Preparation of Nano-structured $BaTiO_3$ Thin Film by Electrophoretic Deposition and Its Characterization

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Nano-structured $BaTiO_3$ (BTO) thin films on conducting substrates are of great interest for electronic applications, such as multilayer capacitors and ceramic integrations. Electrophoretic deposition (EPD), which uses an applied electric field to deposit charged particles from suspension onto an electrode, offers advantages of low cost, process simplicity, uniformity, rigidly control of thickness and deposition on complex shaped substrates over other methods for preparing such films. In this paper, BTO nanocrystallites in a pseudo-cubic perovskite phase with an average particle size of about 10 nm were synthesized by a high-concentration sol-gel process. By dispersing a piece of BTO bulk gel into a mixed solvent of 2-methoxyethonal and acetylacetone, the well-dispersed and stable suspensions of BTO nanocrystallites were obtained. From these suspensions, crack-free nano-structured BTO thin films with different thickness from 100 nm to several micrometers were deposited on $Pt/Ti/SiO_2/Si$ substrates by EPD. The prepared films exhibited a uniform nanostructure, a low porosity and a smooth surface with a roughness under 10 nm. The effects of the ratio of 2-methoxyethonal and acetylacetone, applied field (2 v/cm to 10 v/cm), duration time (5 min to 1 h) upon deposition yields and film morphologies were investigated. The influences of sintering conditions on microstructures and dielectric properties of BTO thin films were also studied.