

Low-temperature sintering of titanium-based perovskite-type oxide semiconductors using alkali metal vapor

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Introduction

Titanium-based perovskite-type oxide ceramics for variable resistors [1] are conventionally produced by sintering green compacts in reducing atmospheres at ~1400 °C. We report the use of Na or K metal vapor to obtain conductive ceramics of CaTiO₃, SrTiO₃, and BaTiO₃ below 1000 °C.

Experimental

Powder compacts of CaTiO₃, SrTiO₃, and BaTiO₃ were placed into a boron nitride crucible and enclosed in a stainless-steel (SUS) container with Na or K metal in an Ar atmosphere. The containers were heated at 600–1000 °C for 1–10 h. Relative densities (RDs) and microstructures of the samples were evaluated by the Archimedes' method and scanning electron microscopy.

Results and Discussion

BaTiO₃ densified at the lowest temperature (~750 °C); maximum RDs (>96%) were achieved at 800–1000 °C for 2 h and the ceramics were conductive (~300 Ω cm) due to the reductivity of Na. Conductive ceramics of other perovskites were also obtained at 900 °C for 10 h. Cuboid grains in the ceramics suggests that a dissolution–precipitation process mediated by condensed Na vapor facilitates low-temperature densification. Furthermore, conductive BaTiO₃ ceramics were obtained in the same temperature range with K vapor.

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Reference

[1]Heywang, *J. Am. Ceram. Soc.*, 1964, 47, 484.

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