# Numerical Modeling of Microstructure Evolution During Directed Energy Deposition Additive Manufacturing of Ti-6Al-4V

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The Directed Energy Deposition (DED) process is a metal additive manufacturing (AM) process in which localized moving heat sources having high-intensity are used to melt and fuse powder materials. The complex and non-uniform thermal gradients generated by rapid heating and cooling cycles in DED process directly affects the microstructural characteristic and thereby the ultimate mechanical properties of AM fabricated parts [1,2]. Hence, understanding how the AM process affects the part microstructure is of critical importance. The objective of this paper is to present a three-dimensional Finite Element (FE) based thermo-kinetics model to investigate microstructural evaluation during the Laser Engineering Net Shaping (LENS) process [3], which is one of the representative processes of DED. The proposed model couples the FE heat transfer calculations [4] with phase transformation kinetics and microstructure of Ti–6Al–4V. The microstructural model based on Kelly's [5] and Charles's [6] models, which enables calculation of the Widmanstätten colony and basketweave phase fractions, and alpha lath width [7] during heating and cooling cycles.

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