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Impact of Metal Droplets: A Numerical Approach to Solidification[1] ROBIN KOLDEWEIJ, University of Twente, RAJESH MANDAMPARAMBIL, TNO, DETLEF LOHSE, University of Twente — Layer-wise deposition of material to produce complex products is a subject of increasing technological relevance. Subsequent deposition of droplets is one of the possible 3d printing technologies to accomplish this. The shape of the solidified droplet is crucial for product quality. We employ the volume-of-fluid method (in the form of the open-source code Gerris) to study liquid metal (in particular tin) droplet impact. Heat transfer has been implemented based on the enthalpy approach for the liquid-solid phase. Solidification is modeled by adding a sink term to the momentum equations, reducing Navier-Stokes to Darcy's law for high solid fraction. Good agreement is found when validating the results against experimental data [2]. We then map out a phase diagram in which we distinguish between solidification behavior based on Weber and Stefan number. In an intermediate impact regime impact, solidification due to a retracting phase occurs. In this regime the maximum spreading diameter almost exclusively depends on Weber number. Droplet shape oscillations lead to a broad variation of the morphology of the solidified droplet and determine the final droplet height.

[1]TNO
[2]S.D.Aziz, S.Chandra, Int. J. of Heat and Mass Trans. 43 (2000)

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