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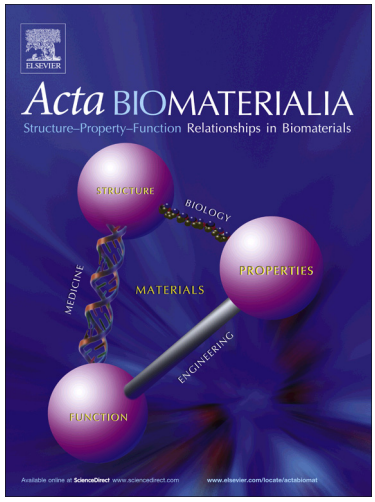

Laser processed calcium phosphate reinforced CoCrMo for load-bearing applications: Processing and wear induced damage evaluation

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Laser processed calcium phosphate reinforced CoCrMo for load-bearing applications: Processing and wear induced damage evaluation

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Abstract

To mitigate shortcomings in current biomedical CoCrMo alloy, composites of CoCrMo with calcium phosphate (CaP) were envisioned. CoCrMo alloy was reinforced with CaP to enhance the wear resistance of the alloy. A powder based direct energy additive manufacturing technique of Laser Engineered Net Shaping (LENS™) was used for processing of CoCrMo alloy with 1% and 3% (by weight) of CaP in the form of hydroxyapaptite. Addition of CaP was found to stabilize the ε (HCP) phase along with the more common γ (FCC) phase of the CoCrMo alloy, and the microstructure showed discontinuous chromium carbide phase. The resultant composite showed hardness similar to the base material, however, there was significant increase in the wear resistance of the alloy due to the addition of CaP. During wear testing, a tribo-layer or a tribofilm was found to develop on the surface. This led to the reduction in the leaching of Co and Cr ions during wear testing. The tribofilm was found to be dependent on the wear distance, and made the CoCrMo-CaP composites an *in situ* self-protecting system. The overall coefficient of friction of the CoCrMo-CaP composite was found to increase but was more stable with the wear distance as compared to the CoCrMo alloy with no CaP addition.

Keywords: CoCrMo alloys, load-bearing implants, wear damage, in vivo, laser processing.