MRS Advances, January 2020, 5(23-24)

LENS manufactured γ-TNB turbine blade using Laser “in situ” alloying approach

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Abstract

A hollow γ-TNB turbine blade was 3D printed in this studying using the –R Optomec LENS machine from the elemental powders of aluminium, niobium and titanium making use of the laser “in situ” alloying approaching. The printed blade was characterised of a nearly lamellar β microstructure in the As-built state. The microstructure of the blade

post heat treated was characterised of grain growth and coarsening and the formation of the γ phase which was of the result of the transformation of β. This transformation was also observed in the As-built state and is reported here for the first time. A massive crack that was observed half-way through in the built was attributed to the thermal shocks that are experienced by the almost immediately after manufacturing. The EDS and Map taken on the As-built and heat treated samples conclude that there was no segregation in the alloying element during manufacturing and that the blade was of the dual phase. Hardness results indicated the heat treated sample was 91 HV0.5 lower in hardness when compared to the As-built component. The successful print of this hollow blade indicate that γ-TNB and other Ti-Al alloys can be printed with the LENS but if a crack free sample was to be achieved the set-up had to be manipulated or addition resources must be added to adapt the set-up. Meanwhile the successes of this study show that LENS is going to be considered as a cost-effective manufacturing tool in the future for 3D printing Ti-Al and other metallic structure that would have improved properties when compared to traditional manufacturing technique such as casting and the powder bed systems