

Sintering-Driven Evolution of Grain Boundary Complexions: Linking GBPD, Energy Distributions, and Atomic Structure Across Oxide and Silicate Systems

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The evolution of grain boundary complexions (Cantwell et al., 2014) during sintering remains insufficiently understood, despite its critical role in controlling transport and functional properties of polycrystalline materials. Here, we combine electron backscatter diffraction (EBSD) and transmission electron microscopy (TEM/PED) to establish a unified framework linking sintering conditions, grain boundary plane distributions (GBPD), and grain boundary energy landscapes across oxide and silicate systems.

Across all systems, EBSD provides statistically robust, population-level descriptors of boundary networks, while TEM and PED resolve the associated atomic-scale structures and validate complexion states. The combined results demonstrate that sintering pathways govern not only densification and grain growth, but also the selection and stability of grain boundary complexions. This establishes a direct link between processing, interfacial thermodynamics, and emergent material properties.

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