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High energy-storage performance of BNT-BT-NN ferroelectric thin films prepared by RF magnetron sputtering

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Abstract: Dielectric materials with high energy-storage density and efficiency have great potential applications in modern electric and electronic devices. In this work, a series of $0.9(0.94\text{Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3-0.06\text{BaTiO}_3)-0.1\text{NaNbO}_3$ (BNT-BT-NN) ferroelectric thin films were deposited on LaNiO_3 (LNO) bottom electrodes by radio-frequency (RF) magnetron sputtering technique. The effects of different annealing temperature on microstructure, dielectric property and energy-storage performance of these thin films were studied in detail. Post-deposition annealing of BNT-BT-NN thin films at an appropriate temperature of $650\text{ }^\circ\text{C}$ was found to greatly enhance film structure and electrical characteristics, such as dense structure, smooth surface, low leakage current density, high breakdown strength (BDS) and large difference between maximum and remanent polarization. As a result, a huge energy-storage density of 32 J/cm^3 and a large energy-storage efficiency of 90% were achieved under 3170 kV/cm in the thin film which was annealed at $650\text{ }^\circ\text{C}$. Moreover, the thin film exhibited a stable energy-storage performance under different temperature and frequency. Therefore, BNT-BT-NN thin film with proper annealing temperature is a promising candidate for high energy-storage capacitors.

Keywords: Thin film; RF magnetron sputtering; Energy-storage performance

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