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Ferroelectric switching behavior of (001) mono-domain $BiFeO_3$ thin films SEUNG-HYUB BAEK, HO-WON JANG, CHAD FOLKMAN, CHANG-BEOM EOM, University of Wisconsin-Madison, YULAN LI, BENJAMIN WINCHESTER, LONG-QING CHEN, Pennstate University, CHRISTOPHER NELSON, XIAO-QING PAN, University of Michigan, RAMAMOORTHY RAMESH, University of California-Berkeley — $BiFeO_3$ has drawn a great deal of attention as a single phase multiferroic material for the magnetoelectric device and non-volatile memory applications. $BiFeO_3$ has a magnetoelectric coupling effect between [111] polarization and (111) anti-ferromagnetic order, which allows manipulation of magnetic property by electric field. However, the anti-ferromagnetic plane can be switched only by non-180^o polarization switching due to this coupling geometry. Thus, for magnetoelectric device applications, it is crucial to selectively control 71^o (or 109^o) switching. Here, we report the selective control of ferroelectric switching by the size of switched area; local field by AFM tip and uniform field by large area top electrodes. The origin of this behavior will be discussed using phase-field simulations. This result implies that the geometry of magnetoelectric devices should be determined by considering the size of switching area. Moreover, this result can be expanded to other rhombohedral systems such as PMN-PT and PZT.

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