VAMAS

Performance Related Properties for Electroceramics

Technical Work Area 24

Call for Participation

Project 3

Quantification of electromechanical coupling measured with Piezoresponse Force Microscopy (PFM)

Objectives

The objective of this work is to carry out an inter-laboratory comparison of piezoresponse force microscopy (PFM) measurements. This will lay some of the groundwork for a future standard procedure for the reliable quantification of the electromechanical coupling in piezoresponse force microscopy.

Background

PFM is a scanning probe technique where an oscillating voltage is applied across the sample through a conductive tip and an electrode on the reverse of the sample. This excites a strain in the sample through the converse piezoelectric effect.

PFM has proven itself invaluable not only in the mapping of piezoresponse of functional materials but also as a way of investigating the response of a sample under electric fields applied on the nanoscale. Such abilities lend the technique directly for the characterisation of devices under conditions closely imitating service conditions.

PFM is the only technique that can probe the electromechanical response of materials at the nanoscale.

Standardization Needs

PFM is already widely used as an imaging technique, mapping piezoresponse of samples. However in most cases, the piezoresponse is represented with an arbitrary unit scale. Static measurements (non-scanning) of the piezoelectric properties, typically in the form of hysteresis loops, can also be made with this technique.

This work aims to investigate many of the challenges facing the quantification of PFM measurements by conducting an inter-laboratory comparison. It is intended that this work will lead to future work that will provide a standard method for the quantification of the piezoresponse with a view to accurately determining the electromechanical coupling of the sample.

This will allow for results from different sources to be reliably compared and could also provide a reference measurement for PFM imaging.

Work Programme

- Design of experimental procedures for the interlaboratory comparison.
- Selection of piezoelectric sample to be used
- Choice of complimentary characterisation techniques to relate to the PFM results.
- Inter-laboratory comparison
- Data compilation and analysis.

Duration

24 months following startup.

Funding

Participation is based on in-kind effort from the partners.

Deliverables and Dissemination

The results from this work will be published in a peer-reviewed journal and a VAMAS report.

Status

Detailed work plan being drafted. Additional participants welcome.

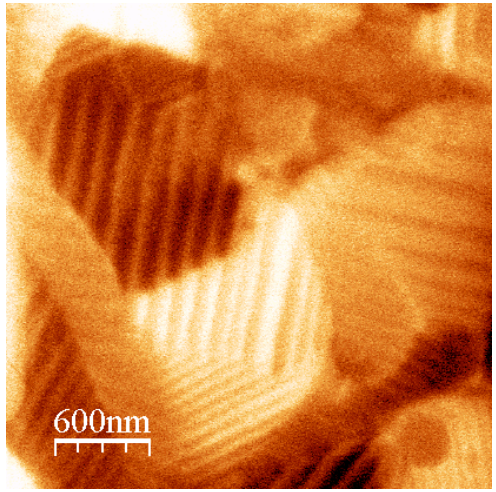

Fig 1: Piezoresponse image of domains in tetragonal lead zirconate titanate ceramic

If you wish to participate, or for more information, please contact:

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