Contribution ID: **164** Type: **2. Invited speaker (by invitation only)**

Advanced phase-field modeling and simulation framework for practical sintering process design

In solid-state sintering, numerical prediction of microstructure and defect evolution is essential for the creation of high-performance products. The phase-field (PF) method is uniquely capable of accurately capturing both densification and grain growth during sintering. However, the high computational cost of PF sintering simulations remains a major obstacle. In addition, rigid-body motion models are still under development. Moreover, because sintering involves overall body shrinkage, the application of conventional periodic boundary conditions is not straightforward. In this talk, I will present our recent efforts to overcome these limitations. By implementing parallel computing with multiple GPUs and developing an efficient summation algorithm for calculating the rigid-body motion of particles, we have enabled large-scale PF sintering simulations. We have also proposed a pseudo-periodic boundary condition (PPBC) on fixed grids, in which periodic boundary planes migrate while microstructures are duplicated across these planes to eliminate surface artifacts. Furthermore, beam elements were introduced between particles to model rigid-body interactions, enabling the representation of particle bonding and separation, as well as translational and rotational motions. The integration of these techniques makes PF sintering simulations a practical and reliable design tool for sintered materials and products.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

No interest

Invitation letter for visa

No

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Session Classification: Modelling and simulation of sintering at multiple scales

Track Classification: Group 1: Modelling and simulation of sintering at multiple scales