Tuning Light-induced Polarization Screening of Ferroelectric Materials by water

F. Liu[1], I. Fina[1,*], F. Sánchez[1] and J. Fontcuberta[1]
[1]Institut de Ciència de Materials de Barcelona (ICMAB-CSIC)
Campus de la UAB, Bellaterra, Spain, 08193
*Ignasi Fina: ignasifinamartinez@gmail.com

Ferroelectric materials are receiving a renewed attention owing to their great application potential in non-volatile memories, optoelectronics, energy harvesting[1], photocatalysis[2], etc. For optoelectronic applications it is important to know how the ferroelectric properties are modified by the effect of light. In particular, it has been reported that the remnant polarization can be largely reduced by the application of light in the range of the UV, see f.i. ref. [3,4].

To elucidate the key factor that dominates the light-induced screening in $BaTiO_3$ thin films and to be able to modify it, a series of $BaTiO_3$ thin films were grown using the same growth parameters but on different substrates imposing different epitaxial strain and with different thicknesses. Dramatic variation of the reduction of polarization by light (at 405 nm) has been observed among the studied films. X-ray photoelectron spectroscopy (XPS) shows a clear correlation between the content of OH^- and H_2O on the surface of the films and light-induced polarization reduction and both effects appear to be related to the strain state of the films. Trying to disclose the effect of H_2O on the surface states different room-temperature treatments with continuous flux of water steam have been performed. The results show that chemically adsorbed OH^- largely enhances the light-induced polarization reduction.

These results illustrate a simple and convenient way of tuning surface states in ferroelectrics and this may be important for applications.

Reference

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