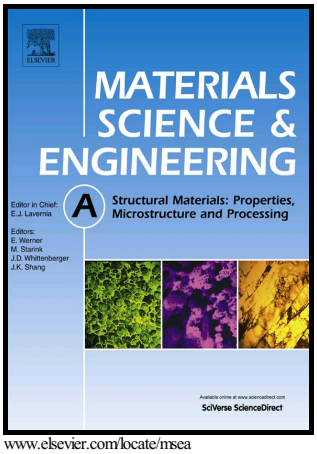
Grain refinement and excellent mechanical properties of a Ti-based alloy via laser melting and subsequent low temperature annealing

X.J. Jiang, G.Y. Chen, X.L. Men, R.H. Han, P. Zhao, X.L. Dong, R.P. Liu



www.elsevier.com/locate/msea

PII: S0921-5093(18)31239-5
DOI: https://doi.org/10.1016/j.msea.2018.09.042
Reference: MSA36923

To appear in: *Materials Science & Engineering A*

Received date: 2 May 2018
Revised date: 31 August 2018
Accepted date: 13 September 2018

Cite this article as: X.J. Jiang, G.Y. Chen, X.L. Men, R.H. Han, P. Zhao, X.L. Dong and R.P. Liu, Grain refinement and excellent mechanical properties of a Ti-based alloy via laser melting and subsequent low temperature annealing, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.09.042

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

X.J. Jiang[a,b], G.Y. Chen[a], X.L. Men[a], R.H. Han[a], P. Zhao[a], X.L. Dong[a], R.P. Liu[b*]

[a]Hebei Provincial Key Laboratory of Traffic Engineering materials, School of materials science and Engineering, Shijiazhuang Tiedao University, Shijiazhuang 050043, China

[b]State Key Laboratory of Metastable Materials Science and Technology, Yanshan University, Qinhuangdao 066004, China

[*]Corresponding author. *State Key Laboratory of Metastable Materials Science and Technology, Yanshan University, Qinhuangdao 066004, China.* Tel.: 0086-335-8074723; fax: 0086-335-8074545. riping@ysu.edu.cn (R.P. Liu)

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 α" martensitic phase after arc melting, at the condition of relatively high cooling rate by laser melting, hexagonal close-packed α' martensitic phase with $\{10\bar{1}1\}$ twinning is observed, and recrystallization with the average grain size of 0.3μm 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