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2D quasicrystals from perovskites

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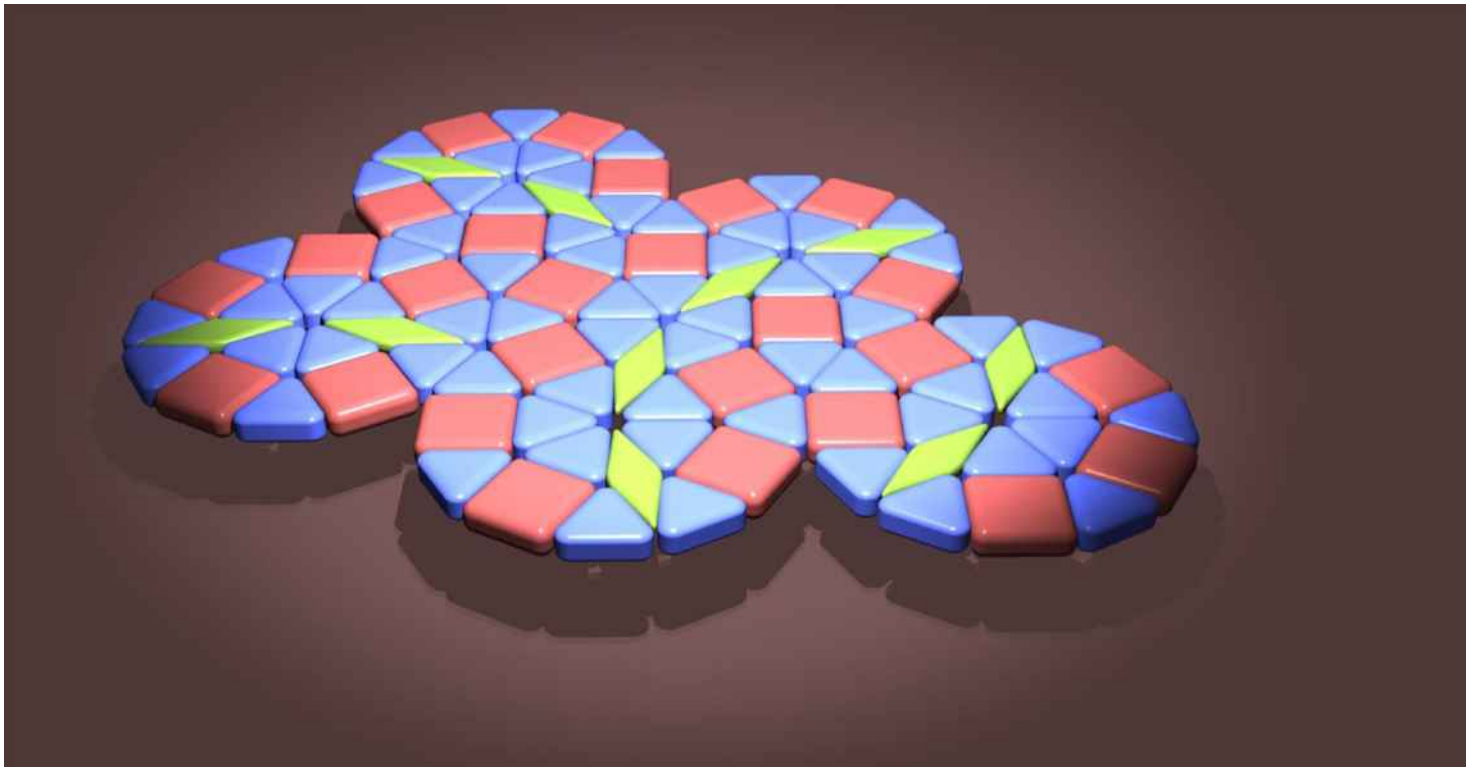
Perovskite oxides represent a versatile class of materials with a simple cubic or pseudo-cubic crystal structure. The family of perovskite oxides contains insulators, metals, semiconductors, and superconductors with nearly identical lattice parameters. This structural equivalence additionally allows to combine perovskites with different properties in multilayer systems to produce functional materials with unique properties. We report here on the formation of a quasicrystal (QC) thin film on a threefold Pt(111) surface. This QC film is derived from the classical perovskite oxide BaTiO3 which is the most intensely studied ferroelectric perovskite oxide. An easily accessible ferroelectric to paraelectric phase transition at 400 K makes the material so interesting for basic and applied research. Due to matching lattice conditions BaTiO3 can be grown epitaxially on selected metal substrates. Periodic thin films of either BaTiO3(100) or BaTiO3(111) have been grown depending on substrate orientation and preparation conditions on Pt(001) and on Pt(111) [1, 2]. As we demonstrate here, astonishingly also a two-dimensional dodecagonal quasicrystalline structure can be formed by annealing an initially 1.4 nm thick BaTiO3 film on Pt(111) [3]. It develops at a temperature of 1250 K from a wetting layer spreading between a few thicker BaTiO3(111) islands. Surface sensitive electron diffraction (LEED) shows a bright and sharp pattern with dodecagonal symmetry. High-resolution scanning tunneling microscopy (STM) images reveal an arrangement of quadratic, triangular, and rhombic elements which compares well to a Gähler tiling. The development of higher-order self-similar structures is widely suppressed by a linear phason strain. This is supported by the fine structure of the diffraction data.

***[1]** S. Förster and W. Widdra, Surface Science 604 (2010) 2163., **[2]** S. Förster et al., J. Chem. Phys. 135 (2011) 104701., **[3]** S. Förster et al., Nature 502 (2013) 215.*



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