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Growth Behavior of Faceted $\text{Na}_{1/2}\text{Bi}_{1/2}\text{TiO}_3\text{-BaTiO}_3$ Grains in Single and Two-step Sintering in Support for the Microstructural Evolution Principle

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We investigated the grain growth behavior in $89\text{Na}_{1/2}\text{Bi}_{1/2}\text{TiO}_3\text{-}11\text{BaTiO}_3$ (mol %, NBT-11BT) at 1100 and 1200 °C, and also under two-step sintering at 1200 (first) and 1100 °C (second). When the powder compacts were sintered at 1100 and 1200 °C, the initial growth behavior was quite normal; however, the subsequent growth behavior was distinctively abnormal and moderately abnormal, respectively. This difference in growth behavior is attributed to a change in the critical driving force for appreciable migration of the boundary with temperature and can be explained by the coupling effect of the maximum driving force for the growth of the largest grain and the critical driving force for appreciable migration of the grain boundary, viz. the principle of microstructural evolution. In contrast, two-step sintered samples exhibited stagnant grain growth behavior at the second sintering step up to 10 h at 1100 °C after appreciable initial growth of grains during the first sintering step at 1200 °C. Measurement of the grain size distribution after the first sintering step at 1200 °C indicated that the maximum driving force for the growth of the largest grain was reduced to a lower value than that in the sample conventionally sintered at 1100 °C without the first sintering step. This suggests that the beneficial effect of two-step sintering for suppressing grain growth is due to the reduction of the maximum driving force after the first sintering step compared with the maximum driving force in the conventionally sintered sample with the same average grain size. The experimental results confirm the general applicability of the recently deduced principle of microstructural evolution.