Poster-2-22

Probing the behaviour of surface water and ferroelectric PbTiO3 thin films as a function of relative humidity and temperature

Loïc Musy, Céline Lichtensteiger, Christian Weymann, Iaroslav Gaponenko, and Patrycja Paruch

Department of Quantum Matter Physics, University of Geneva, Switzerland

A better understanding of the interplay between adsorbates and ferroelectric polarization is key to improving both our fundamental understanding of domain stabilization and unlocking novel applications, such as improved chemical reactions through polarisation-mediated catalysis.
We report on our nanoscale investigation on the behaviour of water on ferroelectric PbTiO3 thin film surfaces under conditions of high humidity and low temperature, using scanning probe microscopy techniques and a home-built humidity control system [1,2]. We observe low charge dissipation, and high localisation of both positive and negative screening charge on patterned domain structures in films with varying as-grown polarisation states, which we attribute to the extremely high quality and low surface roughness of the films, as compared with previous studies where much more extensive charge dynamics were observed [3,4]. In local measurements during temperature cycling at varying humidities, we also note that both polarisation orientation and the presence of written domains appear to influence the nucleation and growth of ice-like water layers: growth appears to be inhibited by written structures. This work demonstrates sub-micron precision control of water layer growth through the engineering of domain structure.

[1] I. Gaponenko et al., Rev. Sci. Instrum. 87 063709 (2016).
[2] I. Gaponenko et al., Eng. Res. Express 1 025042 (2019).
[3] N. Domingo et al., Nanoscale 11 17920 (2019).
[4] I. Gaponenko et al., NPJ Comput. Mater. 7 163 (2021).