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Quasi-Conservation of Microstructural Connectivity During Ceramic Densification

Sintering is a microstructure-driven transformation process in which discrete particles reorganize into a dense load-bearing solid. While classical models describe diffusion kinetics, grain growth, and densification behavior, the evolution of microstructural connectivity is rarely treated as a constrained variable. Experimental observations indicate that pore redistribution, contact formation, and crack initiation cannot be fully explained by density evolution alone.

We introduce a topology-constrained modelling framework based on the quasi-conservation of structural connectivity during ceramic densification. The microstructural state of a powder compact is characterized through coordination topology and connectivity measures. During sintering, local rearrangements modify geometry while preserving global structural degrees within bounded conditions. Densification is therefore interpreted as layered microstructural reallocation rather than purely monotonic density increase.

Simulation of early-stage neck growth and constrained shrinkage shows that structural instabilities correspond to threshold shifts in connectivity redistribution. This explains discontinuities in shrinkage rate and crack onset not fully captured by continuum descriptions.

Coupling connectivity tracking with sintering kinetics improves prediction of defect formation and failure. The framework provides a predictive multi-scale perspective for microstructure-controlled defects in advanced ceramics.

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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