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PROCEEDINGS

The Simulation of Microstructures and Mechanical Properties in Wire Arc Additive Manufacturing

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ABSTRACT

Wire arc additive manufacturing (WAAM) reveals its high efficiency for the fabrications in comparison with laser additive manufacturing. To reveal the relationship between arc settings and the microstructural evolutions, phase field model and Monte Carlo model are established for the simulation of the microstructural evolutions and dislocation dynamics model is established for the simulation of the anisotropic properties in WAAM. Numerical results are compared with Experiments to validate the proposed models. The length/width ratio of the formed grains in solidification becomes smaller when the scanning speed is decreased or the input powder is increased. The difference of the temperature gradient near the border of the melt pool takes the key role determining the change of the grain morphology in WAAM. The combination of the Hall-Patch equation with the dislocation dynamics reveals that the grain morphology changes have direct influence on the anisotropic mechanical properties. The ratio of the grain morphology on the yield strength is around 10% and immobile dislocation and the mobile dislocation take the major contribution to the total yield strength in the mechanical properties of WAAM Ti-6Al-4V. The control of the heat input and the scanning speed can be beneficial to the control of the final mechanical properties in WAAM.

KEYWORDS

Wire arc additive manufacturing; phase field method; Monte Carlo method; dislocation dynamics

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