Technology tethers free radicals

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The science world is abuzz with news of a new platform technology developed by physicists at the University of Sydney - technology that can be used in areas as diverse as disease detection through to biofuel production.

Details of the breakthrough technology are published this week in the international journal Proceedings of the National Academy of Sciences. The paper, 'Free radical functionalization of surfaces to prevent adverse responses to biomedical devices' says the technology uses a layer of carbon and nitrogen, rich in free radicals that anchor proteins to a surface.

It is this easy and strong adherence of the biomolecules, while still preserving their function, that has the science community talking.

Professor David McKenzie of the School of Physics says: "Free radicals are often thought of as 'bad guys' who, if allowed to run free in the body, are understood to be involved in degenerative diseases, biological aging and cancer. In our technology we're putting these radicals to good use.

"The new technology will be of benefit to implantable medical devices such as stents. The breakthrough allows the surface to cloak itself in the patient's own protein, reducing the chance of medical complications such as inflammation and rejection.

"It is also possible to coat the surface with proteins or peptides, selected for their influence on cells, prior to implantation into the body. We have

shown that our human elastic protein tropoelastin can be functionally coated on a diverse range of surfaces, from teflon to stainless steel, improving how they interact with human tissue."

The protein retains its "native" structure and will not trigger adverse reactions such as blood clots or the foreign body response.

"When proteins land on surfaces currently used in implants they unfold and distort, losing their biological function," explains lead author Professor Marcela Bilek, also from the School of Physics.

"When our surface is immersed in a fluid containing protein, the protein is bound by reacting with free radicals that are trapped in the surface's under-layer. The radicals do not harm the protein but tether them gently to the surface."

The new surfaces can be integrated into any material using a patented technology that prevents detachment even under extreme deformation, including during the stent expansion process when inserted in an artery.

The breakthrough technology can also be used for the early detection of diseases.

"Antibodies can be anchored on the new surface in an array of spots. Diseased cells attach themselves to the antibodies in characteristic patterns that enable the disease to be detected long before the symptoms emerge. This will allow early intervention and higher cure rates," says Professor Bilek.

"We have recently demonstrated diagnostic arrays which can detect diseased cells at levels lower than previously possible."

As well the platform technology will have an impact on biotechnology.

"Ethanol is a valuable fuel that could be produced from waste cellulose (cardboard and agricultural waste) with special enzymes. These enzymes will be tethered to the new surface and continue to function, enabling new industrial production methods based on continuous flow rather than batch operation," says Professor McKenzie.

Provided by University of Sydney