Toward a better material for hip replacement and other joint implants

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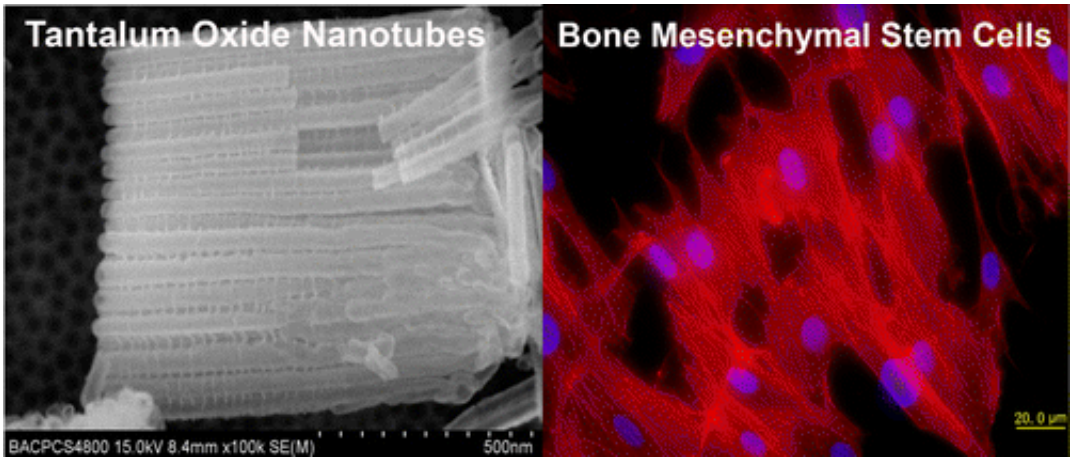

In an advance toward a new generation of improved hip and other joint replacements, scientists are describing development of a potential implant material that flexes more like natural bone, fosters the growth of bone that keeps implants firmly in place and is less likely to fail and require repeat surgery. Their study on these so-called tantalum nanotube materials appears in *ACS Applied Material & Interfaces*.

Hongyi Li, Jinshu Wang and Zhenting Zhang explain that the metal tantalum has advantages over titanium, stainless steel and other metals used in the current generation of bone implants. For example, tantalum implants are more porous than titanium, encouraging bone growth and

making the implants rougher and more elastic, like natural bone. So far, however, tantalum has found use mainly in devices that bridge fractures and other defects in bone, rather than in hip joint replacements and other joint implants. The scientists set out to find a new coating for tantalum to make better implants.

The results suggest that a film of tantalum oxide nanotubes—each more than 1,000 times thinner than a human hair—can help tantalum joint replacements integrate better with existing bone. The coating improves the anticorrosion, biocompatibility and other beneficial aspects of pure tantalum. The films also helped spur bone growth in tests with animal bone cells used as stand-ins for human bone.

More information: Study on the Anticorrosion, Biocompatibility, and Osteoinductivity of Tantalum Decorated with Tantalum Oxide Nanotube Array Films, *ACS Appl. Mater. Interfaces*, Article ASAP. DOI: 10.1021/am300727v

Abstract
With its excellent anticorrosion and biocompatibility, tantalum, as a promising endosseous implant or implant coating, is attracting more and more attention. For improving physicochemical property and biocompatibility, the research of tantalum surface modification has increased. Tantalum oxide (Ta2O5) nanotube films can be produced on tantalum by controlling the conditions of anodization and annealing. The objective of our present study was to investigate the influence of Ta2O5 nanotube films on pure tantalum properties related with anticorrosion, protein adsorption, and biological function of rabbit bone mesenchymal stem cells (rBMSCs). The polarization curve was measured, the adsorption of bovine serum albumin and fibronectin to Ta2O5 nanotubes was detected, and the morphology and actin cytoskeletons of the rBMSCs were observed via fluorescence microscopy, and the adhesion and proliferation of the rBMSCs, as well as the osteogenic

differentiation potential on tantalum specimens, were examined quantificationally by MTT and real-time PCR technology. The results showed that Ta2O5 nanotube films have high anticorrosion capability and can increase the protein adsorption to tantalum and promote the adhesion, proliferation, and differentiation of rBMSCs, as well as the mRNA expression of osteogenic gene such as Osterix, ALP, Collagen-I, and Osteocalcin on tantalum. This study suggests that Ta2O5 nanotube films can improve the anticorrosion, biocompatibility, and osteoinduction of pure tantalum, which provides the theoretical elaboration for development of tantalum endosseous implant or implant coating to a certain extent.

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