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Low dielectric loss in electric field-tunable $Ba_xSr_{1-x}TiO_3$ thin films grown by hybrid molecular beam epitaxy ADAM KAJDOS, EVGENY MIKHEEV, ADAM HAUSER, SUSANNE STEMMER, Materials Department, University of California, Santa Barbara — $Ba_xSr_{1-x}TiO_3$ (BST) is an electric field-tunable dielectric that exhibits both low dielectric loss and high tunability, making it a system of particular interest for microwave device applications. In this presentation we report on the dielectric properties of paraelectric BST films (x = 0.19 - 0.46) grown by hybrid molecular beam epitaxy (MBE) on epitaxial Pt bottom electrodes. Using the hybrid MBE technique to achieve unprecedented stoichiometry control and low defect densities, we demonstrate dielectric quality factors (Q =1/tan δ, where tan δ is the dielectric loss tangent) exceeding 1000, an order of magnitude greater than any previously reported BST thin film. These low-loss films also exhibit high electric field tunability, with the relative tunability, $n(\mathrm{E}) = \varepsilon(0)/\varepsilon(\mathrm{E})$, i.e. the ratio of the dielectric permittivity under zero and positive applied field, respectively, exceeding $n = 5$. The high quality of these BST films enables the investigation of intrinsic dielectric loss mechanisms, such as quasi-Debye loss. We will discuss the effect of point defect densities, stoichiometry and microstructure on the dielectric properties of these BST thin films.

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