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Heat propagation of circular thin-walled parts fabricated in additive manufacturing using gas metal arc welding

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Abstract: A finite element model is developed to calculate the heat propagation of a circular thin-walled component fabricated in gas metal arc welding based additive manufacturing. The heat evolution, thermal cycle feature, and temperature gradient in molten pool and deposited layers are revealed. The temperature simulations at some locations are in agreement with measured values from thermocouples. As the deposition process proceeds, the high-temperature regions of the substrate and molten pool increase. The temperature gradient in the molten pool decreases with the increasing deposition height. The heat dissipation condition in the molten pool of current layer tightly depends on the deposition direction of fore layer. At the deposition ending moment, the heat conduction in the axial direction is the predominant heat dissipation orientation, whereas the circumferential orientation becomes the main heat dissipation direction in the top layers.

Keywords: Additive manufacturing; gas metal arc welding; heat propagation; thin-walled part; temperature gradient