Nanoobjects microscopy

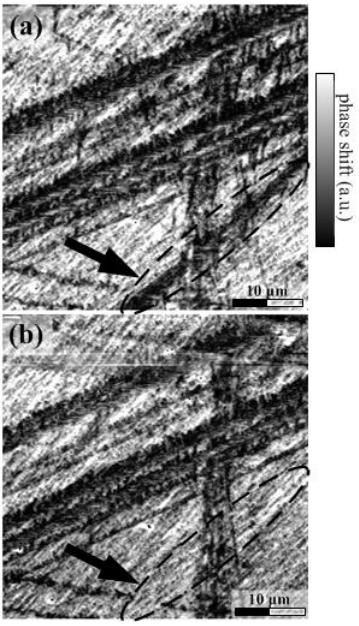
Persistent magnetoelectric changes in perovskite ferromagnetic/ferroelectric heterostructures observed by MFM

D.M. Polishchuk[1], P.M. Lytvyn[2], O.I. Synhaivska[2], A.I. Tovstolytkin[1]

[1] *Department of Physics of Thin Films, Institute of Magnetism, Nat. Acad. of Sci. of Ukraine, Vernadsky Ave., 36b, Kyiv-03142, Ukraine.*
E-mail: dmytropol@gmail.com

[2] *V. Lashkaryov Institute of Semiconductors Physics, Nat. Acad. of Sci. of Ukraine, Nauky Av.,41, Kyiv-03028, Ukraine.*

The magnetoelectric effect (ME) could yield entirely new device paradigms, such as electric-field-controlled magnetic data storage [1]. At present, the highest room-temperature ME responses are observed in ferromagnetic (FM)/ferroelectric (FE) heterostructures [2]. Mechanisms of such interface-mediated giant ME effects are of a high urge to be clarified.



By the use of magnetic force microscopy (MFM) we have observed persistent converse magnetoelectric effects in $La_{0.67}Sr_{0.33}MnO_3$(45 nm)/$BaTiO_3$(0.5 mm) heterostructure. Fig. (a)-(b) presents MFM images of magnetic field gradients over LSMO surface before (a) and after (b) the application of E = 6 kV cm^{-1} perpendicular to the stack. Here, an important finding is the presence of peculiar features, such as the marked one in Fig. (a), which disappear after application of E. Such ME changes remain persistent as time passes. This behavior originates from the switching of BTO FE domains, which alters the local strain and magnetic anisotropy, and thus affects the magnetization of FM LSMO [2].

1. *Spaldin N.A., Fiebig M.* The Renaissance of Magnetoelectric Multiferroics // Science.-2005.-**309.**-P. 391-392.
2. *Eerenstein W., Wiora M., Prieto J.L., Scott J. F., Mathur N. D.* Giant sharp and persistent converse magnetoelectric effects in multiferroic epitaxial heterostructures // Nature Materials.-2007.-**6**.-P. 348-351.