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Tuning the spin-orbit-dependent electronic structure by applying epitaxial strain on ferroelectric $PbTiO_3$

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Understanding and manipulating the spin degree of freedom in materials is a hot topic due to the potential applications to develop low-energy-operating electronic devices. First well-known in semiconductor heterostructures and heavy metals, and now in other materials such as transition-metal-oxide interfaces, the Rashba spin-orbit effect, which appears as a result of the surface inversion asymmetry, has recently motivated lots of research due to its role in transport processes and its ability to be tuned by an external electric field. In 2013, the Rashba effect was also predicted theoretically [1], and later confirmed experimentally [2], in ferroelectric materials. The link between the reversible spin textures resulting from the spin-orbit interaction and the electric polarization is very promising to design devices based on non-volatile magnetoelectric states.

We will present our recent results obtained from *ab initio* calculations applied to the Rashba spin-orbit effect in the well-known ferroelectric perovskite $PbTiO_3$ [3,4]. We will focus our presentation on explaining how biaxial strain resulting from epitaxy could be used to tune the spin-orbit-dependent electronic structure. We will show in particular that these modifications of the electronic properties are intimately linked with the induced changes in the electric polarization and atomic structure in terms of symmetries and tetragonality.

[1] D. Di Sante, *et al.,* Adv. Mater. **25**, 509 (2013).
[2] C. Rinaldi, *et al.,* Nano Lett. **18**, 2751 (2018).
[3] R. Arras, *et al.,* Phys. Rev. B **100**, 174415 (2019).
[4] J. Gosteau, *et al.*, Phys. Rev. B **103**, 024416 (2021).

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