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ARPES study of the Bi/$BaTiO_3$ interface as a function of the polarization

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Transition-metal oxides show a very wide range of physical properties [1]. Among them, the use of ferroelectric (FE) thin films as switchable remanent gates for other materials with spin-filtering properties is a fast-growing research area with fascinating potential applications in electronics. Coupling FE materials with others can allow a modification of the electronic structure at the interface, thanks to the switchable polarization. Carefully choosing the materials for such hybrid systems can increase the properties available, leading to alternative interfaces' functionalities [2].

Among FE materials, the prototypic $BaTiO_3$ (BTO) shows FE at room temperature. Coupling it with a heavy metal presenting a strong spin-orbit interaction can lead to spin-polarized electronic states. As such, the Bi/BTO system has been proven to show a strong Rashba spin-orbit coupling [3], however, measurements of the interface electronic band structure as a function of the BTO polarization are still missing. Indeed, due to the small size FE domains in BTO crystals, the measured Fermi surface had to be averaged over the size of the beam spot, i.e. over both FE polarizations states, making it impossible to differentiate the electronic structure of different polarization states.

To overcome this issue, we deposited BTO thin films (30 nm) on a specific substrate in order to obtain mono domain BTO constrained in a single and uniform polarization state. We then used low photon energy Angle Resolved Photoemission (ARPES), at the BaDElPh beamline at Elettra Sincrotrone to investigate these samples and we were able to access the band structure for Bi/BTO for a single polarization state. Measurements were made along the Γ-M/M' direction (see Fig. 1), where elongated holes and electron pockets were previously observed and predicted by theory [3,4].

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[2] Marinova, M. Nano Lett. **15**, 2533 (2015)
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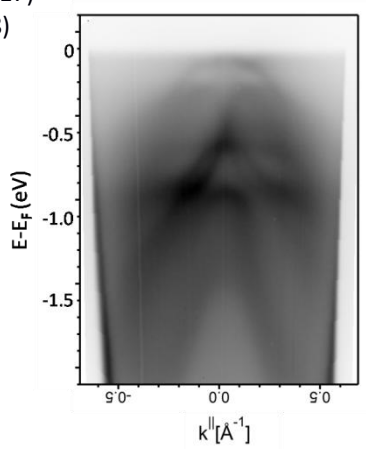

Figure 1 : ARPES spectra of the band structure of BTO/GSO, along the Γ-M direction (hv = 31 eV). (From BaDElPh beamline (ELETTRA))