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Microscopic evidence of strain-mediated magnetoelectric coupling in Co/Pt multilayers/PMN-PT(011) heterostructures YING SUN, Tsinghua University, WENBO WANG, WEIDA WU, Rutgers University, XIAOLI ZHENG, JIANWANG CAI, Institute of Physics, Chinese Academy of Sciences, YONGGANG ZHAO, Tsinghua University, MING LIU, Xian Jiaotong University
— A promising way to control magnetization(M) via an electric field(E-field) is using magnetoelectric(ME) effect in FM/FE heterostructures. We use magnetic(electric) force microscopy(M(e)FM) to study the strain-mediated E-field modulation of M in $(Co/Pt)_n$ with perpendicular magnetic anisotropy(PMA) or in-plane anisotropy on PMN-PT(011) substrates. MFM were performed on $(Co/Pt)_n$ with an DC E-field applied to PMN-PT. In MeFM, we superimpose an AC modulation on a DC one and utilize lock-in technique to detect weak ME effect. For $(Co/Pt)_n$ with PMA, MFM images show stripe domains with no obvious changes at varied DC E-fields. However, MeFM shows interesting structures and the image contrast reverses sign at opposite strain slopes of the PMN-PT substrate. For sample with in-plane anisotropy, both MFM and MeFM images show dipole-like domains. Interestingly, the MeFM image contrast reverses sign at opposite strain slopes of the substrate. The sign reversal of MeFM contrast indicates that features revealed by MeFM are intrinsic local ME effect. Our MeFM data are consistent with the ferromagnetic resonance results showing that strain-induced anisotropy change will cause part of M switching to the in-plane direction. Possible scenarios will be discussed.

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