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Strain tunability and domain structures of epitaxial (001) $BiFeO_3$ thin films[1]

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It was recently discovered that the spontaneous polarization (P_s) values determined in epitaxial $BiFeO_3$ thin films, $\sim$100 $\mu C/cm^2$, are over an order of magnitude higher than those previously measured in bulk samples. This raises a fundamental question: can the remanent polarization and other properties of $BiFeO_3$ be tuned by strain? We studied the strain dependence of remanent polarization and domain structures of $BiFeO_3$ through direct measurements on the *same* epitaxial $(001)_p$ $BiFeO_3$ thin-film capacitors before and after releasing them from an underlying Si substrate. Our measurements reveal that: (1) the large P_s of $BiFeO_3$ is indeed intrinsic; (2) the out-of-plane polarization (P_3) of $(001)_p$-oriented $BiFeO_3$ thin films has a strong strain dependence. These findings can be exploited in studying symmetry-dependent magnetoelectric coupling of $BiFeO_3$, where strain and/or symmetry play a role in the coupling because the direction of magnetic spin ordering is not parallel to that of ferroelectric polarization switching.

[1]This work has been done in collaboration with H. W. Jang, S. H. Beak, D. Ortiz, C. M. Folkman, R. R. Das, Y. H. Chu, P. Shafer, J. X. Zhang, S. Choudhury, V. Vaithyanathan, Y. B. Chen, X. Q. Pan, D. G. Schlom, L. Q. Chen, and R. Ramesh.