NANOTECHNOLOGY

A new gold standard of healing with crystalline polymers

How convenient it would be if we could convince a torn piece of material to return to its undamaged state. Université de Sherbrooke chemist Yue Zhao has been able to purchase just such convenience with some vanishingly small amounts of gold.

The substance in question is gold nanoparticles or nanorods, which are inserted into a thin polymer specimen. When laser light passes through the structure, these agents heat up and initiate a polymer melting-crystallization process that replaces bonds broken by physical damage to the matrix around them. "This photothermal effect is not new," Zhao explains. "But what is new is demonstrating it in healing crystalline polymers. In general it is challenging to heal a mechanically strong material."

Zhao and his PhD student Hongji Zhang published their findings in the American Chemical Society journal *ACS Applied Materials and Interfaces*. They confirmed that gold nanoparticles not only enabled a polymer sample to repair a cut but also provided the material with light-controllable, shape-memory ability, so that it returned to an initial, folded state after being flattened out. "The most surprising part was the small amount of gold nanoparticles we needed," says Zhao. "It took something like 0.003 weight/percent to generate the heat for the healing."

Zhao adds that such a small amount also helps retain the transparency of the polymer, which is necessary so that the laser light can pass through it and activate the nanoparticles. Of course, "small" is a relative term in this context. He also points out that a cubic millimetre of this polymer will still contain upwards of a billion nanoparticles of 10 nanometres in diameter, which turn out to be more than enough to generate the necessary heat for repairs. Moreover, the use of a laser light means that it is possible to heal a polymer from a long distance so long as the laser beam can reach the damage.

Zhao concedes that the potential applications of this physical behaviour are still being discussed. But as the ability to promote self-healing becomes a practical possibility in everything from hard crystals to hydrogels, he suspects the imaginations of inventors will take over. "It's a very general approach," Zhao says. "It's getting easier and easier to get gold nanoparticles, and you just need tiny amounts, so it's not that costly."

ANALYTICAL CHEMISTRY

Testing for banned substances in athletes ups its game

Just as athletes commit to becoming faster and stronger than ever, so too do the authorities testing these competitors for banned substances. For just that reason, the World Anti-Doping Agency has supported the work of chemist Janusz Pawliszyn of the University of Waterloo in Ontario, who has shown how to make the organization's testing regime more efficient than ever before.

For almost 25 years, Pawliszyn has been developing and refining a technique called Solid Phase Microextraction (SPME), which employs thin films of reagents used in high throughput liquid chromatography-mass spectrometry. The format allows for a direct interaction, regardless of the physical properties of the material being assessed. "We can have samples that are quite complex — suspensions and so on — and they will not plug up the system," Pawliszyn says, referring to the kinds of bodily fluids taken from athletes, such as urine, blood or saliva.

Using a standard 96-sample tray, such specimens will take just a few hours to be tested against hundreds of doping compounds and their metabolites, including narcotics, steroids, diuretics, hormones, stimulants and cannabinoids. The details of this innovation were described by Pawliszyn and his colleagues in an article for *Analytica chimica acta* earlier this year. Pawliszyn notes that this is just the latest application to be found for SPME over the past two decades.