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research highlight

Implants: Phoney bones

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Tissue failure can greatly affect the length and quality of peoples' lives, and the need for implants is increasing. Unfortunately, treatments such as tissue grafting or synthetic matrices are often rejected by the body or cause infection. Ideally, new materials for implants should have 'hierarchical' features on the macro, micro and nano scale, to aid the transport of nutrients and encourage cells or tissues to bind and grow into the implant.

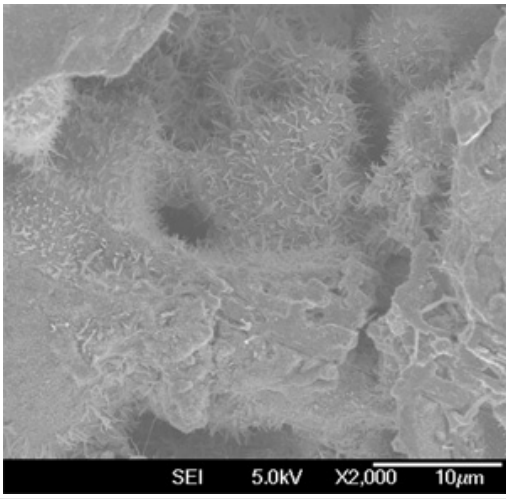

Fig. 1: Microscope image of a new porous titanium-based material developed for bone implants. The fine structure, with features down to the nanoscale, mimics natural bone to encourage compatibility with cells and tissues.

Now Paul Chu at the City University of Hong Kong and co-workers[1] have developed porous titanate structures that could act as excellent orthopedic implants, because they have nano-sized features resembling those found naturally in bones. Their work is based on porous titanium–alloy 'biometal' scaffolds, made by powder metallurgy.

"It is well known that human bones have hierarchical porous structures with the lowest level on the nano scale," says Chu. "Titanium-based biometals, which are commonly used in biomedical fields, show a strong shape memory effect and superelasticity similar to human hard tissues such as bones and tendons."

In their latest work, the researchers modified biometal scaffolds by immersing them in sodium hydroxide solution and gently heating. This induced the gradual growth of nano-sized titanate wires and belts among the existing larger pores. The nanostructures strongly resemble molecules of collagen and hydroxyapatite, the main constituents of bone.

The resulting material is strongly hydrophilic (has a strong affinity for water), which encourages cells to bind on its surface. Moreover, the scaffolds could improve the lifetime of biomedical implants. Current implant materials last an average of 10 to 15 years, which may not be long enough for people today who remain active much later in life.

Chu is optimistic about the future of his titanate scaffold material.

"Soon we will run clinical implantation tests in various animals, he says. "We will also try to control properties of the nano-titanate such as shape, size, direction, and uniformity."

"What's more, as well as bone implants, this scaffold could be used in engineering as an energy absorbing or pollution treatment material due to its large surface area and complex porous structures."

Reference

1. Wu, S. *et al.* A biomimetic hierarchical scaffold: Natural growth of nanotitanates on three-dimensional microporous Ti-based metals. *Nano Letts.* **8**, 3803–3808 (2008). | article |

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