The small things in life

Nanotechnology—involving the manipulation of extremely minute particles—has surged ahead over the past decade and now universities in China and Australia have signed a new partnership agreement.

So what will this new relationship entail and what areas of research will they collaborate on?

Transcript

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Antony Funnell: Welcome to Future Tense on ABC Radio National.

Vicki Thomson: I understand we've got Dr Sun Win Lui, who is the chairman of ISTA, who can actually hear us, and I'm told we should be able to see him at the press of a button. Welcome, Dr Lui. I'd now like to ask Dr Lui to speak to us and hopefully we can hear you OK.

Sun Win Lui: I think so,

Vicki Thomson: Great, OK, over to you.

Sun Win Liu: [Introduces speech...]

Antony Funnell: A video hook-up between China and Australia to mark a new partnership between universities involved in the field of nanotechnology. That's our main story today, and a little later it'll be champagne and tweets all round, as we take you to the first ever Twestival, a real world-gathering of twitter-users.

Antony Funnell: A new partnership has been formed between the Australian Technology Network, a group of five universities in Australia, and ISTA, the International Strategic Technology Alliance which is a consortium of Chinese tertiary institutions.

The partnership has its focus on the development of nanotechnology. That is, the science of using and manipulating extremely small particles to perform certain tasks or to achieve certain results.

Now we'll get to the specifics of this new agreement in a few minutes, but let's first hear some examples of the creative ways in which nanotechnology is being used.

Associate Professor Mike Ford is head of the Department of Physics and Advanced Materials at the University of Technology, Sydney, and he's also the associate director of the Institute for Nanotechnology at UTS.

Mike Ford: One of the big areas that we work in is energy efficiency. So, for example, a really big issue in Australia is cooling houses, and the way we generally do that is with air-

conditioning, which has significant problems for a number of reasons. It's a huge drain on energy, there's all sorts of other issues involved with it.

So what we're trying to do there is to try and come up with ways of making materials that can help us cool buildings without using lots of electricity. An example of that is you can take nanoparticles, very, very small particles of gold, and these are typically in the range of maybe one thousandth of the diameter of a human hair, so if you coat those on to a window, you can make the window so that it absorbs infra-red light, which is the heat that comes from the sun; you can block out that part of the sun's light, but let through all the visible light. So from the inside of the building it looks very, very similar but none of the heat gets through, or a lot less of the heat gets through. So you don't obviously have to air-condition the inside of the building.

One of the other areas that we work in is one of the really big sources of energy usage, is lighting. So we all light our houses, factories, like the insides of their buildings and so on and so forth, traffic lights, car lights, whatever, and we use light sources that are very inefficient. And one of the other projects we're working on is to try and find ways of making light sources that are very, very efficient, that last a long, long time, so you don't have all of the environmental disposal issues associated with it, you don't use so much electricity in generating the light, and one of the ways that this is going to go in the future is to use what's called solid-state lighting. These are LEDs, basically, and so we've seen LEDs.

The real challenge now is to be able to make those LEDs very, very cheaply, so that you can put them into every light bulb in every single house, and in the short term, the energy saving associated with that is enormous. So these are really good short-term solutions to things like climate change.

Antony Funnell: Associate Professor, Mike Ford

Now there are myriad ways in which nanotechnology is being utilised around the world, but it's that issue of using the technology to find new ways of coping with some of the world's most pressing problems that's central to this new China-Australia nanotech partnership.

Projects undertaken under the partnership will have a specific focus on

Improving water quality; enhancing the efficiency of renewable energy systems; and on the development of novel health diagnostics.

Professor Neil Furlong is a consultant to the Australian Technology Network, and he's been the driving force behind this new international arrangement.

Neil Furlong: As institutions that are focusing on the outcomes and the application of the technology, we start by defining what a problem is that we need to attach or approach, and then we look to where we can find the expertise, whether it's in one university or another. So without such a collaboration, you'd find an individual group in a university would focus on quite a small part of the problem, and if I give it a nanotechnology example, you may have chemists who are very able to make very highly functional nanoparticles, but they do not have the expertise to fabricate them into a device, which may be an engineering challenge. So you look for expertise across that spectrum of application.

So it really is about enhancing the pool of talent and high expertise from the member universities, and providing a very effective framework to enable them to come and work together. In usual single university environments, that is not what happens, because university environments are often quite segmented, you know, the chemists work in the chemistry department etc. So we're providing them with really that enabling forum and network to build those teams together.

Antony Funnell: And I take it by what you're saying there, by working together, you mean physically working together, so you'd be looking for opportunities to physically be in the same lab, for teams to collaborate in that way?

Neil Furlong: Yes, absolutely. And again, if you're looking at a series of steps towards the application of a technology, many universities don't have the equipment either, to do some of that work, so we take advantage of both the infrastructure that's built up in individual universities and the people. It's really to learn how to build international teams, which is actually what happens when they go out and work in multinational companies, they need to be comfortable in working in international research teams.

Now I think there are many pragmatic advantages to doing that, with Chinese universities in where the world technology's going. But the other side of that it is, that the research paradigm in Chinese universities, actually is quite different to in ours. So it's important that we get the emerging researches in the graduate students into that environment.

Antony Funnell: Today we're sweating the small things in life, and science. Nanotechnology and a new nanotech research collaboration between universities in Australia and China.

Now if you're like me and you're losing your vision from spending too long in front of the computer, you might be a bit curious about the difficulties involved in actually undertaking nanotech research.

Here's Mike Ford again.

Mike Ford: Nanotechnology, of course, is about trying to engineer things, materials, at a very, very small scale. So the challenge is always how do you do that? How do you see things at that scale? How do you manipulate things at that scale? How do you change their shape or their size, or their surface texture, or whatever, at a scale that's right down to individual atoms. Really, it's only in the last maybe 10 or 15 years that we've begun to develop the skills to be able to do that. And I think that's really why nanotechnology's taken off since probably around the 1980s when those types of capabilities were developed.

Antony Funnell: Do you see a time where nanotechnology will be part of all developments that go on?

Mike Ford: Yes that is an interesting way to put it. I think it already has happened, in that there are already a lot of products out there that you can buy in the chemists, that are nanotechnology, but they're never advertised as nanotech, they're always advertised as 'clear sunscreens' or there are 'energy-efficient window coatings' you can buy already, and these are all nanotechnology. And so I think what's going to happen is, you won't see a nanotechnology industry, what you'll see is that nanotechnology will affect many of the things that we already have around us, and all the sorts of technologies that we currently use, nanotechnology will

be able to modify them in ways that make them more energy efficient or easier to use, or have other properties that are very, very useful to us. And that's going to pervade I think a lot of our lives very soon.

Antony Funnell: Now it's that pervasive nature of nanotechnology that has some people worried. Like genetic modification, there are those who believe that nanotechnology is one of those scientific approaches that's running too far ahead of government regulation.

Georgia Miller is the co-ordinator of the Nanotechnology Project for the environmental group Friends of the Earth.

Georgia Miller: Look, I think the key concerns around nanotechnology are there's been very little research into the risks posed by new products with nanotechnology, but the early evidence is that nanomaterials, which are very tiny particles manufactured using nanotechnology, actually do pose quite serious new risks. For example, last year there were two independent studies that found that carbon nanotubes, which are now used in a whole range of electronic specialty plastics, some building equipment and sports equipment, actually cause mesothelioma, asbestos-like disease when introduced into the linings of mice. So we've got a concern that there's a whole range of products that are on the market, everything from sunscreens, cosmetics, clothing, household appliances, paints, a whole range of products on the market which contain many particles, that haven't gone through any safety-testing, that may be posing quite serious new risks, and about which the products have no choice regarding exposure, because there's no labelling.

The key concerns I think relate to risk. They relate to right to know, they relate to the right of the public to be involved in decision-making about a technology predicted to drive quite large-scale social change, and the fact that this industry does appear to be managed in the interests of the emerging industry players rather than the public.

Antony Funnell: Taking those concerns on board, is there a danger though, of putting all nanotechnology projects in the same basket? I mean, do you see benefits for instance in this new Australia-China partnership, where the focus will be on nanotech work that actually helps address problems like climate change?

Georgia Miller: Look, we definitely are interested in hearing about what nanotechnology can offer in fields like energy efficiency, but we're also very concerned that while worry about nanotechnology risks are subject to a great deal of scrutiny, claims of potential environmental benefits unfortunately usually are not. What this means is that we do run the risk of investing a large amount of money supporting an industry which may actually not deliver net environmental gain, but may introduce quite serious new environmental risks.

Without wanting to say that all nanotechnology applications will prove to have little environmental benefit, we do call for a much greater degree of scrutiny of funding in this area.

Neil Furlong: Well, as a scientist, our perspective is that we work within evidence-based research, and we work within a highly regulated ethical environment. And we take leadership from community expectations. So the research that's done in nanotechnology and nanoscience, both in Australia and China, works within those boundaries. We attempt to understand, ours is an understanding-based science, we're understanding how to modify

properties. We work with companies who are interested in producing products, they might be photovoltaic devices like water purification membranes, but we all work within community expectation around whether those properties are relevant, and acceptable to the community at large.

So at the moment, nanoscience perhaps hasn't really got strongly into that space, except in some emerging concerns about very small particles and how they move around and function in the body. So what we will do is we'll make sure that we understand the research that's going on in that space, particularly around very small particles, and the potential human toxic effects for those. And there is a body of research now that guides us in understanding what the risks are and what the ethical concerns are.

Antony Funnell: Professor Neil Furlong.

The Australian Office of Nanotechnology (AON) estimates there are around 80 nanotechnology companies in Australia and about 75 research organisations also involved in nanotech work.

The AON operates out of the Department of Innovation, Industry, Science and Research. And one of its main roles is implementing what's called the National Nanotechnology Strategy.

It also has a public education responsibility, though you'd have to raise a question mark over some of its recent work in that area.

What do I mean? Well, the AON recently hired what's called a 'stakeholder engagement' consultancy called Straight Talk, to facilitate a workshop in Canberra on social inclusion and engagement relating to nanotechnology.

Now on the surface of it, that might sound like a laudable way of gauging community opinion. But as it turned out, only five actual members of the public were involved, and all of them were chosen by a market research firm. The other 45 participants were hand-picked representatives from industry, government and academia.

The resulting workshop produced such findings as:

'Nanotechnology will have a strong local future if industry and community can agree on the types of technologies that should be adopted'.

Antony Funnell: And:

'The report shows that different interest groups sometimes have strongly differing perspectives on the adoption of new technologies'.

Antony Funnell: Now we'll let you be the judge of whether that workshop was money will spent. Anyway, moving on ...

In 2007-2008, the Australian government funded nanotechnology research and development to the tune of $141 million, of which almost $32 million was spent on research into the health and environmental impacts of nanotech work.

Now it may surprise some people to hear that there are very few laws in the world relating specifically to nanotechnology. In Australia, there are none.

So should that concern us?

Professor Graeme Hodge is the director of the Centre for Regulatory Studies at Monash University's Law Faculty. And he was part of a major study conducted for the Australian government into nanotechnology regulation and policy.

Graham Hodge: When we first began thinking about this area, we focused in on how do we legislate and how do we regulate for this coming new era of nanotechnologies, and the learning is that when you look at our existing regulatory regimes, whether they're in health or chemicals or transport, consumer products, all areas have a huge array or a matrix of regulatory arrangements. There's laws at the top, there are regulations, that are attached to those laws, and there are codes and guidelines, all sorts of different networks of regulatory arrangements, and all of those arrangements that we have in place at the moment that cater for our safety, all of those will operate clearly into the future, when nanotechnologies are being developed.

So we don't start from a kind of blank slate, we start from having all of those existing regulatory regimes also being relevant and covering nanotechnologies.

Antony Funnell: And so in that sense say, if you were using nanotechnology in the food preparation, food development area, it would still have to conform to the standard laws and regulations relating to the production of food, is that what you're saying?

Graham Hodge: Absolutely. Of course and if you go and look at Australian law and Australian regulations, as far as they pertain to food, you can't sell products that make people unhealthy, and unwell, in Australia. It's just illegal. And the same law will continue to apply in any developments in food. When you're putting food in packaging, you can't sell packaging which ends up attaching itself to food, and might somehow contaminate that food. The same laws will also apply for any kind of nanotechnology advances.

Antony Funnell: Given the nature of nanotechnology, the fact that it does spread across so many different disciplines, and that it is changing, is developing, so quickly, is there a reluctance on the part of our regulators and our legislators to try and tie down, or try and codify regulations in this area?

Graham Hodge: No, I don't believe so, Antony. Really what's happening is that the area is so huge. I mean it's a little like Information Technology when it was around several decades ago. We didn't institute one massive legal change to cater for IT, what we did was, we were far more careful. We didn't want to take as the church did at one stage a reaction that kind of threw out new technology like the Gutenberg Press.

What we've got to do, essentially, is to be a lot more careful and more cautious, a lot smarter, if you like, and really what regulators are doing at the moment is they're trying to focus in on where there are some scientific gaps in our knowledge, where we need to learn more about exposure levels and risks and so on, where there are gaps in our—literally our ability to be able to measure and provide standards for these atomic-level developments, and where there are some potential gaps in our regulatory regimes, we need to focus in on those.

For example, we often allow a chemical, for instance, a chemical at federal level, and it may be that a particular company comes along and reformulates that chemical; instead of at the macro scale, they reformulate it at the nanoscale.

There's a question there, isn't there, with this new chemical, is it actually new, given that it was approved under previous regimes and previous rules, it's the same chemistry, but it's now at the nanoscale. So there is a question in the way that we apply our risk protocols, in the way that we apply our regulatory regimes, as to when there's something new—does that mean it completely changes the riskiness of the substance or not? There's certainly lots of novelty in nanotechnologies and that's the reason why a lot of us like transparent sunscreen instead of the white sunscreen that we used to put on. So there's an example of where there's questions being asked about the adequacy of current laws and regulations.

Antony Funnell: Graham Hodge, from Monash University's Centre for Regulatory Studies, and he brings to a close our focus on nanotechnology today.

Guests

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Further Information

Australia-China NanoNetwork

Australian Office of Nanotechnology

National Nanotechnology Annual Report 2007/2008

Friends of the Earth - Nanotechnology Project

Australian Research Council's Nanotechnology Network

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