Australian Government
Department of Innovation, Industry, Science and Research

SCIENTISTS SPEAKING ON
nanotechnology

Professor Tanya Monro

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SCIENCE AT THE BOUNDARIES

The only reliable way to find out whether the internal structures of an aircraft are corroded is to pull the plane apart and look. But new nanotechnology-based techniques being developed by physicists including Professor Tanya Monro, of the University of Adelaide, could make costly visual inspection in preventive aircraft maintenance a thing of the past.

Professor Monro is the director of Adelaide University's Centre of Expertise in Photonics and of the Institute for Photonics and Advanced Sensing. She is part of a team developing a sensor that uses optical fibre to pick up signs of corrosion. Scientists at the Defence Science and Technology Organisation and Melbourne's Swinburne University of Technology are collaborating on the project.

'The fibres will be located in areas that are hard to access, such as joints,' says Professor Monro. 'Once the aircraft is assembled, it will then be possible to inspect these areas by sending a light signal through the fibre and detecting the characteristics of the light.'

The fibres have surfaces that are treated so that they fluoresce on contact with aluminium ions—the tell-tale sign of corrosion. The fluorescent light would be of a different wavelength from that of the light sent down the fibres.

'If you see the 'other' light wavelength, you know that there is corrosion in the structure without having to incur the cost and delay of pulling the structure apart,' she says.

'One can use pulses of light to determine at what point along the fibre the corrosion is occurring. This can be used to pin down the location of the corrosion so that it can be remedied.'

The sensors are among a wide range of glass-based materials under development at the centre. The work is at the boundary of photonics—the use of light to transmit data—and nanotechnology, which exploits the amazing properties of particles and structures measuring on scales of billionths of a metre.

SCIENCE AT THE BOUNDARIES

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Her team's new classes of soft, or low melting point, glass optical fibres have a multitude of potential applications ranging from chemical and biological sensors to medical diagnostics. Much of the vast international research effort in nanotechnology centres on nanoparticles, which have amazing properties differing greatly from those of larger particles of the same chemical composition.

'We are just starting to put nanoparticles into our glasses to make a broader range of materials,' says Professor Monro.

However, some of her research focuses on the fabrication of glasses with nanometre-scale holes in them. One line of research conducted in collaboration with other scientists at the University of Adelaide is the development of polymer optical fibres with lines of tiny holes to guide terahertz radiation. Scientists world wide are racing to develop waveguides for terahertz radiation; low frequency waves between the infrared and radio bands on the electromagnetic spectrum. Terahertz radiation is expected to find applications in high-speed computing, security scanners and medical imaging.

'Instead of acting as a pipe for light, in which the light is contained, these structures can act as rails for light,' she says of the new structures. 'The light travels outside the polymer itself. We're interested in using this approach to open up parts of the electromagnetic spectrum not currently accessible using existing materials.'

Yet another line of investigation centres on real-time pathology tests for diseases such as HIV or bird flu. The tests will be based on fibres with minute holes, the surfaces of which will be coated with antibodies to specific diseases. The fibres would fluoresce if the virus was present.

'Our game here is to create optical fibres with functionalities not normally associated with the materials,' she says.

In 2008, Professor Monro won the Malcolm McIntosh Prize for Physical Scientist of the Year, one of the Prime Minister's Science Prizes.

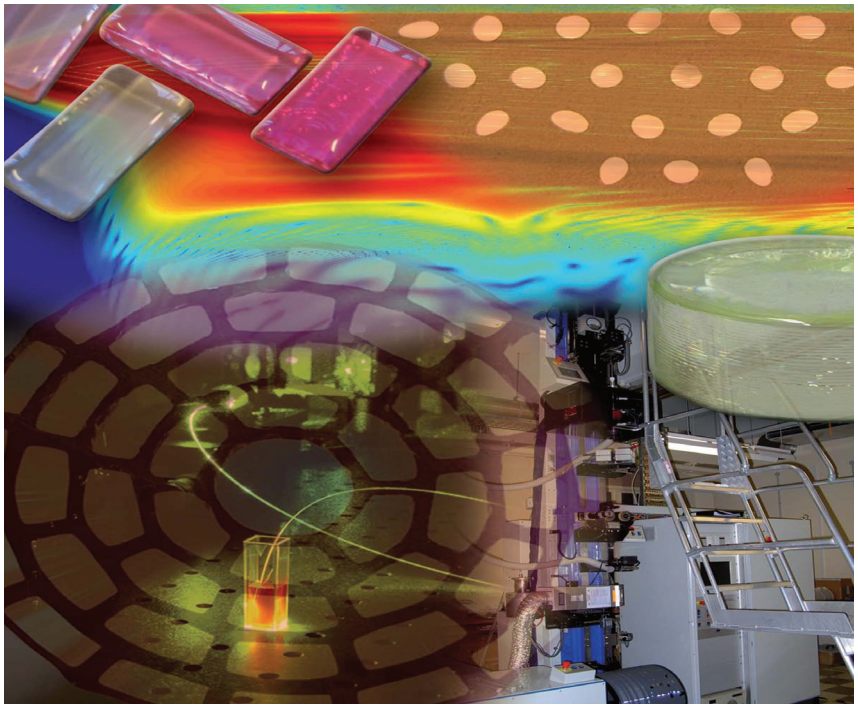

Figure 1: A collage of recent research from the Centre of Expertise in Photonics at the University of Adelaide, including new glasses, microstructured fibres, numerical simulations and experimental demonstrations