

Heterostructure with ferroelectric: growth and conductivity measurements

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Oxide heterostructures are in the focus of solid-state research for more than a decade. The intense exploration of the multilayered systems is well justified as electronic reconstruction at the internal interfaces and the surfaces allows for a plethora of phenomena which are otherwise not observed in a single compound. Moreover, the sensitivity of competing or even coexisting phases to external fields and control parameters in the transition metal oxides makes the oxide heterostructures ideal candidates for multifunctional devices - especially since metallic phases may be confined to lateral extensions of a few lattice constants.

In 2004 the astounding phenomenon was found at the interface between two nonmagnetic wide-band-gap insulative oxides LaAlO₃ and SrTiO₃ [1]. A two-dimensional electronic system (2DES) is formed in the SrTiO₃ layers next to the interface which becomes superconducting below a temperature of 300 mK [1, 2]. Remarkably, this superconducting state coexists with a magnetic state being stable up to the room temperature. It was concluded, that the primary mechanism responsible for the 2DES formation is the electronic reconstruction followed by structural reconstruction. Since then two-dimensional conducting state has been later found in other dielectrics. And all of them have in common is that conductivity occurs due to either the polar nature of one of components or due to defects. Later, it has been shown that 2DES can be created at the interface of nonpolar oxides one of which is ferroelectric [3, 4]. The main advantage of using ferroelectrics is a possibility to switch on and off the polarization and thus to control properties of the electron system. Moreover, ferroelectrics have a range of other outstanding properties which might expand the scope of applications in nanoscale electronic devices: spontaneous polarization switching, high dielectric permeability, dielectric nonlinearity, piezo- and pyro- activity, linear and quadratic electro-optical effects.

By means of *ab initio* investigations within DFT calculations we investigated ferroelectric polarization impact onto the conductive properties of the nonpolar BaTiO₃/SrTiO₃ heterostructure and found that polarization towards the interface might induce conductivity [5]. At the experimental part the thin film of epitaxial Ba_{0.8}Sr_{0.2}TiO₃ (BSTO) was sputtered on the top of single crystalline SrTiO₃ substrate using the magnetron sputtering technique. We also investigated bilayer structure Ba_{0.8}Sr_{0.2}TiO₃/Ba_{0.2}Sr_{0.8}TiO₃ on the MgO and Si substrates and Ba_{0.8}Sr_{0.2}TiO₃/LaMnO₃ heterostructure. Capacitance and conductivity measurements were performed by a four-point probe method. In our investigation we present electrical resistivity at different temperature and photoconductivity measurements.

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