MATERIALS SCIENCE AND ENGINEERING

SEMINAR

"Microstructural Design of Air Plasma Spray Hydroxyapatite to Promote Bone Growth"

by

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ABSTRACT

The demand for orthopedic implants is expanding as human life expectancy increases each year. HA has a similar structure to human bone apatite and has been proven to improve bio-integration. This bioactive material is often spray coated on a bio-inert metallic implant (i.e. Ti-6Al-4V). However, due to the high processing temperature of the spray process, the integrity of the bulk powder is reduced to amorphous form. A highly amorphous coating is undesirable because of its relatively high dissolution rate compared to crystalline HA. Present studies have explained the dissolution behavior of HA coating and the osteointegration process. The use of the air plasma spray technique for HA coating is justified and elaborated. The results of the phase transformation, microstructure, and mechanical properties of the spray coating are reported. However, there has been limited study on coating-substrate adhesive strength. Studies also suggest that post spray treatments such as conventional sintering and spark plasma sintering help to recrystallize amorphous HA. Heat treatment is optimized by conventional sintering at 700°C for 30 minutes to improve coating crystallinity. Additionally, the residual stresses of the as-sprayed and heat-treated coatings are studied. This is followed by the failure mode of the coatings. There is still a lack of knowledge in the adhesive strength of coating with respect to some microstructural properties such as porosity. Finally, remaining questions about porosity and adhesive strength are discussed and it is followed by an experiment designed to fill in knowledge gaps and to propose a new research direction apart from currently available studies.

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