

# Photoelectric effects in ferroelectric thin films

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Hybrid halide perovskites are promising materials for photovoltaic applications because they show very high photovoltaic efficiency owing to their high light absorption and carrier mobility. In turns, they do not perform high stability, on top of containing core materials not environmentally friendly. Alternatively, ferroelectric oxide perovskite thin films, which are *a priori* more stable, are receiving a renewed attention owing to their ability to show gigantic photovoltaic response, among other interesting exclusive properties such as: switchable photovoltaic activity, light induced polarization screening or potentially enhanced photocatalytic activity. [1]

Photovoltaic activity in ferroelectric materials is modulated by light absorption and light intensity and it can be driven by the so-called bulk photovoltaic effect or by the internal electric fields. The internal electric fields that drive photocurrent in ferroelectric materials result from the combination of the depolarization and imprint electric fields. Depolarization electric field stems from the unscreened polarization, polarization screening is produced by internal or external charges, and the external charges can be provided by metallic electrodes or by surface adsorbates. A fully comprehensive understanding of the different contributions on the internal electric field is a key aspect to tailor and enhance the photovoltaic response in ferroelectric oxide materials.

BaTiO<sub>3</sub> is an interesting oxide ferroelectric material for photovoltaic applications because it is lead-free and it can be grown epitaxially in thin film form on a variety of substrates. I will show that in BaTiO<sub>3</sub> films, depolarization and imprint electric fields relative contributions can be tailored by selecting appropriate electrode configuration, allowing to modify the photocurrent response. A detailed analysis of the obtained results indicates that the depolarization electric field is the most important factor determining the photoresponse in our system (Figure 1). The discovered important role of depolarization field, the aforementioned role of surface adsorbates on the depolarization field and the fact that surface adsorbates can be easily modified by sample treatment, allowed a detailed study of the surface adsorbates on the depolarization electric field and, therefore, on the photoresponse. I will show that the modification of surface adsorbates results in a change of polarization screening and concomitantly the depolarization field and the photoresponse. [2]

In brief, my talk will deal with the deeper understanding of the photovoltaic response driven by internal electric fields in ferroelectric materials and with its modification using different strategies.

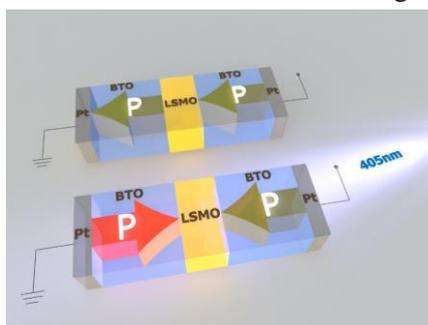


Fig 1. Schematic representation of the reduction of the depolarization field by light allowing the stabilization of a head-to-head polarization configuration in a Pt/BaTiO<sub>3</sub>(BTO)/La<sub>2/3</sub>Sr<sub>1/3</sub>MnO<sub>3</sub>(LSMO)/BaTiO<sub>3</sub>(BTO)/Pt structure.

## References

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2. F. Liu et al., *Adv. Electron. Mater.* **1**, 1500171 (2015); F. Liu et al., *Sci. Rep.* **6**, 25028 (2016); F. Liu et al., *Unpublished* (2016).