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## Grain refinement and excellent mechanical properties of a Ti-based alloy via laser melting and subsequent low temperature annealing

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### Abstract

Compared with arc melting, ultrahigh strength and good elongation of Ti-25Zr-10Al alloy via laser melting and subsequent low temperature annealing are investigated. The results show a strong dependency of the microstructure on the methods of melting and subsequent low temperature annealing process. Compared with orthorhombic  $\alpha''$  martensitic phase after arc melting, at the condition of relatively high cooling rate by laser melting, hexagonal close-packed  $\alpha'$  martensitic phase with  $\{10\bar{1}1\}$  twinning is observed, and recrystallization with the average grain size of  $0.3\mu\text{m}$  occurs after subsequent low temperature annealing. In addition, ultrahigh strength of 1352MPa and good elongation of 10.9% are obtained.

**Keywords:** titanium alloy; selective laser melting; mechanical properties; microstructure

### 1. Introduction

Titanium (Ti) based alloys exhibit an excellent combination of mechanical and physical properties for key applications in aerospace and medical apparatus [1-3]. Recently, a series of Ti-Zr based alloys, such as Ti-Zr [4-6], Ti-Zr-Mo-Cr [7], Ti-Zr-Mo-Sn [8], Ti-Zr-Ta [9], Ti-Zr-Nb [10, 11], and TiZrAl [12, 13] alloys, are reported to have good corrosion resistance and excellent mechanical properties, compared with traditional Ti alloys. However, extensive application of Ti alloys has been still

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