BaTiO₃: More than a prototypical ferroelectric

tutorial

February 27, 2019 | 4:00 pm Lecture Hall MPI | B.1.11

Abstract

 $BaTiO_3$ is one of the working horses in ferroelectrics due to its roomtemperature ferroelectricity and an easily accessible phasetransition temperature at 400 K. Nowadays the effect of structural changes on the ferroelectric properties of ultrathin films is strongly in the focus, e.g. in strain engineering. Already slight distortions as present on a $BaTiO_3$ single crystal surfaces influence the domain structure as we demonstrate here by insitu heating experiments using a photoemission electron microscope (PEEM) [1]. In epitaxially strained ultrathin BaTiO₃ films a strong changes in the conductivity of differently poled ferroelectric domains are reported [2]. Exploiting this effect in scanning tunneling spectroscopy (STS) measurements we could drive the lateral resolution for imaging ferroelectric domains to the ultimate limit. For ultrathin films of BaTiO₃ films on Pt(001) an intrinsic domain configuration on the nm length scale has been resolved. Aside of ferroelectricity, $BaTiO_3$ thin films are the origin of a twodimensional oxide quasicrystal [3]. The aperiodic structure is formed in a complex hightemperature wetting process on Pt(111) substrates in UHV. Insitu lowenergy electron microscopy (LEEM) measurements elucidate the extraordinary formation process inbetween of periodic BaTiO₃ islands. Scanning tunneling microscopy (STM) at room temperature as well as at low temperatures (80 K) allow to resolve an atomic arrangement in squares, triangles, and rhombi which repeats on $(2+\sqrt{3})$ and $(2+\sqrt{3})^2$ larger scales indicating the characteristic selfsimilarity of an ordered QC. The observed interfaced riven formation of a 2D QC from a perovskite oxide in contact with a hexagonal substrate is expected to be a general phenomenon.

[1] A. Höfer, M. Fechner, K. Duncker, M. Hölzer, I. Mertig, and W. Widdra, Phys. Rev. Lett. 108, 087602 (2012). [2] V. Garcia et al., Nature 460, 81 (2009). [3] S. Förster, K. Meinel, R. Hammer, M. Trautmann, and W. Widdra, Nature 502, 215 (2013).

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