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PROCEEDINGS

Gas-Particle-Heat Dynamic Coupling Simulation in Directed Energy Deposition

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ABSTRACT

Powder flow can affect the temperature variations in directed energy deposition (DED). However, the direct coupling mechanism remains unknown. To solve this problem, the heat and mass transfer in additive manufacturing was simulated using dynamic coupling. The interactions between the multiphase flow and heat transfer were established. A comparison with experiment shows that the accuracy of the predictions of the numerical simulation regarding powder size distributions and temperature increases is higher than 95%. The average temperature increase of the metal powders with different weight functions was highly consistent in the simulation process. As the powder size increases, the average temperature of the powder on the printing plane decreases. This was the reason for the formation of a deeper melt pool in the case of smaller particles in the experiment. The different curvatures between the particle surface and melt pool surface lead to a decreased energy absorption efficiency in DED. The relationship between the powder features and the melt pool size was studied. A decrease in the powder flow rate increased the temperature, leading to a larger melt depth.

KEYWORDS

Additive manufacturing, directed energy deposition, powder temperature, laser attenuation, multiphase coupling

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