Sintering Kinetics by Structural Transition at Grain Boundaries in $BaTiO_3$

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For its analysis and understanding, sintering has been conventionally assumed to occur in proportion to driving force. This investigation, however, shows for the first time that the conventional assumption does not apply to faceted boundaries and that the microstructure can be frozen for faceted boundaries. A structural transition from rough to faceted was induced in $BaTiO_3$, by changing oxygen partial pressure. As long as the boundary was rough, continuous grain growth and densification occurred with sintering time, in agreement with the conventional assumption. With the onset of the structural transition from rough to faceted, however, grain growth and densification rates were reduced and became zero at the completion of the transition. This result demonstrates that critical driving forces are present for grain growth and densification for faceted boundaries, unlike the conventional understanding. The result also suggests that the formation or maintenance of faceted boundaries is crucial to inhibit grain growth and thus to produce ultrafine-structured materials.