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Small particles, big business

TRANSPARENT particles, one thousand times smaller than the diameter of a human hair, could revolutionise a multitude of industrial products and processes.

Initially used to improve UV absorption in sunscreens and cosmetics, 'nanoparticles' are finding their way into paints and varnishes and coatings for plastics, glass and textiles. In each case they confer a range of beneficial properties such as greater UV absorption, infra-red reflectivity, increased strength or flame retardancy. And it's all thanks to some clever technology developed by CSIRO Manufacturing Science and Technology and a group of companies led by Melbourne-based milling company, Micronisers.

'The key to this technology is the ability to make the particles small and to stabilise them to stop them clumping together,' CSIRO chemist Dr Terry Turney says. 'To be commercially viable, they also need to be produced in huge quantities, and we've been able to do all that cost-effectively, to the point where we believe we're now world leaders in nanoparticle manufacture.'

While the specifics of nanoparticle manufacture are a secret, the process involves grinding common inorganic compounds such as zinc oxide (used in sunscreens) into a powder of ultrafine particles about 20 nanometres (20 millionths of a millimetre) in size. These particles can then be mixed into different formulations for sunscreens, paints, varnishes and so on.

Because the particles are so small, they allow visible light to pass through them and appear transparent. In the case of sunscreens, their small size also improves coverage and acts as a physical block against UV light.

'If you compare a handful of gravel with a handful of sand, you find that there are no gaps between the sand particles, but there are large ones between the gravel,' Turney explains. 'So smaller particles block light a lot better, provide a smoother coating and require less material for the same coverage.'

The same principles have been applied to bottle coatings designed to protect light-sensitive products such olive oil and wine. UV-blocking particles have also been added to plastic outdoor furniture, while infra-red reflective tin oxide particles can be used in heat-reflective coatings for windows.

Transparent, UV blocking nanoparticles are ideal for sunscreens, cosmetics and clear varnishes. The particles appear transparent because they are too small to scatter visible light.

Attention is now turning to the application of nanoparticles in the areas of health and electronics. For example, Turney says nanoparticles could bring about improved drug delivery systems.

'Because the particles are so small, they could be absorbed through the skin. So there is the potential to deliver drugs transdermally through patch technology,' he says. 'Drug particles may also be ground finely enough to be injected in solution or inhaled.'

In terms of electronics, Turney says that by replacing inks with nanoparticle solutions, it could be possible to print structures, such as electronic circuits, on to surfaces.

The versatility of nanoparticles even extends into the realm of environmental sustainability.

'If you can paint timber with varnish that protects it for twice the length of time, you only need half the amount of timber. If you keep plastic chairs in a useable condition for five times longer, you will use five times less petrochemicals,' Turney says. 'Because these particles can improve property lifetime, they allow us to manufacture products in a more sustainable manner. And because we are dematerialising and decarbonising processes, we're contributing towards a more sustainable industrial ecology.'

Already, nanoparticle sunscreens have captured 60% of the Australian sunscreen additive market and will soon appear in the US and Europe. It is only a matter of time before other commercial nanoparticle applications make their debut.

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