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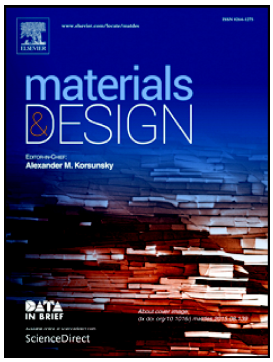

Simulation and experimental studies on microstructure evolution of resolidified dendritic TiCx in laser direct deposited Ti-TiC composite

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Simulation and experimental studies on microstructure evolution of resolidified dendritic TiC_x in laser direct deposited Ti-TiC composite

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Abstract: This paper describes the formation process of resolidified dendritic TiC_x in laser direct deposited (LDD) Ti-40vol.%TiC composite via a combination of a thermodynamic consistant phase field (PF) model and an LDD model. The LDD model simulated the LDD process of this composite and provided the temporal and spatial temperature fields in the molten pool for the PF model, which predicted the solidification process of TiC_x dendrites at different zones in the molten pool. The improved PF model introduced a grain index to link different crystallographic orientations for polycrystalline growth, which improved the computational efficiency by solving one PF equation instead of multiple phase variables. A two-sublattice model was utilized to establish the thermodynamic database of TiC_x. The predicted temperature history, deposition geometry as well as the morphology of polycrystalline TiC_x dendrites matched the experimental observation. As the temperature decreases, microsegregation occurred to the distribution of carbon over the dendrite where dendrite tips had a higher carbon concentration. Due to the increased undercooling, TiC_x dendrites grew at an increased speed from top to bottom of the molten pool. Within 0.007 s, the dendrites were fully developed and inhibited further growth of each other.

Keywords: Phase field model, Thermodynamics, Polycrystalline, Ti-TiC composite, Laser deposition

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