$BaTiO_3$: More than a prototypical ferroelectric

S. Förster[1], M. Christl[1], K. Meinel[1], J. I. Flege[2], J. Falta[2], and W. Widdra[1,3]

[1] *Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, Halle, Germany*
[2] *Universität Bremen, 28359 Bremen, Germany*
[3] *Max-Planck-Institut für Mikrostrukturphysik, Halle, Germany*

$BaTiO_3$ is one of the working horses in ferroelectrics due to its room-temperature ferroelectricity and an easily accessible phase-transition 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 in-situ heating experiments using a photoemission electron microscope (PEEM) [1]. In epitaxially strained ultrathin $BaTiO_3$ 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 $BaTiO_3$ 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 two-dimensional oxide quasicrystal [3]. The aperiodic structure is formed in a complex high-temperature wetting process on Pt(111) substrates in UHV. In-situ low-energy electron microscopy (LEEM) measurements elucidate the extraordinary formation process in-between of periodic $BaTiO_3$ 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 self-similarity of an ordered QC. The observed interface-driven formation of a 2D QC from a perovskite oxide in contact with a hexagonal substrate is expected to be a general phenomenon.

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