

عنوان مقاله:

MODELING OF HEAT TRANSFER AND SOLIDIFICATION OF DROPLET/SUBSTRATE IN MICROCASTING SDM PROCESS

محل انتشار:

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خلاصه مقاله:

Microcasting Shape-Deposition-Manufacturing is an approach to Solid-Freeform-Fabrication (SFF) process which is a novel method for rapid automated manufacturing of near-net-shape multi-material parts with complex geometries. By this method, objects are made by sequentially depositing molten metal droplets on a substrate and shaping by a CNC tool, layer by layer. Important issues are concerned with remelting depth of substrate, cooling rate and stress build up. In the present study attempts were made to numerically model the heat transfer and phase change within the droplet/substrate, making a better understanding of process performance. Thus, making a brief literature review, a 2-D transient heat transfer Finite Element Analysis was carried out by the use of ANSYS multiphysics, in which solidification is handled using apparent capacity method. Verification was done by available experimental data in the open literature to ensure model predictions. The model was run under various process parameters and obtained results presented in the form of temperature fields, solidification profiles, cooling curves and remelting history curves. Solidification profile studies predict a columnar dendritic solidified structure in the vertical orientation which was in agreement with metallographic sections published earlier. Parametric studies were also carried out under different boundary conditions, initial temperature of the droplet and Substrate temperature. It was concluded that 1) the process is not sensitive to convection/radiation effects from the surface. 2) the main parameter that can control the maximum remelting depth is initial temperature of the droplet. the more drop temperature, the more remelting depth. This parameter also affects cooling rate during solidification. 3) Increasing substrate temperature showed a decreased cooling rate in solid, which can be used to reduce residual stresses, but it had a minor effect on the cooling rates during solidification.

کلمات کلیدی:

Heat Transfer, Solidification, FEM, Shape Deposition Manufacturing, Microcasting

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