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Origin of 90° Domain Wall Pinning in Pb($Zr_{0.2}Ti_{0.8}$)O_3 Heteroepitaxial Thin Films DONG SU, Center for Functional Nanomaterials, Brookhaven National Lab, QINGPING MENG, MMYUNG-GEUN HAN, CMPMS, Brookhaven National Lab, CARLOS VAZ, YARON SEGAL, MATTHEW MARSHALL, FRED WALKER, Department of Applied Physics and CRISP, Yale University, MONICA SAWICKI, CHRISTINE BROADBRIDGE, Department of Physics, Southern Connecticut State University, CHARLES AHN, Department of Applied Physics and CRISP, Yale University — Researchers have studied the effect of ferroelectric fields in controlling the spin state via electric fields in multiferroic composite structures. For instance, in a bilayer system composed of a ferroelectric perovskite ($PbZr_{0.2}Ti_{0.8}O_3$) and a colossal magnetoresistive (CMR) manganite ($La_{0.8}Sr_{0.2}MnO_3$, LSMO), the spin state in the CMR film can be controlled by switching the ferroelectric polarization state, thereby generating a large magnetoelectric coupling. For this system, the domain's structure and switchability is critically important to the device's performance. We describe transmission-electron-microscopy study of the ferroelectric domains in a epitaxial Pb($Zr_{0.2}Ti_{0.8}$)O_3(PZT) film grown on $La_{0.8}Sr_{0.2}MnO_3$/$SrTiO_3$(001). We directly observe the pinning of 90° domain walls by pairs of misfit dislocations with Burgers vectors $\boldsymbol{a}$[100] and $\boldsymbol{a}$[001]. Model calculations based on the elastic theory confirm our finding that, in addition to the depolarization field surrounding the dislocation, the strain field of misfit dislocation-pairs plays the primary role in the formation and pinning of $\boldsymbol{a}$ domains.

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