On the Spreading and Solidification of Molten Particles in a Plasma Spray Process : Effect of Thermal Contact Resistance

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Abstract

The spreading and simultaneous solidification of a liquid droplet upon its impingement onto a substrate permitting thermal contact resistance has been numerically simulated; the effect of contact resistance and the importance of solidification on droplet spreading are investigated. The numerical solution for the complete Navier-Stokes equations is based on the modified SOLA-VOF method using rectangular mesh in axisymmetric geometry. The solidification of the deforming droplet is considered by a one dimensional heat conduction model. The predictions are in good agreement with the available experimental data and the model may be well suited for investigating droplet impact and simultaneous solidification permitting contact resistance at the substrate. We found that the final splat diameter could be extremely sensitive to the magnitude of the thermal contact resistance. The results also show that for the condition of higher Reynolds and/or higher Stefan numbers the effect of solidification on the final splat diameter is more important.