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Combinatorial discovery of morphotropic phase boundary in a lead-free high T_c piezoelectric perovskite $Bi_{1-x}(RE)_xFeO_3$ S. FUJINO, D. KAN, A. VARATHARAJAN, C.J. CHENG, V. NAGARAJAN, M. MURAKAMI, S.-H. LIM, D. HUNTER, C.J. FENNIE, L. SALAMANCA-RIBA, M. WUTTIG, I. TAKEUCHI — We have recently discovered a morphotropic phase boundary (MPB) in $Bi_{1-x}Sm_xFeO_3$ which has a simple perovskite structure. We have systematically investigated compositionally varied Sm doped $BiFeO_3$ thin films using the combinatorial approach and found that ferroelectric properties and piezoelectric properties show pronounced enhancement at the MPB. The samples were fabricated by combinatorial pulsed laser deposition on $SrTiO_3$ (001) substrates with a $SrRuO_3$ buffer layer. The boundary is a rhombohedral to pseudo-orthorhombic structural transition which exhibits a ferroelectric to antiferroelectric transition at approximately $Bi_{0.86}Sm_{0.14}FeO_3$ with intrinsic d_{33} comparable to those of $PbZr_{0.52}Ti_{0.48}O_3$ thin films. Transmission electron microscopy (TEM) reveals presence of nanodomains at the MPB. TEM also reveals onset and formation of antiferroelectric domains as the composition is swept near the MPB, where electron diffraction patterns show systematic structural tilt transitions of the system as a function of Sm doping. Finally, we report on structural transitions and ferroelectric properties in other $Bi_{1-x}(RE)_xFeO_3$ systematically studied by the composition spread technique. This work is supported by NSF MRSEC, ARO, and the W. M. Keck Foundation. Research at UNSW is supported by DEST Australia, Australian Research Council Grant DP 0666231 and ARNAM Travel Grant.

Shigehiro Fujino
University of Maryland

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