

MS25-P6 Two-dimensional oxide quasicrystals from perovskites

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In addition to the well-known intermetallic and soft quasicrystals (QC), recently a two-dimensional oxide quasicrystal (OQC) has been discovered [1]. This OQC is derived from BaTiO₃ thin films on a hexagonal Pt(111) substrate. Low-energy electron diffraction (LEED) reveals a twelve-fold rotational symmetry. Scanning tunneling microscopy (STM) at room temperature as well as at low temperatures (80 K) allow to resolve the atomic structure. The aperiodic structure is formed by primitive atomic arrangements in squares, triangles, and rhombs with a universal edge length of 0.69 nm. The resulting tiling is comparable to an ideal Stampfli-Gähler tiling [2]. In addition to this dodecagonal atomic arrangement, building blocks of squares, triangles, and rhombs are also found on $(2+\sqrt{3})$ and $(2+\sqrt{3})^2$ larger scales indicating the characteristic self-similarity of an ordered QC. The high-resolution STM measurements allow furthermore to identify phason flips on the atomic scale.

The observed interface-driven formation of a 2D OQC is not limited to this particular materials combination. Following an analogous preparation procedure, we show that SrTiO₃ on Pt(111) develops an OQC as well. As a consequence of the 2% smaller lattice constant of SrTiO₃ in comparison to BaTiO₃, the fundamental length of the SrTiO₃-derived OQC is 2% smaller. Nevertheless, the epitaxial alignment of the SrTiO₃-derived OQC with respect to the Pt(111) lattice as determined by LEED as well as the local atomic arrangement as measured by STM are identical with that of the BaTiO₃-derived OQC. Our results suggest that OQC formation is a general process of perovskite oxides on suitable substrates.

[1] S. Förster, K. Meinel, R. Hammer, M. Trautmann, and W. Widdra, *Nature* 502 (2013) 215.

[2] F. Gähler in: *Quasicrystalline Materials* (World Scientific, 1988)

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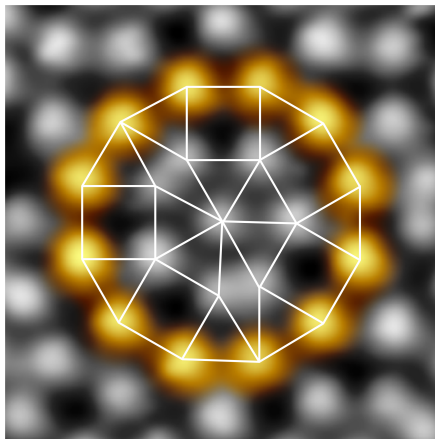


Figure 1. Atomically resolved STM image of the typical dodecagonal motif of the BaTiO₃-derived OQC on Pt(111). A similar tiling is observed for the SrTiO₃-derived OQC. 4x4 nm², I = 30 pA, U = 0.1 V.

Keywords: Oxide quasicrystal, Bariumtitanate, Strontiumtitanate, STM, LEED