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CONTINUUM MESO-MACRO MULTISCALE MODELING OF ANISOTROPY DURING SINTERING OF PARTS PRODUCED VIA ADDITIVE MANUFACTURING

In this study, the anisotropy of parts produced via binder jetting is investigated during sintering across multiple scales, using a coupled kinetic Monte Carlo–Finite Element simulation framework.
The process begins with the calibration and validation of a microscale Monte Carlo (kMC) sintering model, benchmarked against experimental data obtained through X-ray computed tomography (X-ray CT), discrete element modeling and optical microscopy at key densification stages captured via interrupted thermal cycles. Once validated, the model provides microscale descriptors such as strain rate and pore orientation, which are then incorporated as anisotropic sintering stress inputs into a continuum-level sintering model. This macroscopic model is based on the Skorohod-Olevsky Viscous Sintering (SOVS) finite element framework, tailored for 316L stainless steel.
The continuum formulation accounts for key material behaviors, including the influence of initial relative density, grain growth kinetics, the δ-ferrite phase transformation that occurs at elevated temperatures, friction and gravity.
Using a combination of experimental imaging, tensor-based quantification, and numerical simulations, the proposed approach links microscopic directional dependencies to macroscopic responses. The results demonstrate that anisotropy evolves nonlinearly with structural hierarchy, and that cross-scale coupling plays a critical role in determining effective material behavior.

Professional Status of the Speaker

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Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

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