X-RAY PHOTOELECTRON SPECTROSCOPY OF ELECTRIC FIELD-CONTROLLED INTERFACE EFFECTS IN MULTIFERROIC TUNNEL JUNCTIONS

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Coexisting tunnelling electroresistance (TER) and tunnelling magnetoresistance (TMR) effects in multiferroic tunnel junctions (MFTJ) is an emergent phenomena for non-volatile, energy efficient memory components [1]. In an MFTJ, two ferromagnetic (FM) electrodes acting as spin polarizer and analyzer, respectively, are separated by an insulating ferroelectric (FE) barrier instead of the more traditional dielectric barrier in magnetic tunnel junctions. In an MFTJ, in addition to the bistable resistance states due to parallel (P) and antiparallel (AP) aligned FM electrodes, two more resistance states can be accessed by rotation of the FE polarization in the tunnel barrier. Therefore, MTFJs can retain four non-volatile resistance states. Moreover, owing to the coupling between FM and FE polarization at the interfaces of an MFTJ, the spin polarization of the tunneling electrons can be reversibly inverted by switching of the FE polarization in the barrier [2]. Large TER effect in MFTJs has often been explained by electric field induced modification of the electronic properties at the FM - FE interface either via charge accumulation/depletion [3] or ion migration [4]. In the current work, we investigate electric field induced electronic reconstruction at an interface between FM electrode $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) and FE layer P(VDF-TrFE) using X-ray photoelectron spectroscopy (XPS) [5]. Our measurements show that polarization switching in ultrathin organic FE film modulates the Mn valence state at the LSMO-P(VDF-TrFE) interface that in turn can induce large change in magnetic and transport properties at the LSMO interface. After removal of the bias, the induced electronic effects partially remain for more than 24 hours. Additional measurements on temperature dependent relaxation of the electronic states after the removal of electric field is on the way that will give us a clear indication whether the modulation of Mn valence state is electronic or ionic in origin.

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