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Giant enhancement of magnetocrystalline anisotropy in ultrathin manganite films via nanoscale 1D periodic depth modulation ANIL RAJAPITAMAHUNI, LE ZHANG, VIJAY SINGH, JOHN BURTON, MAK KOTEN, JEFFREY SHIELD, EVGENY TSYMBAL, XIA HONG, University of Nebraska-Lincoln — We report a unusual giant enhancement of in-plane magnetocrystalline anisotropy (MCA) in ultrathin colossal magnetoresistive oxide films due to 1D nanoscale periodic depth modulation. High quality epitaxial thin films of $La_{0.67}Sr_{0.33}MnO_3$ (LSMO) of thickness 6 nm were grown on (001) $SrTiO_3$ substrates via off-axis radio frequency magnetron sputtering. The top 2 nm of LSMO films are patterned into periodic nano-stripes using e-beam lithography and reactive ion etching. The resulting structure consists of nano-stripes of 2 nm height and 100-200 nm width on top of a 4 nm thick continuous base layer. We employed planar Hall effect measurements to study the in-plane magnetic anisotropy of the unpatterned and nanopatterned films. The unpatterned films show a biaxial anisotropy with easy axis along [110]. The extracted anisotropy energy density is ~1.1 x 10^5 erg/cm^3, comparable to previously reported values. In the nanopatterned films, a strong uniaxial anisotropy is developed along one of the biaxial easy axes. The corresponding anisotropy energy density is ~5.6 x 10^6 erg/cm^3 within the nano-striped volume, comparable to that of Co. We attribute the observed uniaxial MCA to MnO_6 octahedral rotations/tilts and the enhancement in the anisotropy energy density to the strain gradient within the nano-stripes.

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