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Oxides for Spin Electronics

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Due to the richness of their intrinsic properties (such as magnetism, ferroelectricity and superconductivity), oxide materials can bring novel functionalities to the electronic industry. As a result, there is a great interest in harnessing the multifunctional character of these compounds in spintronics devices, where the spin of electrons is exploited, in addition to their charge. Here I review our work in two classes of oxides of potential interest in spin electronics, namely, oxide multiferroics and high-mobility oxides.

Multiferroics belong to a class of compounds which show simultaneous electric and magnetic orders. Much attention has been focused on this family of materials due to their potential for applications in electronics resulting from both the ferroelectric and magnetic orders and additional functionalities resulting from the coupling between these two orders. We present experiments performed on multiferroic based heterostructures in order to check the potential of such multifunctional materials in the field of spintronics. Two kinds of materials have been studied: the ferromagnetic-ferroelectric $La_xBi_{1-x}MnO_3$ ($x \leq 0.1$) [1] and the antiferromagnetic-ferroelectric $BiFeO_3$ [2].

On the other hand, high-mobility oxides have raised large expectations since the finding of high-mobility conduction in $LaAlO_3/SrTiO_3$ (LAO/STO) structures. STO is being intensively investigated due to the dramatic sensitivity of its electronic properties to extrinsic impurity doping. We have analyzed the mechanisms of oxygen vacancy formation and diffusion in STO to provide accurate protocols to control the electronic properties [3]. We have also explored alternative methods for the generation of high-mobility carriers in STO, with the objective of achieving two-dimensional conduction. We discuss the relevance of these results for all-oxide electronic devices.

[1] M. Gajek et al., Phys. Rev. B 72, 020406(R) (2005); M. Gajek et al., Nat. Mat. (march 2007)

[2] H. Béa et al.; Appl. Phys. Lett., **88,** 062502 (2006); H. Béa et al., Phys. Rev. B74, 020101(R) (2006)

[3] G. Herranz et al., Phys. Rev. B 73, 064403 (2006); G. Herranz et al., Phys. Rev. Lett. 98, 216803 (2007)

Voditelji seminara
Hrvoje Buljan i Ticijana Ban