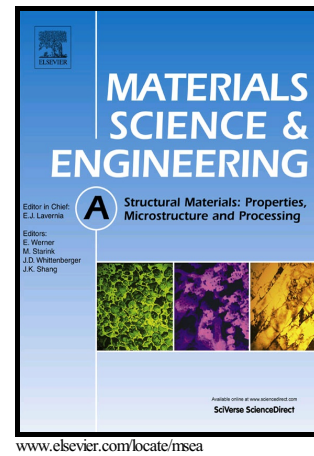


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A novel hybrid selective laser melting/hot isostatic pressing of near-net shaped Ti-6Al-4V alloy using an in-situ tooling: Interfacial microstructure evolution and enhanced mechanical properties

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Abstract

In this study, fully dense Ti-6Al-4V alloy parts were successfully fabricated by an in-situ tooling (skin or shell) via a novel hybrid process of selective laser melting (SLM)/hot isostatic pressing (HIP). In this hybrid process, the in-situ tooling of Ti-6Al-4V parts was prepared via selective laser melting, then filled with Ti-6Al-4V powder, and finally consolidated by hot isostatic pressing to build fully dense complex parts without the need of removal of anything. The interface between tooling and consolidated powder was investigated in detail using scanning electron microscope (SEM) and electron backscattered diffraction (EBSD), and the bond strength was evaluated by tensile and fatigue testing. It was found that there was no obvious element diffusion around the interface, but the pronounced difference in microstructure type and grain size could be seen. Regardless of HIP temperatures, the tensile and fatigue samples preferentially failed on the tooling side due to the coarser Widmanstatten microstructure. Compared with the as-SLMed parts, the samples prepared by this hybrid SLM/HIP process exhibited higher mechanical properties such as superior strength and outstanding ductility, and became more competitive, even than wrought Ti-6Al-4V parts.

Keywords: Selective laser melting, hot isostatic pressing, interface, tensile behavior, fatigue property

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