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Physical and Electrical features of Nano-grained $BaTiO_3$ Ceramics Prepared by Two-step Sintering

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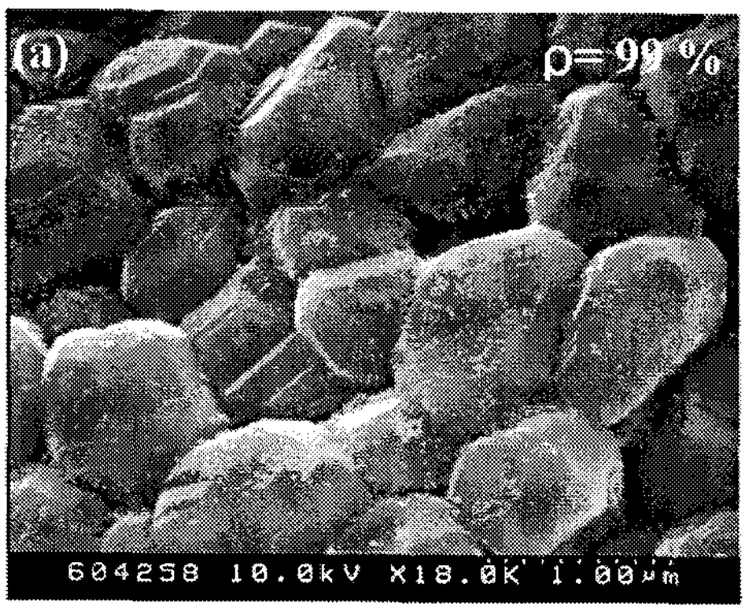
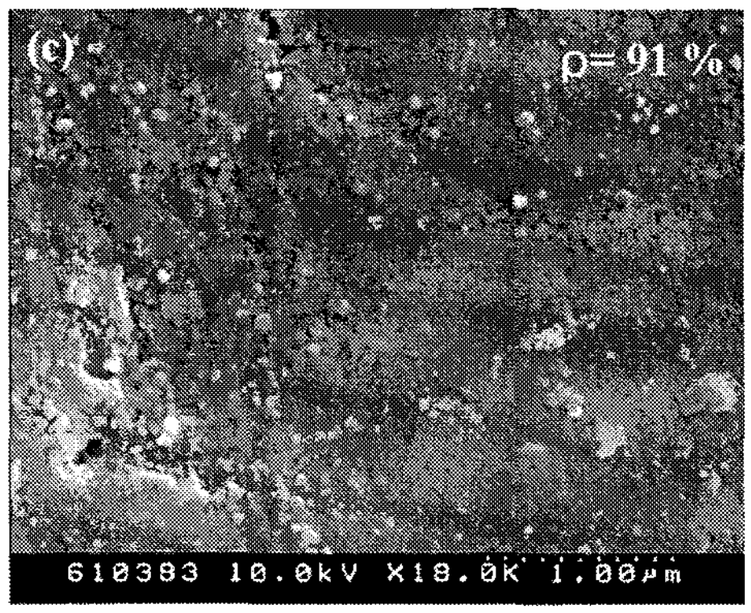
Barium titanate ($BaTiO_3$) is one of the most popular ferroelectric materials with a perovskite structure. It has been widely used in various electronic devices like multilayer capacitors, infrared detectors, fuel evaporators, varistors, and electro-optic devices for their unique and useful electrical characteristics. The electrical features of $BaTiO_3$ ceramics have been known to be crucially determined by the structural and chemical characteristics of grains.

One of promising areas to employ two-step sintering is in electroceramics, where the trend of miniaturization is continuing, requiring ceramic capacitor and ferroelectric components in multi-layer-chip capacitors (MLCC) or multi-layer-chip inductors (MLCI) to become ever thinner and smaller. Moreover, there is also a continuing trend to lower the sintering temperature of MLCC and MLCI in order to satisfy the co-firing requirement with electrode. In this respect, the two-step sintering method offers an additional advantage as it requires a substantially lower sintering temperature than conventional sintering methods.

In this study, Nano-grained $BaTiO_3$ ceramics were prepared by normal sintering and two-step sintering. The $BaTiO_3$ ceramics prepared with 20-nm-sized powders exhibit that grain size increased to be about 1 μm when normal sintering was performed at T=1250 ℃ (4 hours). However, the $BaTiO_3$ ceramics prepared with 20 nm-sized powders by two-step sintering at T_1 = 1200℃ and T_2 = 1120℃ (10 hours) exhibit that there is very little variation in their grain size. The physical and electrical features of nano-grained $BaTiO_3$ ceramics were discussed in terms of process parameters such as the two-step sintering conditions.





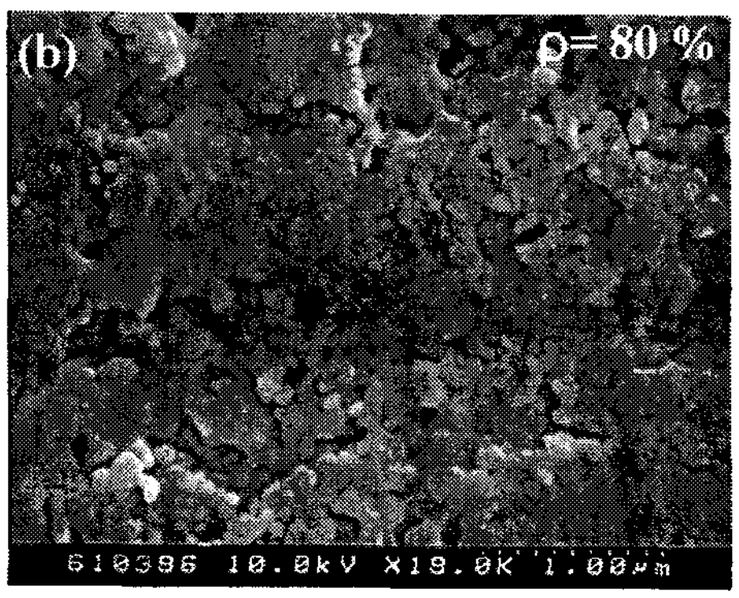


Fig. SEM images of the nano-grained $BaTiO_3$ ceraimics. (a) The $BaTiO_3$ ceramics were prepared by normal sintering at 1250°C for 4 hours. (b) The $BaTiO_3$ ceramics were prepared by two-step sintering at T_1 = 1180℃ and T_2 = 1020℃ (10 hours). (c) The $BaTiO_3$ ceramics were prepared by two-step sintering at T_1 = 1200℃ and T_2 = 1120℃ (10 hours).

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