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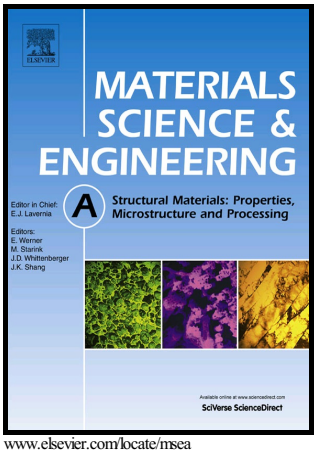

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Effect of heat treatment on microstructure and mechanical properties of the selective laser melting processed Ti-5Al-2.5Sn α titanium alloy

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Abstract

In the present work, selective laser melting technology (SLM) has been used to produce Ti-5Al-2.5Sn α titanium alloy and the influence of post-deposition heat treatments on microstructure and mechanical properties of the as-deposited alloy has been in-depth analyzed for the first time. As-deposited Ti-5Al-2.5Sn exhibits a columnar prior-β microstructure with martensitic α′ needles filled inside and a small amount of grain-boundary α (α_{GB}) stripes precipitated at the prior-grain boundaries. After subtransus heat treating at 600 °C to 750 °C for 2h, incomplete recrystallization of the as-deposited microstructure occurs and the recrystallized α grains with equiaxed morphology nucleate mainly through grain boundary migration of the stripe-like α_{GB}, leading to a duplex microstructure composed of the soft recrystallized α and 75.1%~97.6% high-strength α′. After subtransus heat treating at 850 °C to 950 °C for 2h, complete recrystallization of the as-deposited microstructure occurs and the coarsening of recrystallized α grains becomes more pronounced at 950 °C. By contrasting, an excessively coarsened widmanstatten microstructure composed of α laths with lengths up to several hundred micrometers has been obtained after supertransus heat treating at 1100 °C for 2h. Both of the as-deposited and heat-treated samples exhibit relatively weak textures, resulting in very little mechanical