Numerical Simulation and Experimental Validation of Single Clad Laser Metal Deposition

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Abstract

Laser metal deposition is widely adopted for coating, reparation and 3D printing. Using COMSOL, we have developed a numerical model with full coupling of laminar fluid flow and heat transfer. The Marangoni effect is considered to capture the enhanced convective heat transfer as well as the effects of melt-pool fluid flow on the clad bead profile. The clad bead shape is determined by the balancing of the external ambient pressure with the tangential and normal surface gradient. Mass addition into the melt-pool from the powder jets is accounted for by using the moving mesh method. The numerical results match well with results from experiment in terms of clad dimension & melt-pool depths under different laser power, laser scanning speed & powder feeding rates.

Figures used in the abstract

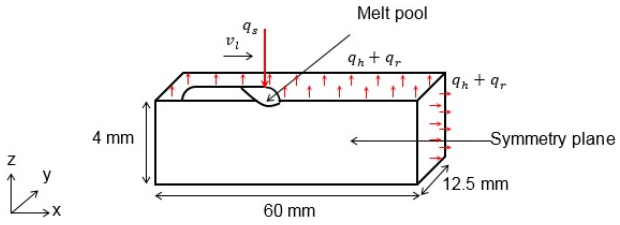

Figure 1: Schematic of the modeled laser metal deposition process