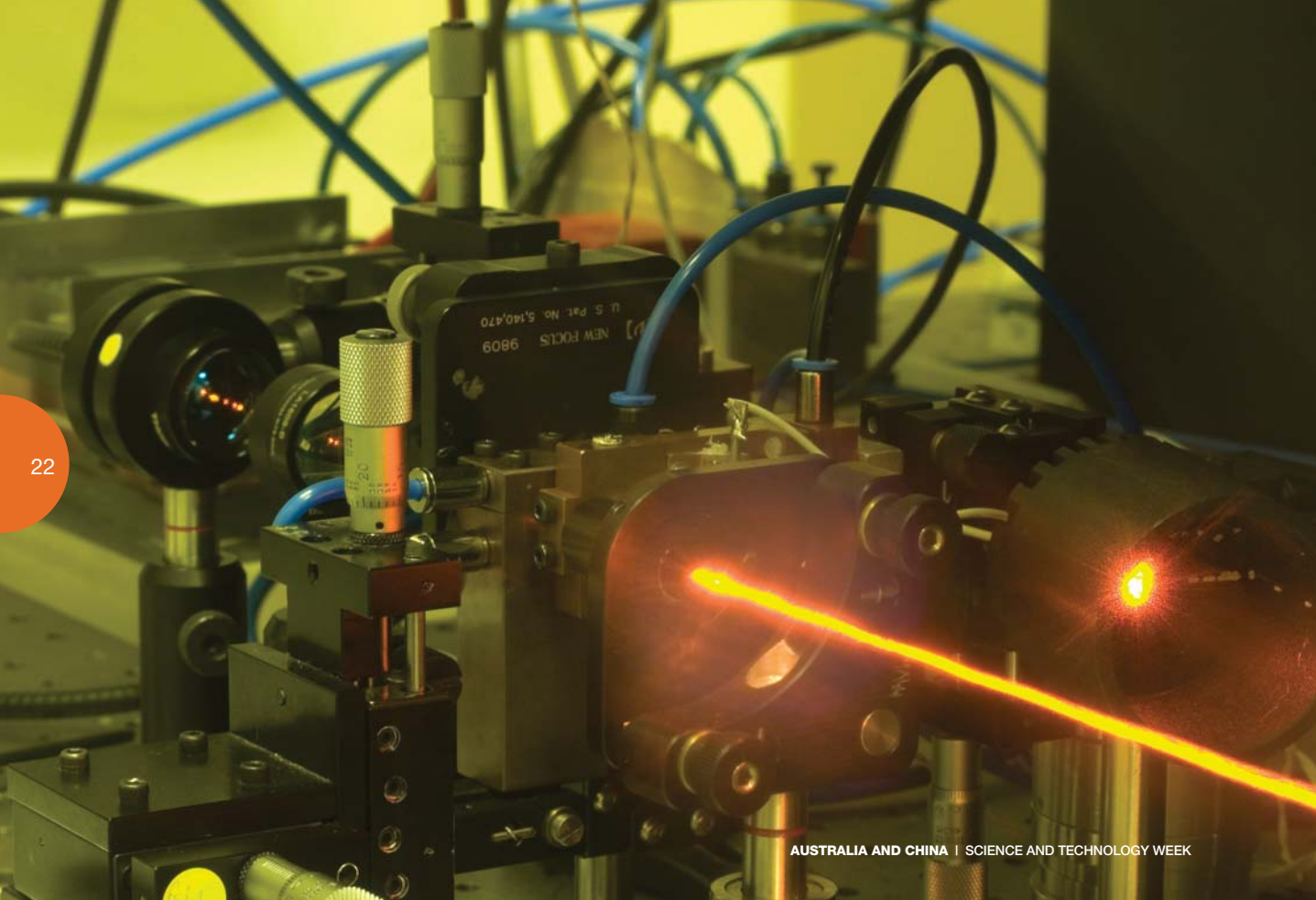
Entomologists, taxonomists, scholars and students at both institutions can now study insects in either collection from their laboratories in Canberra and Beijing with remote microscopes equipped with web-based cameras. They can see close-up and in real-time the same insect their colleagues or supervisors are viewing at the other end.

This should revolutionise the way taxonomy is done, says co-founder, Dr John La Salle, who is head of the Australian National Insect Collection. It should increase sharing of knowledge about insect species and make scientific classification more efficient.

"It's about accelerating the way we deliver information, to help inform the decisions governments make on the big issues, to help quarantine and pest managers identify new or invasive pests, or just to help you know what to do to keep the praying mantis and ladybugs in your garden."

The virtual laboratory is also linked to the *Atlas of Living Australia* project, another collaborative initiative encouraging free access to Australian biodiversity information online. This will eventually expand to welcome other taxonomic institutions throughout the Asian region and then globally.

This moth, *Tetrachroa edwardsi*, is one of 12 million specimens made available through the Virtual Taxonomic Laboratory (CSIRO)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Yellow laser to improve health

Australian and Chinese researchers are developing new, energy efficient, yellow lasers for bio-medical purposes, especially instrumentation and the treatment of eye and skin disease. Yellow light is preferred because it matches the absorption of human blood. Yellow lasers however have been difficult to make, expensive, and limited in power.

The researchers have now bypassed the problem by using crystals which modify the colour of the laser.

In Raman lasers, light of one colour or frequency is shifted to another by shining it through a crystal, in this case a crystal of tungstate which occurs in many forms.

"Our partners at Shandong University are world experts in growing these tungstate crystals," says Macquarie University innovation fellow Dr Helen Pask, a member of the team. "We are world experts in building Raman lasers. We are working together to specify the material properties that are required to make a good Raman laser, and they are then growing the crystals."

Most of the collaboration so far has centred on reciprocal visits, discussing ideas and planning the work.

"The idea is to develop new materials to expand our capabilities. In the end, it will mean we can do certain things better, more efficiently, and more robustly."

The researchers have already developed new crystals which have been evaluated and determined to be effective lasers. They hold the possibility of reaching new wavelengths (colours), says Dr Pask, and also of building much more powerful lasers at the existing wavelengths.

Chinese crystals will be at the heart of new yellow lasers (Macquarie University)

Laying natural gas pipelines faster

China needs natural gas to support its economic development. Much of that will come from Australia's vast natural gas resources deep under the Indian Ocean, and from China's own off-shore gas fields.

Laying undersea pipelines is expensive. The gas industry is always on the lookout for ways to weld pipes together faster, and to ensure that the welds do not corrode.

Researchers at The Institute of Oceanology, Chinese Academy of Sciences in Qingdao, Shandong Province, and Curtin University of Technology in Perth, Western Australia have combined their skills—in stress corrosion and carbon dioxide corrosion respectively—to tackle the problem.

They are investigating how weldable martensitic stainless steel alloys corrode. These alloys are increasingly being used in undersea pipelines off Australia and China because they are less expensive than previous alloys.

Martensitic alloys have an important drawback. They must be heat-treated to harden them immediately after welding to prevent susceptibility to corrosion.

The researchers are analysing the metal content and structure of the welds with a battery of microscope and electrochemical techniques. The aim is to unravel the mechanism of corrosion and modify the alloy mix so heat-treatment can be avoided.

"A laying barge costs $250,000 a day just for being there," says Professor Rolf Gubner, from Curtin. "Post-weld heat treatment adds a minimum of 15 minutes to the welding process. If you can avoid this, you save a lot of money."

Researchers are developing ways of laying pipes faster to feed China's demand for oil and gas

Solar power and hot water from one affordable unit

Solar panels that generate either electricity or hot water are commonplace on suburban rooftops around the world. A collaborative project that linked Australian and Chinese researchers together with a US company has resulted in technology that fulfils both functions at once, cheaply and simply.

The collaboration was launched in 2009 by Professor Yiping Wang, Director of the Green Technology Centre, Tianjin University, Tianjin Province, along with Professor Andrew Blakers and Dr Igor Skryabin from the Australian National University. The new system is at prototype stage.

"It's a single rooftop box which addresses a household's energy needs—electricity and heat. Plus, it uses less roof area. We expect it to be very cost effective," says Dr Skryabin.

The breakthrough concept was to immerse the solar cells in liquid. The new technology is a sealed unit which uses mirrors to concentrate sunlight onto solar cells for electricity production. Behind the cells run water pipes that transfer the heat from the solar cells into hot water for the home below.

"We focused on a simple solution that most households can afford," Dr Skryabin says.

"The project benefited from our expertise in concentrator solar cells, from the expertise of Tianjin University in thermal modelling, and from the expertise of Chromasun Inc in system integration."

These thermal trough concentrators efficiently generate electricity and heat water (ANU)

Rice reveals its growth secrets

Rice is the only crop plant that can germinate, develop and function without oxygen.

How does it do that? Can we improve its ability? Can we teach other crops to germinate in low oxygen environments such as flooded deltas?

These are important questions which are being tackled by the Australia-China Joint Research Laboratory in Genomics and Nutriomics, a centre that's grown from an agreement signed in 2004 between Zhejiang University and the University of Western Australia.

There is much more at stake than scientific curiosity, says the centre's co-director, Professor James Whelan.

"We all need oxygen to live. This plant can do without it. If we find out how, we could teach other plants to grow in adverse circumstances like flooding—particularly plants like wheat and barley that are closely related."

"It may be possible to develop varieties of rice with good potential to survive in flood-prone areas like the river deltas of Bangladesh, India, Burma and Vietnam. As sea levels rise we may also need crops that can survive being covered with brackish waters."

The collaborators are also working to improve the uptake of natural soil nutrients in leached crop soils in China and Australia.

By combining the genetic and plant breeding expertise of the Chinese with Australian skills in plant biology and biochemistry, the partners can find biotechnological solutions to secure the region's future food production.

"It's in everyone's interests, to ensure food security across Asia," Professor Whelan says.

Exploring how rice can start to grow without oxygen (UWA)

Why do some people never get sick?

A multi-million dollar collaboration could lead to new treatments to strengthen our ability to fight disease. The collaborators are exploring the genetics of the immune system to understand what makes us more or less susceptible to infectious disease.

The project grew out of a conversation between young medical researchers on exchange and was launched as the Australia-China Centre for Phenomics Research in 2008.

Two years on, the researchers are ready to look at data on mutations in mice which increase resistance or susceptibility to a range of infectious diseases, in particular to avian influenza (bird flu). In almost all cases those mutations can be matched to equivalent human genes.

"We hope to identify targets for designing new treatments to boost the immune system against these diseases," says the Program Manager for the Centre, Dr Edward Bertram.

The plan is to induce point mutations in mice of a known genetic make-up and then test to see which mice become more or less susceptible to disease. The genomes of these mice are sequenced to identify the causative mutations, then mice carrying these mutations are again tested to validate the effect. Finally, the protein products of the altered genes will be studied to determine their function and how they work.

This major undertaking brings the expertise in mouse genetics of the John Curtin School of Medical Research and the Australian Phenomics Facility at the Australian National University, and The University of Melbourne, together with that of the Centre for Infection and Immunity, Institute of Biophysics, Chinese Academy of Sciences in Beijing, the Beijing Genomics Institute Shenzhen, and the Chinese National Avian Influenza Reference Laboratory in Harbin.

Chinese students working at the China-Australia Centre for Phenomics Research in Canberra (ANU)


C-G
A-T
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G-C
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A-T

Fast DNA testing at the crime scene

A portable DNA testing device that avoids the need for analysis in a laboratory could save time and money.

“Normally, DNA samples have to be transported back to the lab and need trained people using expensive instruments to conduct the analysis,” says Dr Danny Wong from Macquarie University who is collaborating with biosensor expert Professor Huangxian Ju at Nanjing University, Jiangsu Province, to develop the technology.

“We are developing a portable biosensor that anyone can use to conduct these analyses within minutes,” Dr Wong says.

The sensor detects DNA hybridisation, the process where two single strands of DNA bind to each other to form a double strand. The more closely related the two strands of DNA, the more strongly they bind.

One strand, the probe, is immobilised on the surface of an electrode and is exposed to a single strand of unknown DNA, known as the target. If they are closely related, the DNA will bind strongly, or hybridise. A label attached to the target DNA changes the level of current running through the electrode depending on the extent of hybridisation.

“This change in current is so very small, it is incredibly difficult to measure without generating experimental errors,” says Dr Wong. “To overcome this, we have developed a biosensor that gives an amplified signal.”

Not only does this technique have applications in forensic medicine and medical diagnosis, but it will also enable study of the interactions between DNA and viruses and bacteria.

Researchers are developing a portable DNA testing device for forensic and medical research


4

China and Australia team up for World Cup bid

WrightEagleUnleashed! is an international soccer team, but you won't find it in the World Cup or the Asian Champions League. WrightEagleUnleashed! is a robot soccer team—a joint venture of Chinese and Australian researchers and students combining their efforts in robotics research.

WrightEagleUnleashed! represents the union of two robotics teams. WrightEagle was the best Chinese team, and Unleashed! was the top team internationally in 2004. The two teams worked together to organise the first international robot soccer exhibition in China and then decided to combine the efforts of 16 scientific minds across both countries to create WrightEagleUnleashed!

The new team placed second in the standard platform (four-legged) league in the 2008 RoboCup World Championships in Suzhou, China. In 2010 the team entered the Nao League and came ninth at the 2010 World Championships in Singapore.

Teaching robots to play soccer is an interesting challenge, but the real purpose of the team is to strengthen the relationship between researchers and students in China and Australia and to generate new, exciting, cognitive robotics research. The team plays in the standard league, in which all teams work with the same hardware, so the team uses advanced software to outsmart the competition.

The team is a scientific partnership between the University of Science and Technology of China in Hefei and the University of Technology, Sydney. Guest professorships, student exchanges and public robot exhibition matches both in Suzhou, China and Perth, Australia have strengthened the relationship between the two institutions.

WrightEagleUnleashed! aims to defeat the world champion *human* soccer team by 2050.

Solar energy gets competitive

A $24 million, three-year Australian-Chinese collaborative research venture aims to produce technology to generate and sell electricity from the sun as cheaply as from coal.

Suntech Power Holdings Co Ltd is partnering with the University of New South Wales (UNSW) and Australian solar panel manufacturer SilexSolar to develop the technology. Suntech, the world's largest crystalline silicon solar panel company, was founded by Dr Zhengrong Shi and utilises technology co-developed with UNSW where he studied for his PhD.

The research team plan to move improvements in the efficiency of conversion from sunlight to electricity out of the laboratory and into the marketplace.

Using new cell surface designs and conventional silicon materials they expect initially to achieve at least 19 to 20 per cent efficiency—significantly greater than the current market standard of 17.5 per cent. And with the advent of cheaper new silicon wafers—the principal component of solar cell manufacture—they expect the new processing techniques to continue to provide excellent performance at lower cost.

"We elected to work with Suntech and Silex because we believe these companies have the greatest chance of commercialising this technology within the life of this project," says the Director of the Australian Research Council Photovoltaics Centre of Excellence, Professor Stuart Wenham. "We think we will pass the cross-over point within the next three years—beyond which solar power will be cheaper than the retail cost of electricity today.

"If we are successful, we would hope to see these cells on rooftops across all over the world, and also in very large panels for use in power stations."

In three years, solar cells could be producing electricity as cheaply as coal (UNSW)

Faster, greener wireless broadband

Little more than a year since it was launched, the Australia-China Research Centre for Wireless Communications has already developed a new kind of antenna for base stations and mobile devices. It can select the best band for communication before starting transmission.

It's the first of what Centre director Dr Jay Guo hopes will be a steady stream of enabling technologies to emerge from the partnership between CSIRO, the Beijing University of Posts and Telecommunications, and several other Chinese and Australian universities.

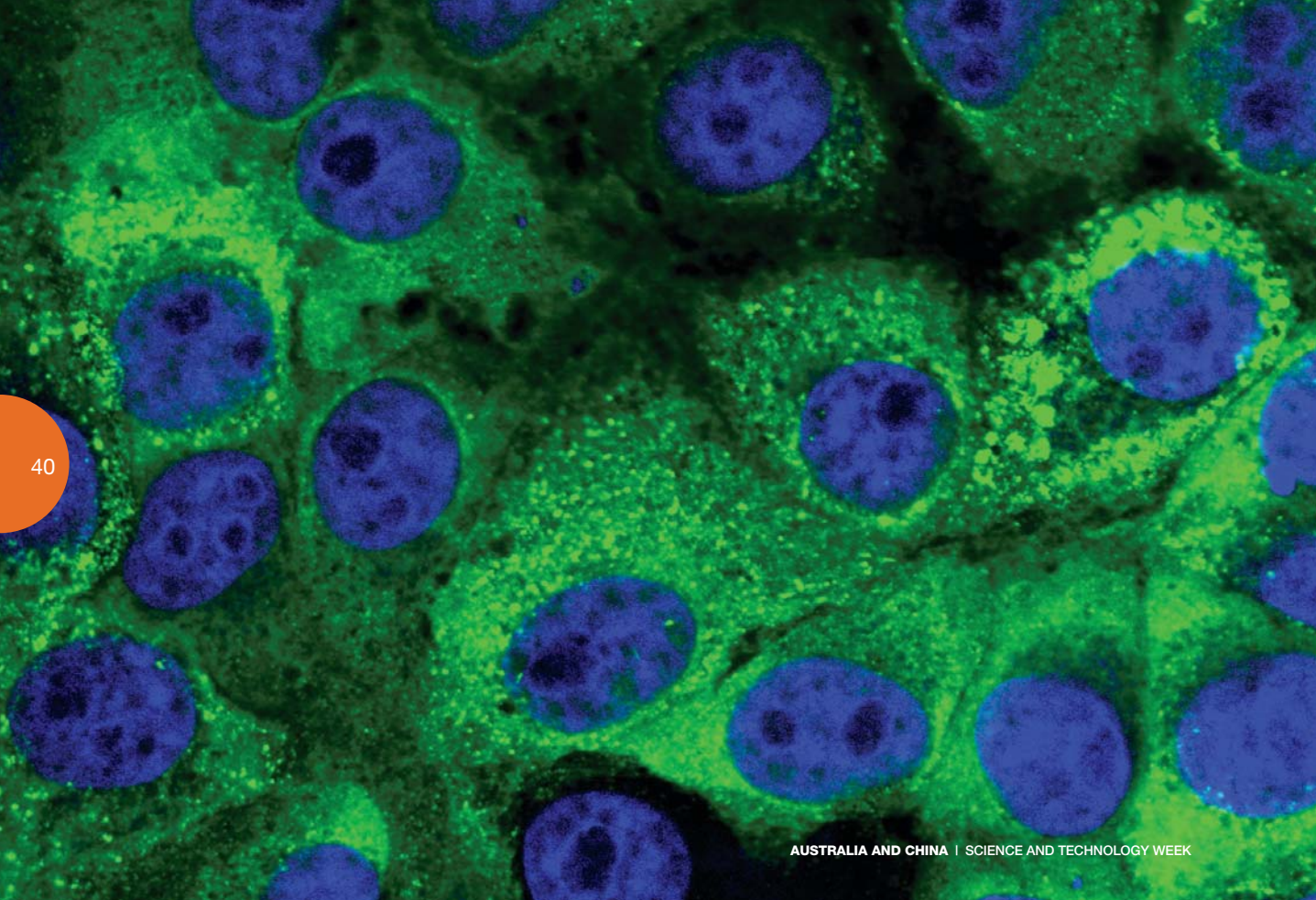
In 2011, the Centre will begin trialling the new antenna, he says, and by 2012 researchers will be testing 4G capabilities, sending data across the mobile and wireless system at rates which can support high definition video.

The collaboration is a good fit, Dr Guo says. "The Chinese work much more closely with mobile network operators than we do. They have a more system-based expertise. We build transmitters and receivers; they build network controllers and base stations."

The Chinese partners' strong industry links will help bring the new technology to market quickly.

One of the results will be a greening of mobile base stations. "We are focusing on reducing the number of base stations—not by increasing their power, but by increasing their efficiency. We will have fewer base stations. They will use smart antennas with the capability to transmit flexibly and efficiently across the whole wireless spectrum."

One of a new generation of antennae for wireless communication (CSIRO)



Working together against viral disease

The development of antiviral drugs is the core aim of an agreement recently signed between the Institut Pasteur Shanghai and the Institute for Glycomics at Griffith University's Gold Coast campus. The partners will focus their interests on a range of bloodstream, gut and respiratory tract viruses, including SARS, influenza and para-influenza.

"The Shanghai Institut has a strong infectious disease orientation, particularly in virology, and we are involved in structure-based drug design," says Professor Mark von Itzstein, director of the Griffith Institute, and a key developer of the Australian anti-flu drug Relenza. "Together we will be identifying key targets for structure-based drug discovery on clinically significant pathogens relevant to both Australia and China."

"They have already been working with us on the flaviviruses, which include dengue fever and Japanese encephalitis. We have made good headway in understanding the cellular carbohydrates which are recognised by the virus," Professor von Itzstein says.

"It turns out that a lot of these clinically significant viruses utilise carbohydrate-recognising proteins on their surface to cause infection and to propagate infection. The idea is to end up with a drug which can block these proteins, or indeed to identify vaccine opportunities."

To achieve their aims the two institutes have established joint laboratories in Australia and China to facilitate exchanges of student and post-doctoral researchers. The heads of both bodies have been appointed adjunct professors at their partner institution.

Rotavirus—the major cause of serious diarrhoea in children—infecting cells (Griffith University)

CHIM could hold the key to hidden ores

There was a time when a prospector might hope to strike it rich simply by panning for gold in a riverbed, but these days minerals exploration is a highly sophisticated business involving equipment at the forefront of technology.

Now, thanks to an exchange between scientists from the Guilin University of Technology, Guangxi Province, and other institutes in China with the Geological Survey of South Australia, both countries are sharing technology that could help in the hunt for economically valuable resources.

CHIM, prospecting wizardry using an electro-geochemical technique, was originally developed by Russian geochemists and uses an electric current and specially coated carbon electrodes placed in the soil to extract tell-tale signs of ore deposits from the behaviour of metallic ions.

As a result of a visit to China by Dr Baohong Hou, from the Geological Survey of South Australia in 2009, Australian companies are now testing a highly mobile version of the Chinese CHIM system developed by Professor Luo Xianrong of Guilin University of Technology.

"We brought this Chinese technology to Australia for trials, testing if it works in the Australian geological landscape," Dr Hou says. He hopes that CHIM's ability to see through soil and other material to the rocks below will open up Australia's exploration frontiers.

The Chinese scientists, meanwhile, are evaluating a night-time satellite thermal and spectral imaging developed in Australia for mineral exploration.

A mobile exploration technology could 'see through soil' to find mineral resources

Plants need fungal help to fight arsenic

Soil arsenic is a major problem in many parts of China. It stunts rice growth and accumulates in the grains, posing a health threat. Some crops such as upland rice, tomatoes and barley can cope well with arsenic. How? That's the question that the Joint Research Laboratory in Soil and Environmental Science—the brain-child of Professor Zhu Yongguan—is tackling.

The Laboratory was opened in 2002 by Professor Lu Yongxiang, President of the Chinese Academy of Sciences (CAS). It is a collaboration between the Research Center for Eco-Environmental Sciences of the Chinese Academy of Sciences in Beijing, and University of Adelaide soil scientists.

Professors Andrew and Sally Smith, working with Professors Zhu Yongguan and Chen Baodong of the CAS Research Center have discovered that the plants that can cope with soil arsenic have secret helpers: fungi that are associated with their roots and screen out the arsenic.

Soil arsenic is usually present as arsenate which mimics phosphate in the soil. Many plants have a symbiotic association with mycorrhizal fungi in their roots. These fungi collect and provide nutrients like phosphate to the plant in return for plant sugars. In the process they screen out the arsenate.

So the solution to soil arsenic may simply be to develop and use more crops with the right fungi in their roots.

Rice with symbiotic fungi in its roots can avoid arsenic poisoning

Driving stem cells from the lab to the clinic

Cancer, increasing the success rate of IVF, and developing stem cell banks, are all targets of a partnership between Australian and Chinese stem cell scientists that is revealing the true nature of stem cells and moving discoveries out of the laboratory and into the clinic.

Established in 2007, the Australia-China Centre for Excellence in Stem Cell Sciences connects the people, knowledge, and scientific technologies of Peking University and Monash University.

"Stem cell research is all about treating people. So, when you've got 1.3 billion people, the numbers of people turning up to hospital in China is a remarkable resource that has helped us. That's a resource that has helped us to more rapidly drive our pre-clinical research through to the clinic," says Professor Richard Boyd, who jointly leads the Centre with Professor Lingsong-Li head of the Peking University Stem Cell Research Centre.

Four interactive workshops have led to the formation of a number of collaborative pre-clinical and clinical research projects and commercial opportunities. The workshops have also extended the collaborative networks in China, leading to new nodes of the Centre being opened at Harbin Medical University and the West China Second University Hospital in Chengdu.

The team is now focusing on developing comprehensive stem cell banks, induced pluripotential stem cell therapy to model an individual's disease in a test tube, and genetically predicting the success of an embryo before implantation.

Testing a single cell for genetic disease (Dr David Cram, Monash University)


充矿集团调度指挥中心
鲍店主页
生产工况图
通风示意图

Using radio tags to improve mine safety

Seven miners die every day on average in China, so it is no surprise that scientists from China University of Mining and Technology (CUMT) and Royal Melbourne Institute of Technology (RMIT) University are working at improving mining safety through better monitoring of personnel and of mining activities underground.

“Mining safety is a key issue in China where the death toll per million tonnes of coal production is 50 times higher than in Australia,” says RMIT’s Professor Kefei Zhang who leads the study.

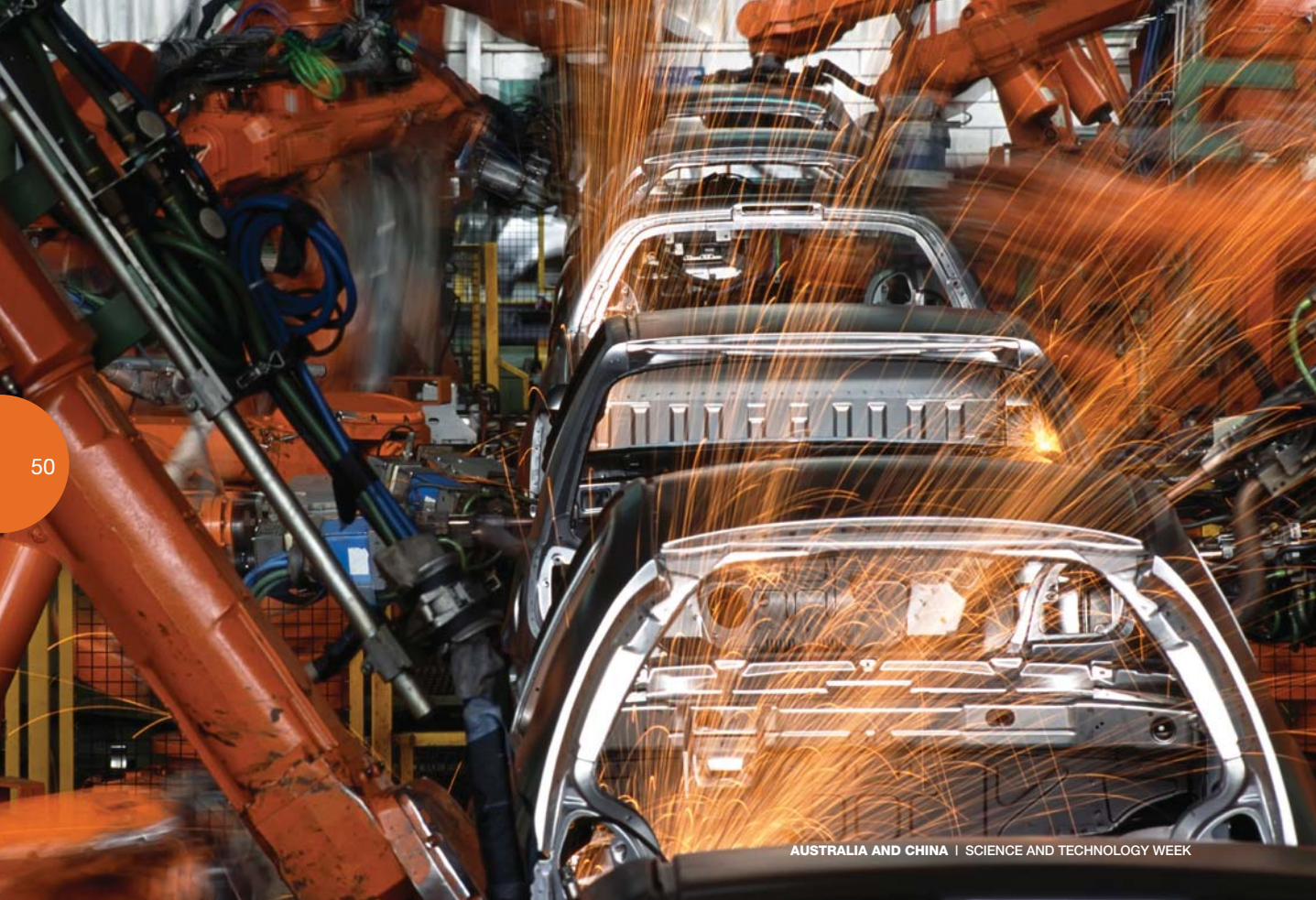
“We are trying to improve the monitoring systems so that we can pinpoint a miner’s position at any time—before, during and after any mining disasters.”

Current monitoring systems rely on closed-circuit TV cameras positioned around the mine but, as Professor Zhang says, they are of little use when the power supply is cut or the camera’s view is obstructed by falling debris. They are also expensive and difficult to automate.

Unlike satellite positioning systems such as GPS which only work above ground, the radio frequency identification (RFID) system doesn’t require physical contact or line of sight to collect data. Its signals are strong enough to penetrate through walls making them ideal for tracking systems in mines, especially when trying to locate miners after a disaster.

“CUMT have strong connections with the Chinese mining industry. This allowed us to visit mines and see the monitoring systems first hand. Our Chinese partners also have a detailed knowledge of the geographic information systems that are required to integrate the geospatial data with data from other sensors like gas sensors and radio communication systems,” says Professor Zhang.

An information control centre at work, monitoring miner safety (CUMT)



New alloys for cars and aircraft

Metallurgists at the Australia-China International Centre for Light Alloys Research are creating new alloys to assist the development of China's automotive and aircraft industries. They expect to be trialling new and hybrid aluminium alloys for use as body panels in cars and aircraft within two years.

The Centre is a partnership between the Aluminium Corporation of China Ltd (CHALCO) and Monash University.

Aluminium alloys offer the potential for lighter, more fuel efficient cars. But most car manufacturers still prefer to use steel, because while steel panels are heavier they are cheaper and easier to make. To date the use of aluminium has been largely restricted to prestige cars produced by companies such as Audi and BMW.

In addition, the existing aluminium alloys are covered by patents which restrict commercial opportunities. So the project partners are going back to basics and exploring the fundamentals of aluminium alloys. They are adding various combinations of magnesium and silicon to the aluminium in the hope of creating a new alloy with a nanostructured matrix that gives the desired balance between strength and formability.

"This is old-fashioned physical metallurgy, but it's also classic nanotechnology," says Professor Barry Muddle of Monash University, who leads the project.

The new materials will be licensed to CHALCO, with the intellectual property jointly owned by CHALCO and Monash.

"Coming up with completely new materials usually takes 10 to 12 years. We're only two years into the project and we're already talking about trialling the technologies," says Professor Muddle.

Their next step will be to look at improving fatigue and corrosion resistance in the aluminium alloy panels used in aircraft.

New aluminium alloys will lead to lighter, more fuel-efficient cars

Modified carbon nanotubes for early cancer detection

Australian and Chinese scientists are exploring ways of modifying and using carbon nanotubes to improve medical imaging. The project brings together Chinese skills in making carbon nanotubes and Australian expertise in polymer chemistry.

“After modification, nanotubes have unique properties which allow them to be drawn into diseased tissue and be imaged at high resolution,” says Dr Xiaojuan Hao from CSIRO Material Science and Engineering Technologies, who began working on the project earlier this year with Professor Jieshan Qiu from Dalian University of Technology, Liaoning Province, and Dr Tim Hughes also from CSIRO.

“If the nanotubes can be seen at high resolution in the body, it makes it possible to detect smaller tumours, and that can potentially lead to earlier treatment for patients.”

“We plan to make nanotubes that contain metal ions, so they can be detected with magnetic resonance imaging or we can make them absorb infrared radiation, so they are detected with optical imaging,” says Dr Hughes.

The Dalian researchers generate carbon nanotubes in the shapes and sizes required, introduce the metal ions and specially treat them to allow further modification. The team in Australia then modify them to improve their properties for imaging. Sticking different polymers and biomolecules onto the nanotube surface, for instance, can make them more soluble and can improve their ability to infiltrate diseased tissue and be picked up by imaging techniques.

The team also hopes to develop a drug delivery system in which modified carbon nanotubes can be used to administer drugs to specific disease targets.

Exploring new ways to modify carbon nanotubes to improve their properties for medical imaging (CSIRO)

Plants within plants harbour anti-cancer secrets

Chinese specialists in traditional medicine are guiding Australian microbiologists in a search for anti-cancer compounds within traditional Chinese herbal plants known for their medicinal qualities. They are not only looking in the plants themselves, but also in the microscopic bacteria or fungi living inside them known as endophytes.

In particular, bio-prospectors from the University of New South Wales Cyanobacteria and Astrobiology Research Laboratory and the University of Sydney's Cancer Immunology group believe the colonising endophytes may provide novel compounds which target multiple myeloma, a cancer of blood plasma cells.

They have turned their attention to Yunnan Province, which borders Myanmar, Laos and Vietnam, and are collaborating with the Key Laboratory of Pharmacology for Natural Products of Yunnan University.

"We wanted to do this with our Chinese partners in Yunnan, because they have a pharmacological background," says pharmaceutical chemist Ms Kristin Miller, a key member of the Australian team. "They can guide us in selecting the plants that have traditional medicinal use, because it's those plants that are more likely to contain the bioactive compounds."

"Our Chinese colleagues also have the biodiversity available to them, plants that are not available in Australia. We have some of these, but they're dried so the endophytes are dead, and we wanted to go where they're freshly harvested."

The collaboration sets the foundations for assimilating Western and traditional Chinese medicines in pursuit of new treatments for cancer, she says. "I'm sure we will find a lot of novel compounds."

Ms Miller, in the lab looking at endophytes which have been isolated from plants (UNSW)

Assisting the search for buried treasure

A computer model that simulates geological history has helped researchers and miners to generate a clearer picture of the formation of a gold deposit in southern China, improving the chances of finding similar ore bodies elsewhere. The computational system and results were demonstrated to the President of China, Hu Jintao, during his 2007 visit to Australia.

"It does not say precisely, 'Drill here or there'," says CSIRO principal researcher on the project, Dr Yanhua Zhang. "It is for geologists to use when they plan their exploration programs."

It can potentially save mining companies huge amounts of time and money by focusing their efforts on the right terrain.

The predictive system, which employs computer simulation technology, uses multiple sets of data from a region—such as geological, magnetic, seismic and chemical data. These data sets are then used to construct numerical models to simulate how minerals may have formed over time. Already the technology has been used to assist mineral exploration programs and the discovery of ore bodies in several regions of the world such as Shuikoushan, Hunan Province, and Stawell, Victoria.

The technology was developed by researchers from CSIRO, and its application in southern China involved collaboration with colleagues at the Guangzhou Institute of Geochemistry of the Chinese Academy of Sciences.

The system is continually being improved and, as a result of the project's success, Dr Zhang is now a member of a high level international group of geoscientists advising China on future collaborations.

The President of China Hu Jintao visited CSIRO and BHP Billiton laboratories in 2007 and met with CSIRO Chairman John Stocker (CSIRO)

Protecting grain crops naturally

Chinese and Australian grain farmers face a common enemy: three fungi that can devastate the roots and seedlings of their growing crops.

Researchers are looking to the soil itself for solutions in a collaboration that has brought three Chinese research laboratories together in partnership with Australia's CSIRO: Hebei Academy of Agricultural and Forestry Sciences, the Shandong Academy of Sciences and China Agricultural University.

They are investigating fungi and bacteria as natural counter-attack agents against the fungi 'Take-all', *Pythium*, and *Rhizoctonia*.

Their principal candidates are *Trichoderma* (a fungus), and *Bacillus* and *Pseudomonas* (both bacteria). *Trichoderma* was chosen for its capacity to suppress pathogens by infecting or parasitising them, or hitting them with antibiotic compounds that suppress growth. The two bacteria were chosen because they also produce antibiotics that inhibit pathogens.

The Chinese researchers have identified several types of antibiotics from these beneficial microbes, and their colleagues at CSIRO are working on related strains to identify the genes involved.

Spreading the genetic detective work across borders is simplified because the scientists have a shared history of collaborating on common diseases and the microbes that supress them, according to Australian team leader Dr Paul Harvey.

Another exciting spinoff is the potential for new sources of antibiotics for pharmaceutical use.

"The antibiotic potential of soil microbes is known, but because knowledge of soil biology is limited there is a diversity of new organisms and potential antibiotics waiting to be identified."

Researchers hunting for soil fungi and bacteria that can supress plant diseases (CSIRO/P. Harvey)

Bridging the terahertz gap

Fool-proof weapon scanners, harmless cancer screening, and the unveiling of long-lost artworks are a few of the many possible applications of terahertz radiation. Unfortunately, this useful part of the electromagnetic spectrum has proven elusive—difficult and expensive to generate.

Now researchers at the University of Wollongong in Australia and China's Shanghai Institute of Microsystem and Information Technology (SIMIT) have shown that artificial materials with strong spin-orbit coupling have the potential to generate efficient terahertz radiation. The project has laid the foundation for long-term collaboration between the two institutions in this important field.

The unexploited 'terahertz gap' lurks between microwave and infrared radiation at wavelengths of 0.1 and 1 millimetres. It can penetrate several millimetres of tissue and plastic, but is too weak to be dangerous.

"The main challenge is to find efficient emitters," says project leader Professor Chao Zhang, associate director of the Institute of Superconducting and Electronic Materials at the University of Wollongong.

Certain spintronics materials have strong spin-orbit coupling—where the spin of the electrons interacts significantly with the material's electromagnetic field, altering the frequencies of radiation it can absorb and emit.

SIMIT's state-of-the-art Molecular Beam Epitaxy (MBE) facility was used to grow just such a material. The terahertz radiation from spintronic materials has the bonus of tuneable frequency and intensity.

This Australia-China collaboration was built on the complementary expertise and facilities of the two institutions. The modelling and spectroscopy study was done at the University of Wollongong and material fabrication was carried out at SIMIT.

"It was a perfect match" says Professor Zhang.

An untapped part of the electromagnetic spectrum may offer safer medical scanning

Bitter melon could be good news for diabetes

Teams of scientists from China and Australia recently pulped a tonne of bitter melon, a cucumber-like fruit used in Asian and Caribbean cooking. From the residue they extracted four bioactive compounds, all effective in activating the enzyme AMPK, which enables glucose uptake. That may be good news for the world's 200 million type 2 diabetes sufferers.

It's all part of a collaboration between China's Shanghai Institute of Materia Medica and the Garvan Institute of Medical Research in Sydney, Australia, to investigate the healing powers of natural substances used in traditional Chinese medicines.

The program reflects a growing interest in alternative ways of targeting new therapies, says Garvan Institute Senior Research Scientist Dr Nigel Turner. "There has been a history of the use of these medicines over hundreds of years so there's already information about whether the compounds we're looking at have efficacy. We're saying, let's investigate it in more detail."

Chinese healers have long believed that bitter melon could assist in diabetes. Two years ago the research team confirmed that belief in a paper in the journal *Chemistry and Biology*. Now the researchers are investigating precisely how the compounds work—aiming eventually to find ways to mimic the action in an anti-diabetic drug.

As the work on bitter melons continues, scientists are also investigating therapeutic properties in other natural products long recognised by Chinese healers for their healing properties.

One key candidate is berberine, a natural compound present in plants, such as pepperidge bushes and goldenseal. Berberine also has anti-diabetic properties.

Bitter melon has active compounds that improved sugar uptake in mouse trials (Garvan Institute)

Cleaning up on coal

China is the world's largest coal user and Australia is the world's largest exporter of coal. Both countries came together in 2005 to form a China-Australia research alliance with the shared goal of strong interest in making better use of coal.

The collaboration is between Curtin University of Technology's Centre for Advanced Energy Science and Engineering and the State Key Laboratory of Coal Combustion at Huazhong University of Science and Technology (HUST) in Wuhan, China. The focus is on sharing ideas for cleaner and more efficient coal burning, and for better use of biomass, both woody and agricultural wastes, for producing electricity and chemicals.

Half a dozen joint projects on improving the utilisation of coal and biomass are already underway and attracting international attention. The collaboration has been reported at biannual joint symposia in 2007 and 2009, and has been of such interest that the symposia proceedings have led to special issues of *Energy and Fuels*, a high-impact international journal published by the American Chemical Society.

Both laboratories have a track record in developing low emission coal technologies and both have advanced research facilities.

"We are bringing together complementary skills, capabilities, equipment and state-of-the-art facilities," says Professor Hongwei Wu who studied at HUST and is now deputy director of the Curtin Centre. He has been an important catalyst of the venture.

In the past year these exchanges, symposia, and the sharing of information have led to the establishment of a virtual Joint Research Laboratory for Coal and Biomass Utilisation.

Repairing the hole in joint disorders

A painful condition of the jaw that affects 10 per cent of the Chinese population has stimulated Australian and Chinese bioengineers to develop an innovative approach to treating degenerative joint diseases, such as osteoarthritis.

The results of the work should provide valuable information on therapy for such conditions in other areas, such as the spinal cord, says Associate Professor Yin Xiao from the Institute of Health and Biomedical Innovation at Queensland University of Technology.

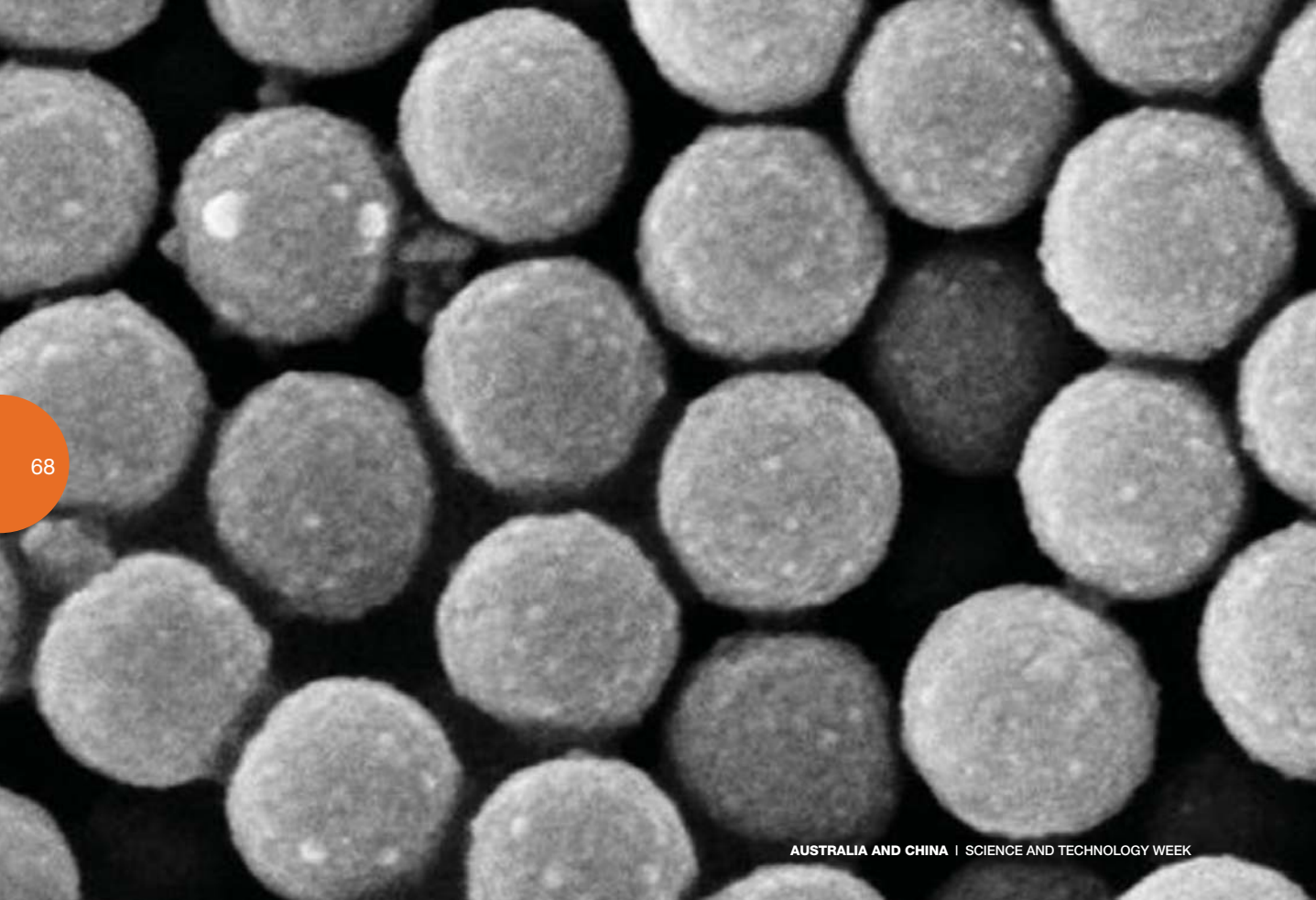
"In China, over 130 million people suffer from temporomandibular joint (TMJ) disorders where the joint disc between the jaw and the skull damages and develops a hole. Our Chinese colleagues at Wuhan University have very strong clinical links to help us develop novel therapeutics to treat this disorder."

Unlike typical finger joints or vertebral junctions, each TMJ actually consists of two joints, allowing it both to rotate and to slide. Over time, the bone and surrounding cartilage undergo natural wear and tear. In some people this can cause inflammation leading to constant pain even without moving the jaw.

There is a significant lack of understanding of TMJ disorders, Dr Xiao says. They are currently treated either by removing the disc entirely or using surgery to repair the hole. Neither of these interventions is particularly effective, according to Dr Xiao.

"We are working with Professor Xing Long from Wuhan University to develop a treatment where we generate stem cells, implant them in a collagen scaffold and deliver them to the site of tissue injury. It has already been tested in rabbits using samples from Wuhan University which were analysed here in Queensland, to develop a cellular treatment which will survive immune system attack."

This tissue engineered cartilage could help treat millions of people affected with a painful jaw condition (QUT)



Nanoparticles with a silver lining

Sulphur, ammonia and a pinch of salt could be the recipe for creating monitors to track pollution in China's great rivers.

Researchers at the China-Australia Joint Laboratory for Functional Nanomaterials have used these simple chemicals to solve a bottle neck in the creation of hybrid silver/plastic nanoparticles for biosensors.

"China is a big agricultural country where farm chemical-related persistent organic pollutants are a serious threat to health and the environment," says Professor Zhu Xianfang, director of the Joint Laboratory at Xiamen University, Fujian Province. "These new particles could lead to better ways of monitoring these problems, along with many other applications."

The particles were created from cores of PMMA (the plastic used in Perspex) coated with silver. The thickness of the coat can be varied, 'tuning' the response of the nanoparticles to light of a chosen colour.

Unfortunately, silver and carbon do not bond naturally, the silver does not deposit evenly, and the nanoparticles themselves have a stubborn tendency to stick together.

The team resolved these difficulties with some clever chemistry: studding the nanospheres with sulphur and silicon compounds, which bind to both plastic and silver, and then thoroughly stirring them with ultrasonic waves in an amine broth, resulting in particles with smooth, stable and uniform coatings.

The success of this project has led to a much larger collaboration with 20 papers, seven patents, and the exchange of more than 30 researchers between the Joint Laboratory in Xiamen, and the Australian Research Council's Centre of Excellence for Functional Nanomaterials.

"It was a great success for China-Australia scientific collaboration," says Professor Xianfang.

Silver/plastic nanoparticles could track agricultural chemicals in China's rivers


onfining Pressure
Downstream Pressure
Vent Valve
(DownStream)
Vacuum Supply
Vacuum
Actuator Pressure
Gauge Isolator
Link Valves
CSIRO
kPa
CSIRO

Zero emissions, energy to burn

Two thousand tonnes of carbon dioxide stored with zero emissions—that's the aim of a recently announced project between the China United Coalbed Methane Corporation Limited (CUCBM) and CSIRO. In storing the CO_2 in the coal seams of Shanxi Province, the partners also plan to drive out methane which can be used to generate energy. The CO_2 from burning the methane will also be stored.

The $10 million project is part of the development process for enhanced coal-bed methane recovery, and provides a pathway for the adoption of near zero emissions technology for coal-fired power. The project will trial new approaches to maximise CO_2 injection and methane recovery.

"Enhanced coal-bed methane wells are typically drilled vertically to inject CO_2 into coal seams, but this demonstration project will drill horizontally—meaning the entry point of the well is more directly embedded in the coal seam. We predict this will increase the flow rate of CO_2 for underground storage," says the director of CSIRO's Advanced Coal Technology research, Dr John Carras.

"CUCBM's expertise in drilling and in methane extraction will combine with CSIRO's capabilities in coal analysis, reservoir modelling, carbon dioxide monitoring and storage assurance to develop techniques that maximise both CO_2 storage and methane recovery rates."

The joint project addresses critical global issues of low emission energy supply, climate change and emissions reduction.

"The experience will inform the development of a low emissions coal technology that can also be deployed in either country," Dr Carras says.

Advanced reservoir modelling techniques are used to simulate the profile of injected carbon dioxide plumes deep underground (CSIRO)


TOPCON
love
project

Twins reveal the genetics of myopia and glaucoma

More than 3,400 twin children in Australia and China are participating in one of the biggest population-based twin studies ever undertaken, to establish whether myopia (short-sightedness) and the eye disease glaucoma are hereditary.

Myopia affects over 40 per cent of the Chinese population, and glaucoma is one of the commonest causes of blindness in the world.

The Australian and Chinese researchers conducting the studies believe the research will help establish why both diseases are becoming more prevalent and why the incidence of myopia is accelerating among Chinese adolescents.

The results will be correlated with other international studies to help identify the principal causes of these two diseases. Are they genetically determined, and if so, which genes are responsible?

The research, conducted over the past eight years, involves 2,000 children in Tasmania and Queensland and 1,400 in Guangzhou Province, China.

The twins have had their eyes and optical characteristics measured: in Australia over five years, and in China over four years.

By studying large cohorts of healthy, same-age siblings across different ethnic populations, researchers from the Zhongshan Ophthalmic Centre in Guangzhou, Guangdong Province, and the Centre for Eye Research Australia (CERA) aim to isolate any genetic influences from environmental and other factors.

Evidence to date confirms strong genetic influences in both myopia and glaucoma, according to Professor David Mackey, from the CERA.

1,400 Chinese twins are participating in studies to better understand short-sightedness and glaucoma

Ancient wheat seeds rewrite human history

A few seeds of wheat, barley, rice and millet were all it took for Australian and Chinese scientists to rewrite history. One of the seeds is the earliest wheat seed so far found in Eastern Asia, suggesting there were early trade routes linking China and the Middle East. How were they discovered?

Researchers from the Institute for Earth Environment, Chinese Academy of Sciences, in Xi'an, Shaanxi Province, identified potential locations in far north-western China in what is now desert. Under the guidance of Dr Li Xiaoqiang they undertook the complex task of extracting ancient seeds from the desert sands.

The grains were carbon dated in Australia at the Australian Nuclear Science and Technology Organisation's (ANSTO's) Australian National Tandem Research Accelerator (ANTARES) facility

"It turned out that one of the seeds was 4,200 years old," says ANSTO's Professor John Dodson. "It's from predynastic China and 2,000 years older than the Silk Route, the most famous route connecting West and East Asia."

The presence of the wheat seeds, together with other evidence from Bronze Age artefacts in the region, are strong indications of trade between China and the Fertile Crescent around modern day Iraq, Iran and Syria, Professor Dodson says.

"We had been trying to find evidence of early technology transfer between these areas. The seeds are a clue that people were making that journey earlier than we had previously thought."

More broadly, the discoveries help build a picture of how humans and the environment have interacted over the millennia in China. "If you are interested in human impact on the environment, China is a great place to look."

A few seeds of wheat and a tandem linear accelerator could help rewrite the history of early trade in Asia (ANSTO)

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Exploring how rice can start to grow without oxygen (UWA)

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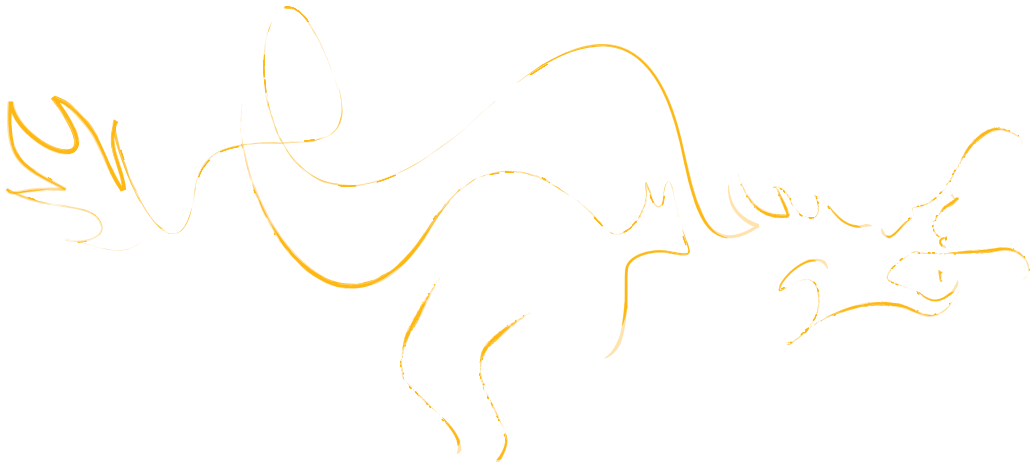
The future of international soccer? Robots learn the world game (UTS)



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