New optimized coatings for implants reduce risk of infection

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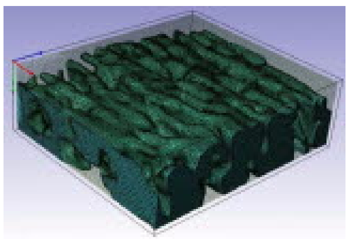

This is a model for inverse humeral (shoulder) implant. Credit: Aalto University

Implants are commonly made from metals such as titanium alloys. These materials are being made porous during processing used to prepare them for medical use. Whereas this is important to ensure good contact between the implant and the bone, this also allows dangerous bacteria to adhere and grow both on the surface as well as inside leading to increased risk of infection.

"Our work has focused on developing an analysis of surface treatments for commercial implants which reduces risk of infection," said Professor Michael Gasik at Aalto University. "What we wanted to do is find a way to avoid the formation of any undesirable products during the processing of the implant." "At the same time we needed to make sure that the bio-mechanical properties of the implant would remain intact and, even more, become better."

A thin coating of a biomaterial called Hydroxyapatite (HAP) or bioactive glass (BAG) is typically applied to orthopaedic and other implants to alter the surface properties. Such coatings improve the body ability to recognize a foreign object in a more friendly way and promote implant integration into surrounding tissues. During the heat treatment process, excessive stresses can cause premature cracking and removal of the coating layer. This can lead to the development of unsuitable compounds and increase the risk of infection.

"Normally, implants require a certain level of porosity and elasticity to function properly," added Professor Gasik. "The challenge for us was to ensure full functionality of the implant while maintaining sufficient density of the coating during the heat treatment process." "We have proven that by adding a certain amount of another compound called beta-tricalcium phosphate (ß-TCP) such stresses are reduced and therefore preserves the biomaterial coating better." Thus minimizing the risk of coating destruction and bacterial adhesion, and improving cell proliferation, allows the implant surface to achieve its function in an optimal way.

This shows the shoulder implant two main parts. Credit: Aalto University

This research is significant in the battle against the spread of drug resistant bacteria. An estimated 10-15% of post-implant complications are caused by bacterial infections. Post-operative diseases are becoming more challenging and developing new treatments that are resistant to infection are crucial. In response to this research, Aalto University and partner manufacturers have already started developing new experimental devices for advanced testing of biomaterials at the conditions most close to life. Besides proving developed technology, it will allow high-throughput screening of the biomaterials with substantially better properties.

This is a computer tomography of porous titanium coating made on the implant surface. Credit: Aalto University

The research was conducted at Aalto University and supported by Tekes, the Finnish national innovation agency, and by the EU FP6 project "Meddelcoat".

More information: Michael Gasik, Anu Keski-Honkola, Yevgen Bilotsky, Michael Friman: DEVELOPMENT AND OPTIMIZATION OF HYDROXYAPATITE - ß-TCP FUNCTIONALLY GRADATED BIOMATERIAL. Journal of the Mechanical Behavior of Biomedical

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