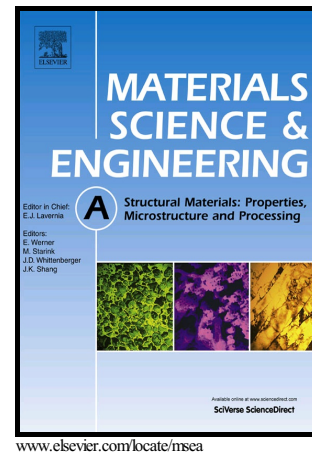


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Comparison of microstructures and mechanical properties of Inconel 718 alloy processed by selective laser melting and casting

Dongyun Zhang^{a,b*}, Zhe Feng^{a,b}, Chengjie Wang^{a,b}, Weidong Wang^{a,b}, Zhen Liu^{a,b}, Wen Niu^{a,b}

^aInstitute for Laser Engineering, Beijing University of Technology, Pingleyuan No. 100, Chaoyang District, Beijing, 100124, China

^bBeijing Engineering Research Center of 3D Printing for Digital Medical Health, Pingleyuan No. 100, Chaoyang District, Beijing, 100124, China

*Corresponding author. Dongyun Zhang; Tel.: +86 1067396557; fax: +86 1067396557. zhangdy@bjut.edu.cn.

Abstract

The paper comparatively investigates the microstructures and mechanical properties of Inconel 718 superalloy manufactured by selective laser melting (SLM) and casting. The finite element analysis (FEA) method is used to simulate the temperature fields during SLM and casting processes. Driven by ultra-high temperature gradient and ultra-fast cooling rate during SLM process, the fine grains (average grain size of 48 μm) and dispersed fine precipitation in SLM-ed sample even after HSA (homogenization + solution + aging) and HA (homogenization + aging) heat treatment significantly enhance its mechanical properties, which far exceeds that of casting with average grain size of 1300 μm , and is comparable to that of forging. The microstructure of casting with coarse irregular Laves phases, acicular δ precipitates and globular carbides in the interdendritic zones after HSA heat treatment and some defects existed possibly result in premature failure of tensile samples. The microstructure without δ phases but only some globular carbides in the grain boundary of SLM-ed sample after HA heat treatment possesses higher mechanical properties than that after HSA heat treatment, in which there is only some finer needle-like δ phase and few

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