

A Comparative Study on the Sintering and Casting of a Blended Elemental Ti-6Al-4V Alloy

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Abstract

Over the past years, the blended elemental powder metallurgy (PM) approach has been identified as one of the most promising strategies to reduce the cost of titanium-based components. However, oxygen pick-up, inhomogeneity of the microstructure and chemical composition are sometimes reported for PM parts. This work compares properties of a blended elemental Ti-6Al-4V alloy obtained by sintering under argon gas atmosphere with those of a vacuum cast alloy. Argon was purified by passing it through a series of oxygen and moisture traps prior to being introduced into the sintering furnace. Casting was performed under vacuum (1×10^{-3} mbar). The starting material in both processes was the cold isostatically pressed blended elemental (BE) Ti-6Al-4V powder compact. The BE powder was prepared by mixing 60Al-40V master alloy powder with commercial Grade 4 titanium powder (0.377 wt.% O₂). The sintered and cast alloys were compared on the basis of oxygen pick-up, density, microstructure, chemical composition and hardness to determine which method is better. Although the BE approach could not eliminate the common challenges associated with powder metallurgy processing of Ti alloys, oxygen pick-up and additional contamination was lower compared vacuum casting. Sintering at 1350°C for 1 h could not achieve full density compared to casting, but the microstructure appeared more homogeneous. Both sintered and cast Ti6Al4V alloys were harder than wrought Ti6Al4V due to a high concentration of interstitial oxygen. The sintered and sintered plus HIPed Ti6Al4V alloys were softer than as-cast Ti6Al4V due to lower oxygen pick-up and incomplete densification. From the contamination and homogeneity perspective, the BE approach is an attractive technique for processing of Ti6Al4V alloy.