Ferroelectric Transition in Compressively Strained Epitaxial SrTiO$_3$\(^1\) AMIT VERMA, Electrical Engineering, Univ. of Notre Dame, SANTOSH RAGHAVAN, SUSANNE STEMMER, Materials Dept., Univ. of California, Santa Barbara, DEBDEEP JENA, Electrical Engineering, Univ. of Notre Dame — Strontium titanate (SrTiO$_3$) is a transition metal oxide semiconductor that crystallizes in the cubic perovskite crystal structure and exhibits incipient ferroelectricity. The dielectric constant of bulk unstrained SrTiO$_3$ crystals saturates at temperatures below 4K while above $\sim$50K, its dielectric constant decreases following the Curie-Weiss law of ferroelectricity [Muller et al., Phys. Rev. B 19, 3593 (1979)]. Based on the Landau-Ginzburg-Devonshire theory of ferroelectrics, it is theoretically predicted that under biaxial compressive or tensile strain, SrTiO$_3$ thin films should become ferroelectric [Pertsev et al., Phys. Rev. B 61, R825 (2000)]. Heteroepitaxial growth on lattice-mismatched substrates was used earlier to demonstrate near room temperature in-plane ferroelectricity in tensile strained SrTiO$_3$ thin films [Haeni et al., Nature 430, 758 (2004)]. In this work, we have epitaxially grown compressively strained SrTiO$_3$ thin films on (001) LSAT substrates, fabricated Pt/SrTiO$_3$ Schottky diodes, and performed temperature-dependent capacitance-voltage (CV) measurements of these diodes. As predicted by the theory, the out-of-plane dielectric constant of SrTiO$_3$ extracted from these CV measurements shows a divergence, implying a ferroelectric transition in compressively strained SrTiO$_3$.

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