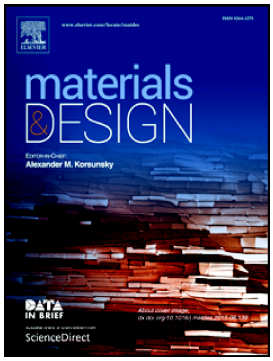

Effect of Nb content on microstructure, property and in vitro apatite-forming capability of Ti-Nb alloys fabricated via selective laser melting

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Abstract

Ti-Nb alloys were in-situ fabricated by selective laser melting (SLM) to study the effect of Nb content on their phase transformation, microstructure evolution, mechanical properties and in vitro apatite-forming capability. Results show that α′ martensite and β (Ti, Nb) phase are obtained in SLM-processed Ti-Nb alloys. The increase of Nb content results in the increase of β phase amount but decrease of β grain dimension. The former effect is due to the suppression of martensitic transformation and strengthening of solid solution behavior, while the latter phenomenon can be attributed to the increase of heterogeneous nucleation sites. The Ti-25Nb alloy possesses the lowest modulus of 18.7 ± 1.4 GPa due to the maximum content of β phase. The SLM-processed Ti-45Nb alloy exhibits superior strength of 1030 ± 40 MPa and microhardness of 356 ± 7 $HV_{0.1}$, which is 97.32% and 52.53% higher than cast ones, respectively. The in vitro apatite-forming capability of Ti-25Nb alloy is the most superior compared to other Ti-Nb alloys. It demonstrates that β phase has the ability to induce apatite formation. The research shows that SLM could be used for in-situ fabrication of Ti-Nb bone implants with tailored mechanical and biomedical properties by adjusting Nb addition.

Keywords: Ti-Nb alloy; Selective laser melting; Nb content; Mechanical property; In vitro apatite-forming capability

1. Introduction

Selective laser melting (SLM), an additive manufacturing process, is capable of fabricating complex functional parts directly by using high energy laser to selectively