

Epitaxial BiFeO₃ Multiferroic Thin Film Heterostructures

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BiFeO₃ is a multiferroic perovskite, i.e., it exhibits both magnetism and ferroelectricity. This unique property makes it attractive for a variety of tunable sensor applications. This nugget, summarizes results of epitaxial growth of BiFeO₃ films. The key idea is to control the film structure through hetero-epitaxy, leading to unique (and possibly enhanced) physical properties. XRD indicates that the film is phase pure and well oriented. Electron diffraction

shows it has tetragonal structure with $c/a=1.02$ (in contrast to bulk, which is rhombohedral). Ferroelectric measurements show a dramatically enhanced polarization value of about $40\mu\text{C}/\text{cm}^2$, which is much higher than reported bulk value of $3-6\mu\text{C}/\text{cm}^2$. Piezoelectric measurements show a d_{33} value of 80-100 pm/V. The films exhibit magnetism with a saturation magnetization of 15-17 emu/cc at room temperature.

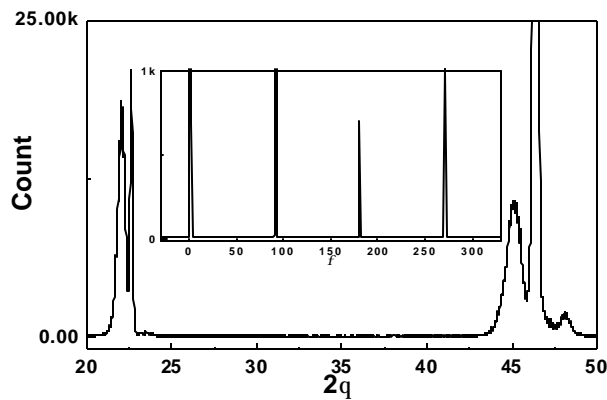


Figure 1. X-ray q-2q scan showing that the film is phase pure and (001) oriented. The 4-fold symmetry in the F⁻scan supports a tetragonal structure.

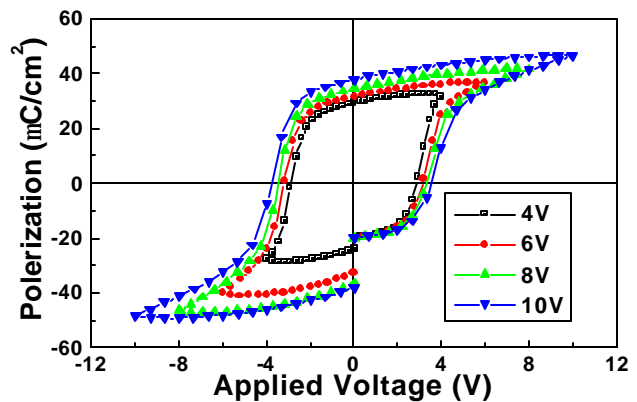


Figure 2. Hysteresis loops measured at 10kHz, which shows that the film is ferroelectric with $P_r = 40\mu\text{C}/\text{cm}^2$.

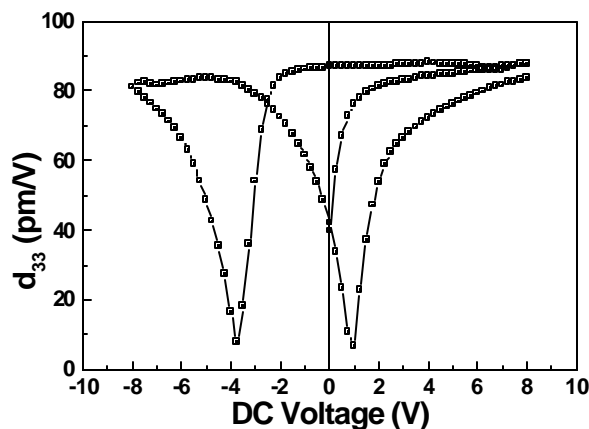


Figure 3. Small signal d_{33} for a 50mm capacitor.

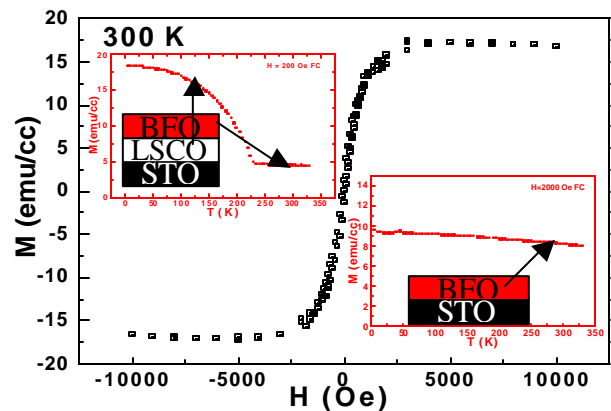


Figure 4. Magnetic hysteresis measured by SQUID. Film saturated at 2000Oe, $M_s=17\text{emu}/\text{cc}$ and $M_r=2.5\text{emu}/\text{cc}$.