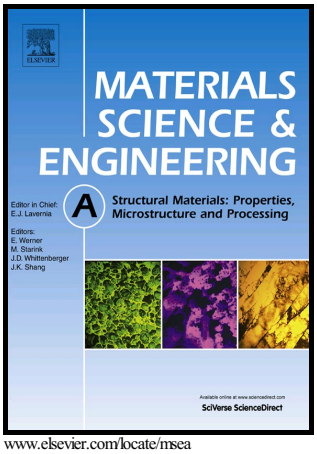
Microtexture in Additively Manufactured Ti-6Al-4V Fabricated Using Directed Energy Deposition

D.R. Waryoba, J.S. Keist, C. Ranger, T.A. Palmer



www.elsevier.com/locate/msea

PII: S0921-5093(18)31032-3
DOI: https://doi.org/10.1016/j.msea.2018.07.098
Reference: MSA36762

To appear in: *Materials Science & Engineering A*

Received date: 7 May 2018
Revised date: 25 July 2018
Accepted date: 26 July 2018

Cite this article as: D.R. Waryoba, J.S. Keist, C. Ranger and T.A. Palmer, Microtexture in Additively Manufactured Ti-6Al-4V Fabricated Using Directed Energy Deposition, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.07.098

Microtexture in Additively Manufactured Ti-6Al-4V Fabricated Using Directed Energy Deposition

D.R. Waryoba[1], J.S. Keist[2], C. Ranger[3], T.A. Palmer[4,5]

[1]Engineering, Applied Materials, The Pennsylvania State University, DuBois, PA 15801, USA
[2]Applied Research Laboratory, The Pennsylvania State University, State College, PA 16804
[3]Department of Physics, Carnegie Mellon University, Pittsburgh, PA 15213
[4]Department of Engineering Science and Mechanics The Pennsylvania State University, University Park, PA 16802.
[5]Department of Materials Science and Engineering, The Pennsylvania State University, University Park, PA 16802.

ABSTRACT:
The additive manufacturing (AM) of α+β titanium alloys using electron beam (EB) and laser directed energy deposition (DED) processes has been widely characterized in both the as-deposited and post processed conditions. Fine basket weave α lath structures are commonly observed in both the as-deposited and post processed hot isostatically pressed (HIP) conditions for both laser and EB DED processes, but more in-depth knowledge of the crystallographic texturing and variant selection of the α laths growing from the primary β-grains across the height of EB DED Ti-6Al-4V structures is not well established. At locations near the substrate in both conditions, microtexturing is weak, but EB DED builds exhibit a strong microtexture and pronounced variant selection with increasing build height. On the other hand, the laser DED builds displayed weak texturing and no prominent variant selection across all heights. With the addition of HIP post processing, there was no change in microtexturing of the coarsened α laths for both the laser and EB structures, and the same variant selection observed in the as-deposited EB DED builds was present.

Keywords: Additive manufacturing; Directed energy deposition; Ti-6l-4V; EBSD; HIP

1. Introduction

Directed energy deposition (DED) is an additive manufacturing (AM) processing method in which a powder or wire feedstock material is introduced directly into a molten pool in a layer by layer manner to produce a three-dimensional component. Microstructures formed in the DED process are governed by a complex combination of processing parameters, which include the heat input of the energy source, scan rate, deposition rate, and the dwell time between individual layers [1,2]. Among the range of materials commonly used in AM processes, titanium alloys, especially Ti-6Al-4V, have received considerable attention because of their applications in aerospace and biomedical industries [3-9].