REVIEW OF MICRO AND MESOSCALE SIMULATION METHODS FOR LASER POWDER BED FUSION

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Additive manufacturing (AM) is an advanced method of manufacturing which is used to produce complex parts layer by layer until the required design is achieved [1]. Laser powder bed fusion (L-PBF) is used to produce parts with high resolution because of low layer thickness. L-PBF uses laser beam and material interaction where the powder material is melted and then solidified [2]. This occurs in a short time frame [3] and makes it challenging to study the process in real time.

Studies have shown the development of numerical methods and the use of simulation software to study the laser beam and material interaction. [4]. This phenomenon is key to understanding the material behavior under melting and mechanical properties of the part produced by L-PBF process as it is directly linked with the solidification of the melted powder material [5]. A detailed study of the laser beam and material interaction is needed on a microscale and mesoscale level as it provides a better understanding and helps in the development of the given material for the L-PBF process. This review provides a comprehensive understanding of the background for the use of simulation in AM and the different simulation scales of feature under interest.

This literature review provides an analysis of the gap that is present between the simulation of laser beam and material interaction and the real time process. A summary of various simulation software used to replicate the laser beam and material interaction is shown as microscale phenomena need to be understood. This article will also provide a pathway for future researchers to use the concept of simulation in an efficient manner for fastening material development for L-PBF.

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