Improvement in Bioactivity of Plasma Sprayed TiO2 Coating with Nanostructured Surface

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Plasma-sprayed hydroxyapatite coatings are used clinically but still suffer from their low crystallinity and poor bonding strength to titanium alloys. The former gives rise to fast dissolution of the hydroxyapatite coating in contact with human body fluids subsequently shortening its lifetime, whereas the latter results in delamination causing safety concerns. Although some types of TiO₂ powders and gel-derived films can exhibit bioactivity, plasma-sprayed TiO₂ coatings are always bioinert, thereby hampering wider applications in bone implants. In this work, a TiO₂ coating with nanostructured surface was obtained by plasma spraying using nano-sized TiO₂ powders. Its bonding strength onto Ti-6Al-4V substrate is high and up to 38 MPa. At the same time, we have successfully improved the bioactivity of plasma sprayed TiO₂ coating with nanostructured surface using an acid treatment. Bone-like apatite can form on the surface of the post-treated TiO₂ coatings after they are soaked in simulated body fluid for a period of time. Introduction of surface bioactivity (bone conductivity) to plasma-sprayed TiO₂ coatings which are generally recognized to have excellent biocompatibility and corrosion resistance makes them more superior than many current biomedical coatings such as plasma-sprayed hydroxyapatite.