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Probing high heating rate sintering with the phase-field method

Sintering is an energy-intensive process used in many materials manufacturing routes.
High heating rate sintering promises to reduce the time and energy costs and possibly achieve better properties as well.
However, it may induce large thermal gradients which can lead to inhomogeneous microstructures and cracks forming.
In this work we seek to further the understanding of how the spatiotemporally evolving temperature field influences the microstructure evolution during sintering by using large-scale phase-field simulations.
The employed phase-field model builds upon recent work to more accurately model the motion of grains due to vacancy absorption, ensuring homogeneous densification in homogeneous settings.
This property can make the numerical Péclet number arbitrarily large, which can lead to artifacts if not accounted for.
Based on the simulations results, it is found that even a simple isothermal model reproduces common high-heating rate sintering observations, with order-of-magnitude matches to experiments without parameter adjustment.
Taking into account thermal gradients on a parts scale shows that the Biot number is still a good predictor for inhomogeneous temperature effects even in a evolving, porous microstructure.
Depending on the processing conditions, sintering fronts may form and hence cause temporal inhomogeneity but with a final homogeneous structure.
Finally, the effect of combining temperature gradients and constrained sintering is considered.

Professional Status of the Speaker

Postdoc

Interest in submitting a paper in a special issue of

No interest

Invitation letter for visa

No

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