Evolution of Micro-texture and Stress under Monotonic Tension in an Additively Manufactured near-α alloy

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Abstract

In the present study, we have investigated the localized stress and strain partitioning among the different microstructural constituents of near-α Ti-6Al-2Sn-4Zr-2Mo alloy prepared by Directed Energy Deposition (DED) process of additive manufacturing. A suitable heat treatment schedule was designed to control the microstructure. To correlate the effect of heat treatment on microstructure and consequently on mechanical properties microstructural characterization was done using electron backscatter diffraction. Heat treatment leads to an increase of beta phase fraction and size of alpha laths. To study the stress and strain partitioning among the alpha and beta phase, as a function of heat treatment, which in turn governs the global response under mechanical loading, a full field crystal plasticity tool based on the fast Fourier transform was employed. The crystal plasticity simulations were carried out using the open-source Dusseldorf Advanced Materials Simulation Kit (DAMASK) package. The simulation results show the higher equivalent von Mises stress in alpha, than beta phase. The prismatic slip system, being the most active, has the lowest CRSS values, while pyramidal has the highest CRSS values. The simulated texture evolution is well in agreement with the experiment results.

Keywords: Additive Manufacturing, Crystal plasticity, Microstructure

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