Abstract Submitted
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Simulation on the Effects of Surfactants and Observed Thermocapillary Motion for Laser Melting Physics[1] ROBERT NOURGALIEV, Lawrence Livermore National Laboratory, REBECCA BARNEY, University of California, Daivs; Lawrence Livermore National Laboratory, BRIAN WESTON, Lawrence Livermore National Laboratory, JEAN-PIERRE DELPLANQUE, University of California, Davis, ROSE MCCALLEN, Lawrence Livermore National Laboratory — A newly developed, robust, high-order in space and time, Newton-Krylov based reconstructed discontinuous Galerkin (rDG) method is used to model and analyze thermocapillary convection in melt pools. The application of interest is selective laser melting (SLM) which is an Additive Manufacturing (AM, 3D metal laser printing) process. These surface tension driven flows are influenced by temperature gradients and surfactants (impurities), and are known as the Marangoni flow. They have been experimentally observed in melt pools for welding applications, and are thought to influence the microstructure of the re-solidified material. We study the effects of the laser source configuration (power, beam size and scanning speed), as well as surfactant concentrations. Results indicate that the surfactant concentration influences the critical temperature, which governs the direction of the surface thermocapillary traction. When the surface tension traction changes sign, very complex flow patterns emerge, inducing hydrodynamic instability under certain conditions. These in turn would affect the melt pool size (depth) and shape, influencing the resulting microstructure, properties, and performance of a finished product part produced using 3D metal laser printing technologies.

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