Reversible control of electric polarization in SrTiO3-CoFe2O4 at room temperature by XAS

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Strain engineering of thin-film heterostructures is one of the most widespread and successful approaches to improve the performance of real devices such as transistors, electrochemical energy conversion devices, or multiferroic memories [1,2]. We have engineered local strain in quantum paraelectric SrTiO3 exploiting CoFe2O4 magnetostrictive properties and succeeded in reversibly controlling the electron distribution in the Ti valence band of SrTiO3-CoFe2O4 heterostructures at room temperature. Using soft x-ray absorption spectroscopy, we have observed changes in the energy level scheme of Ti $3d$ orbitals upon the application of an external magnetic field which suggest the development of a net electric polarization. Such an induced state disappears upon field removal. Our approach might be applied to other 2D heterostructures offering the possibility to induce and reversely control novel properties found at the interface, such as polar vortexes or two-dimensional electron gases, and thus it could lead to the realization of a new class of functional devices for information storage and sensing applications.

References:

[1] *Interfacial room temperature magnetism and enhanced magnetocaloric effect in strained La0.66Ca0.34MnO3/BaTiO3 heterostructures*, N.S. Bingham, A.K. Suszka, C.A.F. Vaz, H. Kim, L.J. Heyderman, Phys. Rev. B 96, 024419 (2017)

[2] *Spatially resolved strain-imprinted magnetic states in an artificial multiferroic*, R.V. Chopdekar, V.K. Malik, A. Fraile Rodríguez, L. Le Guyader, Y. Takamura, A. Scholl, D. Stender, C.W. Schneider, C. Bernhard, F. Nolting, L.J. Heyderman, Phys. Rev. B 86, 014408 (2012)