A Materials World

Materials science and Engineering at the ANU

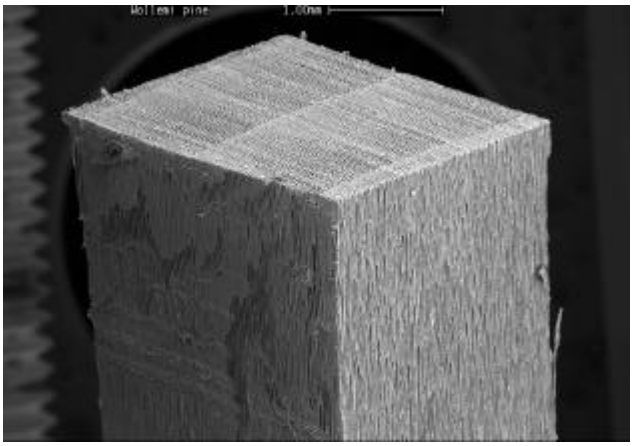
Do you love science, enjoy a challenge and want to work at the cutting edge of technology? Then you should be thinking about a career in materials science and engineering. Materials science is emerging as one of the most important driving forces of technological change in the 21st Century. And one of the best places to join this revolution is at The Australian National University. Here's some of the exciting work happening at the ANU.

Secrets of
dinosaur wood

The death of a mature Wollemi pine tree has given materials scientists at ANU the opportunity to be the first to study the wood properties of this 'living fossil'.

Wollemi pine, only discovered a few years ago, dates back to the age of the dinosaurs, some 150 million years ago. It's related to some of Australia's native pines but little is known about the properties of its timber. The trees live for around 500 to 1000 years.

With only a handful of Wollemi pines in existence, it's unlikely they will be a major source of timber in the near future. However, it's hoped a detailed analysis of the dinosaur pine might reveal valuable information on the evolution and structure of one of nature's truly amazing materials – wood.



◀ Scanning electron micrographs of Wollemi wood, taken by Dr Roger Heady at ANU's Electron Microscope Unit.

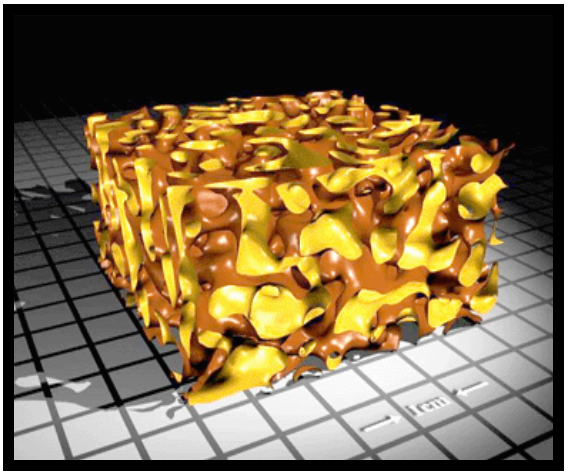
Seeing deep within

How do contaminants move through soil? How can we accurately assess a patient's risk of osteoporosis? Why does ink-jet printing give clear and sharp lines on some papers, while it smudges on others?

These questions are of enormous interest to both scientific and the industrial communities. The answers are all linked to a common source; they require the ability to characterise and predict properties of complex, often disordered, materials.

Scientists at the ANU Department of Applied Maths, in the Research School of Physical Sciences and Engineering, have built one of the world's most advanced experimental micro-Xray computer tomography laboratories for imaging the 3D structure of natural and synthetic materials.

This has allowed the scientists to develop theoretical and computational tools to characterise materials and understand the relationships between their structure and properties. It also enables them to 'see' inside materials down to a micron scale.

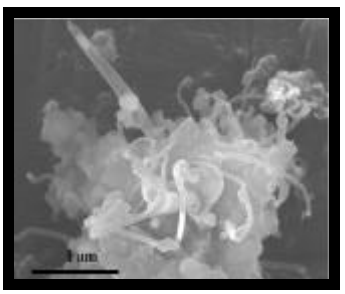


▲ Seeing inside a termite mound: a structure that maximises strength using a minimum of material.

Wonder tubes

Nanotubes are 50,000 times thinner than a human hair, and many materials scientists believe they will be the wonder material of the 21st century. The range of uses for nanotubes are endless. Some applications include: a new generation of high-strength materials, 'fountain pens' that deposit atoms instead of ink; and nano-sized electric circuits. We're only beginning to see how they can be used.

However, nanotubes are difficult to manufacture in large quantities. Researchers at ANU's Department of Electronic Materials Engineering are leading nanotube science in the construction of boron nitride (BN) nanotubes. They're being produced at ANU using a novel technique which involves grinding boron to a nanosized powder and then heating it in nitrogen gas. This work represents a breakthrough in nanotube preparation and opens a whole new research area for nanotube studies.



▲ BN nanotubes grown using ANU's novel technique.

For a challenging and rewarding career working at the cutting edge of technology

Join the materials revolution at ANU

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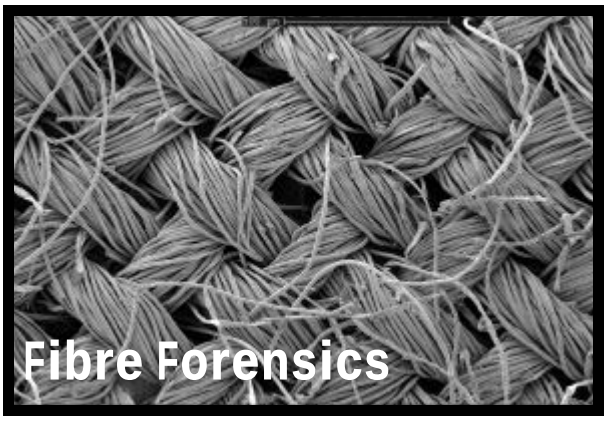
Info tech, nanotech, biotech, aerospace engineering and photonics are the emerging leaders in science and technology of the 21st Century? Underpinning the breakthroughs that are being made in each of these areas is materials science and engineering. Some of the best materials science and engineering in the world is being conducted at The Australian National University. For a challenging and rewarding career at the cutting edge of technology you should consider materials science at ANU.



▲ Scanning electron micrographs of a piece of fabric left at the scene of a crime. Materials science plays an important role in forensic investigations as it often allows for the identification of an unknown material and can provide valuable information connecting a suspect with the crime. For example this picture shows the fabric has experienced melting in the top centre of the picture indicating ironing damage. This indicates the shirt is made of a synthetic fabric, terylene in this case, rather than a natural fibre. The BSc in materials science at ANU allows an option to take several forensic courses at the Canberra Institute of Technology (thereby giving you a good background in basic science and allowing you to study forensic science at the same time). *Image taken by Dr Roger Heady at ANU's Electron Microscope Unit.*

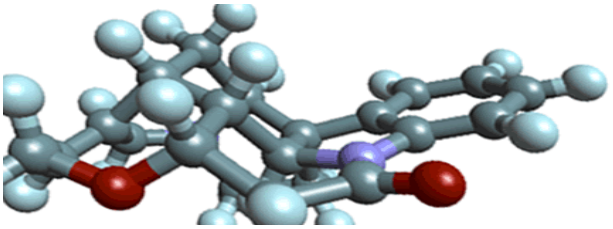
The Biggest Chill

It's one of the rarest, coldest and most exotic materials in the Universe – a Bose Einstein condensate – and it's been created for the first time in Australia by a team of scientists from ANU's Department of Physics.

A Bose Einstein condensate, or BEC for short, is formed when atoms are cooled down to almost absolute zero (-273°C) and they are incredibly difficult to create. Only a handful of scientists in the world have been successful.

The ANU team created a BEC by cooling approximately a million rubidium atoms down to 100 billionths of a degree above absolute zero. The atoms were first cooled in laser beams to 20 millionths of a degree above zero. The cloud of atoms was then held in a magnetic trap that allowed hotter, more energetic atoms to escape.

Eventually the remaining atoms became cold enough to condense into a BEC – a state in which all the atoms in the condensate are exactly the same.



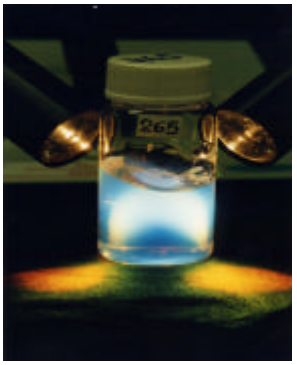
Masters of the Mix

Emulsions are an intimate mix of two immiscible liquids. For example, salad dressing is a mixture of vinegar and vegetable oil – two liquids that will never mix. If an emulsion is shaken and then left to stand the liquids eventually separate out. However it's possible to slow down this separation by adding a stabilising agent, which will coat droplets of one of the component liquids keeping them suspended in the other liquid. It's basic kitchen chemistry as well as being big business, with emulsions being the basis of many foods, paints, resins and even explosives.

Keeping emulsions from breaking down allows for the design of stabler, more easily handled and cheaper materials. To do this scientists need to understand how emulsions behave at a nanoscale level, knowing the size and shape of their component droplets and how much stabiliser needs to be added. But obtaining this information is difficult.

Scientists at ANU's Research School of Chemistry are studying a variety of emulsions using a range of high powered techniques. These devices probe the emulsion structure at a scale of 1-100 nm scale, well below the range of normal optical microscopes.

They have found that emulsions have a complicated structure in which large micron-scale stabilised droplets float in a 'microemulsion' liquid containing a myriad of much smaller nano-scale spheres composed mainly of the stabilising compound. This contrasts with the old theory of uniform sized droplets, often with flat sides, in an ordinary liquid.



Different colours indicate changing particle size in each emulsion. ▶◥

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More information: www.anu.edu.au/CSEM