EFFECT OF LITHIUM FLUORIDE ON THE DIELECTRIC PROPERTIES OF BARIUM TITANATE

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Barium titanate oxide (BTO) is a well-known perovskite material used in various microelectronic devices thanks to its piezoelectric, pyroelectric, ferroelectric and optoelectric properties. BTO ceramics are mostly used as dielectric in the fabrication of type II multilayer capacitors (MLCs), however, the sintering temperature of pure BTO is too high ($T_{sint.} \geq 1400$ °C). At such temperatures, the manufacture of MLCs needs expensive electrodes in palladium (Pd) or platinum (Pt). Therefore, since more than three decades, the research on BTO is focused on the densification at low temperature ($T_{sint.} \leq 1000$ °C) allowing the use of cheap metals or alloys as electrodes in MLCs. A lot of chemical additives were tested and several authors pointed out lithium fluoride (LiF) to be a suitable agent for the sintering of BTO at low temperature [1–5]. The main objective of the present study is the investigation of LiF effect on the dielectric properties of BTO.

Fine powders of BTO with various ratio BaO/TiO_2 (0.97; 1.00; 1.03) are synthesized by calcination of $BaCO_3$ and TiO_2 (rutile) at 1100 °C. The different BTO powders are mixed with 1, 2 or 3 wt. % of LiF and wet-ground in ethanol. The mixtures thus obtained are cold-pressed to pellets with the organic binder “latex”. The disks are sintered in free-air or sealed tube at 750, 850, 950 or 1100 °C for 2 or 8 hours.

The obtained ceramics are checked by X-ray diffraction, scanning electron microscopy, differential thermal analyses and Auger microprobe. Dielectric measurements are performed under vacuum at 1 kHz in the temperature range 180–500 K.

As results, the addition of LiF to BTO lowers both the sintering temperature and the ferroelectric Curie temperature T_C. Each ceramic exhibits a broad maximum of the permittivity ε'_r and small dielectric losses $\tan\delta$ at T_C. The best dielectric characteristics are observed from BTO (1.03) ceramic sintered with 2 wt. % of LiF at 950 °C for 2 hours then reheated at 1200 °C for 2 hours in sealed tube: $T_C = 248$ K, ε'_r at $T_C = 8650$, $\tan\delta$ at $T_C = 6 \times 10^{-3}$. Most of the prepared ceramics could be of interest for Z5U multilayer capacitors manufacturing at low factory cost.

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