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Incorporating Complex Thermal Histories in Grain Microstructure Simulations of Additively Manufactured 316L SS

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Predicting microstructure evolution due to the rapid solidification and complex thermal histories of additive manufacturing (AM) is key to understanding the resulting process-structure-property relationships. To meet this objective, this research employed numerical heat transfer modeling combined with kinetic Monte Carlo (KMC) simulations. Previously, the KMC technique has been utilized to predict grain morphology using linear temperature gradients without time evolution. To further refine microstructure predictions using this method, spatial temperature histories were generated by simulating the production of a 316L stainless steel tube via powder bed technique. The temperature histories were then used in KMC simulations to model microstructure evolution of grain morphology. These results provide a novel methodology to link physically-based thermal simulations to microstructure.

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