Carl von Ossietzky
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Institut für Physik

Physical Colloquium

„Quasicrystals in two-dimensional ternary oxides“

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Our perception of crystals is strongly linked to lattice periodicity. We are used to translational symmetry in crystals and learn to associate 2-, 3-, 4- and 6-fold symmetric diffraction pattern with crystal lattices. Quasicrystals, however, exhibit 5-, 8-, 10-, or 12-fold symmetries, which are incompatible with lattice periodicity. Their discovery about 40 years ago forced a paradigm shift in the definition of crystals to include aperiodic order and release the constraint of translational invariance.

In my talk, I will present recent work dedicated to oxide quasicrystals. This new class of quasicrystalline materials has been discovered in our group at the MLU and represents the first aperiodically ordered 2D material. Oxide quasicrystals form in ternary oxide monolayers on metal support. They exhibit a dodecagonal symmetry arising from an atomic arrangement of one cation species into triangles, squares, and rhombuses. I will focus on the surface science characterization of oxide quasicrystals and their related periodic approximants on various substrates, involving microscopies on the atomic scale (STM, nc-AFM) as well as the micro scale (LEEM), area integrating techniques for structure determination by diffraction (LEED, SXRD), and the analysis of their chemical composition and electronic properties by electron spectroscopy (XPS, UPS). This complementary approach has been applied in-situ to study the high-temperature formation process of oxide quasicrystals. Furthermore, it allowed to solve the atomic structure of oxide quasicrystals, by combining the results obtained for Ba-Ti-O and Sr-Ti-O monolayers on different metal substrates. The basic ingredient to the dodecagonal structure is a network of Ti_nO_n units organized in rings of different sizes in which the largest rings host alkaline earth metal ions. Thus, oxide quasicrystals are bridging the gap between strict periodic arrangements of six-member rings in honeycomb structures and rings of varying sizes in glass-like two-dimensional oxides.

Host: Prof. Dr. Niklas Nilius