Melt pool analysis and meso-scale simulation of laser powder bed fusion process with Ti-6Al-4V powder particles

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Abstract

Laser powder bed fusion (L-PBF) process is accompanied by rapid melting and solidification that results in intense thermo-capillary convection within the melt pool. An open source particle simulation software is utilized to generate a single layer of spherical powder particles of variable diameters. Considering the importance of particle size and particle size distribution (PSD) in L-PBF process, three distinct categories of PSD are generated with identical settings. A 3D thermo-fluid model is developed in this study that incorporates the generated layer of powder particles of non-uniform sizes over a thick substrate. A moving volumetric heat source is applied to melt a single track in the powder layer through the user defined function (UDF) in FLUENT software. Temperature dependent material properties including variable surface tension is considered for the computation. The numerical model is used to simulate Ti-6Al-4V powder particles to observe the melt pool flow dynamics. Presence of particles of smaller diameter in the powder mix supports a consistent and continuous melt pool flow while any kind of void enhances fluid convection in the downward direction causing a temporal increase in melt pool depth.

Biography of Presenter

Santosh K. Rauniyar is currently a Ph.D. student in the Department of Industrial Engineering at the University of Louisville. Mr. Rauniyar received his B.S. in Mechanical Engineering from Tribhuvan University in Nepal. His research interest includes additive manufacturing technologies, finite element analysis, design and simulation, and computational mechanics, etc. Santosh was a recipient of College Fellow Scholarship from Tribhuvan University and Mahatma Gandhi scholarship from Government of India.