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Microstructural sintering simulations for optimized microstructure evolution during sintering

A novel integrated microstructure model of sintering (IMS) has been developed to enable the simulation of realistic time-temperature cycles during sintering processes (F. Raether, G. Seifert, Open Ceramics, 25, 2026, 100900). Designed for solid-state sintering processes, the IMS includes grain boundary and surface diffusion, as well as grain growth. To obtain realistic results from the simulations, the model combines four established approaches: (i) analytical sintering equations; (ii) an ideal sintering model for minimizing interface energy; (iii) a Monte Carlo model for atomic diffusion processes; and (iv) a model for displacements and rotations of entire particles during sintering.

This contribution will present the concept of IMS and its practical implementation in a voxel-based representation. To validate the model, the results of simulations using typical alumina (Al_2O_3) material and process parameters will be presented and discussed. The simulation results will also allow conclusions to be drawn about practical strategies for improving homogeneity and reducing grain growth during sintering through the correct choice of temperature cycle. Finally, an outlook will be given on the next development stage of IMS, which is intended to provide specific input (e. g., parametrization functions) for improving continuum mechanical sintering models.

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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