Disclosing piezogeneration at the nanoscale with Direct Piezoelectric Force Microscopy

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Abstract

In this work I will present the new advances in the Atomic Force Microscopy (AFM) mode introduced in 2017 which enables researchers to map the piezogenerated charge with an Atomic Force Microscopy[1]. Until that date, the only method available to study piezoelectricity and ferroelectricity was Piezoresponse Force Microscopy. Despite the efforts this last decade, it is assumed by scientific community that PFM cannot be considered a quantitative technique [2]. The new mode aims to complement PFM, offering true quantitative data acquisition by collecting the current generated when a tiny force is applied to the material. A special transimpedance amplifier, with ultra-low level of leakage current is used in order to collect such amount of piezogenerated current.

In the talk I will introduce not only the mode itself, which was originally tested in three different piezoelectric materials, but the new advances there in. The speed of data acquisition has now been improved from 3 hours for a full images, to less than 10 minutes. Moreover, I will introduce some new measurements carry out in our facility that enables the use of the mode with a lockin amplifier, boosting the signal to noise ration of the measurements.

References

[1] A. Gomez, M. Gich, A. Carretero-Genevrier, T. Puig & X. Obradors, Nature Communications 8, Article number: 1113 (2017)
[2] Kalinin SV, Rar A, Jesse S. IEEE Trans Ultrason Ferroelectr Freq Control. ; 53(12):2226-52 (2006)

Figures

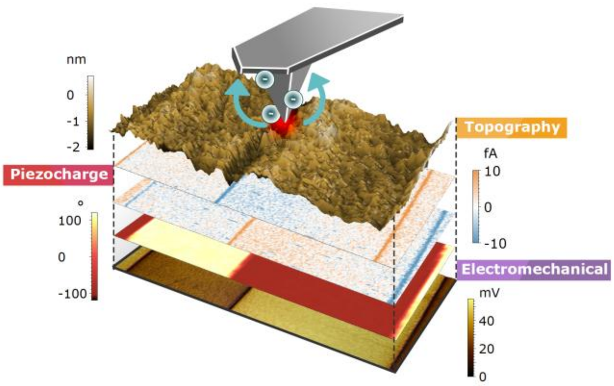

Figure 1: 3D rendered image obtained with the full information acquisition: both electromechanical and piezogeneration at the nanoscale are acquired with this new AFM mode.

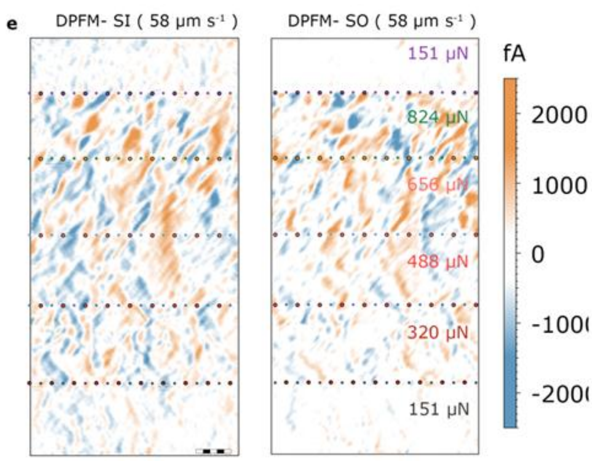

Figure 2: DPFM-Si and DPFM-So of a PZT sample acquired by performing DPFM. The images are obtained after a thermal treatment to grown the natural domains structure into the material to study