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NANOSTRUCTURED BIOACTIVE TiO_2 SURFACES FOR BONE IMPLANTS

Researchers at the City University of Hong Kong and Shanghai Institute of Ceramics, Chinese Academy of Sciences, China, have used nanoparticle plasma spraying that is followed by hydrogen plasma immersion ion implantation (PIII) to successfully produce a bioactive nanostructured TiO_2 surface having grain size less than 50 nm. Paul Chu, a researcher in City University of Hong Kong, says that they have been working on plasma surface modification of biomaterials for several years and the materials that they have worked on include titanium, titanium oxide, nickel-titanium shape memory alloy, diamond-like carbon, polymers, and so on. Plasma-sprayed nanostructured TiO_2 is one such material.

Some types of TiO_2 powders and gel-derived films exhibit bioactivity. However, plasma-sprayed TiO_2 coatings are usually bioinert and this hampers their application in orthopedic/dental implants. Surfaces play a key role in the response of biological environments to implants. The performance of processes such as cell surface interaction, protein adsorption and cell/tissue development at the interface between the biomaterials and body is controlled by the physical, chemical and biochemical properties of the implant surface. Nanosized surface topography may result in the enhancement of properties of the biomedical implants in a biological environment.

When immersed in a simulated body fluid the hydrogen PIII nano-TiO_2 coating can induce bone-like apatite formation on its surface. In contrast to this, apatite cannot form on either hydrogen-implanted TiO_2 with grain size greater than 50 nm or the as-sprayed TiO_2 surfaces (both less than and greater than 50 nm grain size). Growth of the apatite is governed by the small grain size (<50 nm) that boosts surface adsorption as well as the hydrogenated surface that forms negatively-charged functional groups on the surface.

Plasma-sprayed TiO_2 coatings are known for their corrosion resistance, biocompatibility and high bonding to titanium alloys. The addition of bioactivity to the list of attributes makes them far superior to other existing biomedical coatings. On the potential application of this work, Chu tells *Technical Insights* , "The materials have commercial potential as artificial prostheses. The enhanced surface bioactivity bodes well for *in vivo* bone growth during healing processes." Additionally, this research group is believed to have pioneered the production of bioactive plasma-sprayed nanostructured TiO_2 coatings that support *in situ* bone growth.

Chu says that at the moment they do not have any plans to collaborate with any industry, as they would like to continue their research work to understand the physical mechanism and perhaps extend the concept to other biomaterials. The researchers have not yet applied for patents.

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