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Thickness dependent ferroelectric properties of ultrathin $BaTiO_3$ thin films D.A. FELKER, H.W. JANG, C.B. EOM, M.S. RZCHOWSKI, University of Wisconsin - Madison — The thickness dependence of the coercive field and the spontaneous polarization were studied for epitaxial trilayer heterostructures with $SrRuO_3$ electrodes and ultrathin (001) $BaTiO_3$ ferroelectric layers grown on TiO_2 terminated (001) $SrTiO_3$ substrates. The $BaTiO_3$ thickness ranged from 2.4 (6 unit cells) to 50 nm. The 3.2 nm (8 unit cells) sample provides the thinnest direct electrical measurement of ferroelectricity in $BaTiO_3$ in a device structure, showing the thickness dependence of ferroelectric properties down into the ultrathin regime and providing an experimental upper bound on the critical thickness. The coercive field increases dramatically in thinner samples consistent with the Kay-Dunn model of domain nucleation and propagation. Below 10 nm the spontaneous polarization decreases with decreasing thickness due to decreasing screening of the depolarization field by the electrodes. For barriers thicker than 10 nm the polarization decreases due to strain relaxation in the ferroelectric barrier. We discuss these measurements, as well as the temperature dependence of the coercive fields and hysteresis loops.

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