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Barium Titanate Ferroelectric Thin Films for Electro-Optic Applications

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Barium titanate (BaTiO3) has great prospects in integrated and high-performance electro-optic (EO) devices due to its large EO coefficient and its ability to fabricated as thin films on commercially substrates using conventional deposition techniques. However, when grown as films, the EO performance of BaTiO3 considerably degrades with minimal improvement upon adjusting deposition parameters. The aim of this research was to therefore investigate strategies for improving the EO performance of BaTiO3 thin films through manipulation of mechanical and electrical boundary conditions. Films were deposited on LSAT substrates by pulsed laser deposition and laser molecular beam epitaxy. Atomic force microscopy, X-ray diffraction techniques, second-harmonic generation and piezoelectric force microscopy were used for characterization. Mechanical boundary conditions were manipulated by inserting PrScO3 buffer layers of varying thicknesses to modulate epitaxial strains delivered by LSAT to the BaTiO3 epilayer. The films were smooth and single crystalline with a tetragonal phase having a predominantly in-plane domain structure. An effective EO coefficient of 249 pm/V was attained, which is significantly higher compared to films deposited on unbuffered LSAT.

Keywords: ferroelectric; barium titanate; electro-optic effect; pulsed laser deposition, laser molecular beam epitaxy, optical second-harmonic generation

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