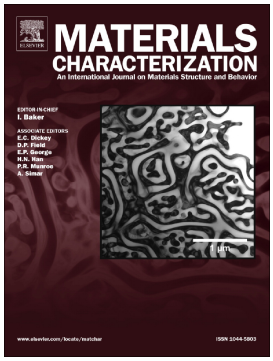

Nickel-based superalloy microstructure obtained by pulsed laser powder bed fusion

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Nickel-based Superalloy Microstructure Obtained by Pulsed Laser Powder Bed Fusion

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Abstract

A methodology using pulsed laser powder bed fusion to produce crack-free AM parts from Superalloy was demonstrated on Inconel 718. In the as-deposited condition, columnar grains with epitaxial growth were observed. The texture was observed to be towards (100) planes. Dendritic structure with average dendrite arm spacing of 0.37 ± 0.12 μm was observed, which suggested the cooling rate in the magnitude of 10^6 K/s. This high cooling rate yielded the precipitation of both γ' and γ", and broke down the continuous feature of eutectic phases formed from the residual liquid phase during terminal solidification. The eutectics consisted of mainly discrete Laves phases and small portion of NbC. The discrete Laves phases contributed to the good solidification behavior of the Inconel 718 build. After solution annealing and two-step aging treatment, partial recrystallization occurred and resulted in the nucleation of small equiaxed grains. Laves phase dissolved and δ phase with needle-like shape formed. Precipitates also developed through the solid-state transformation during heat treatment.