STM spectroscopy on correlated topological materials

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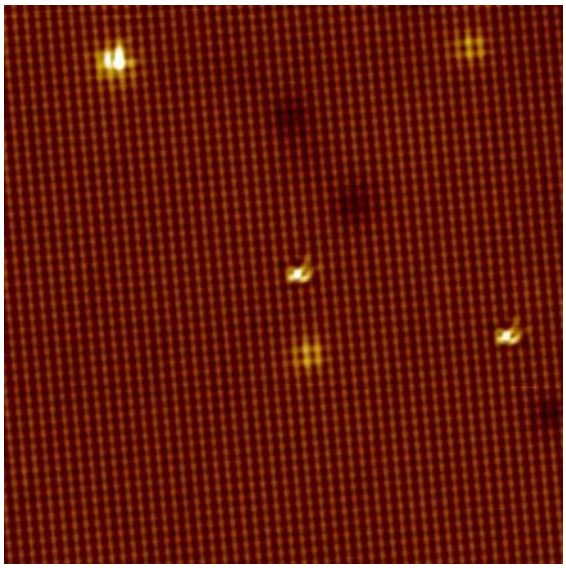
Electronic correlations give rise to a plethora of interesting phenomena and phases. Specifically, hybridization between 4*f* and conduction electrons in Kondo systems may result in such fascinating properties like quantum criticality, unconventional superconductivity or Kondo insulators [1]. One of the most important techniques that helped shaping our understanding of nonlocal correlations has been scanning tunneling spectroscopy (STS) with its unique ability to give local, microscopic information that directly relates to the one-particle Green's function. We combine STS with bulk measurements to obtain complementary information on different length scales.

SmB_6 has been proposed as a topological Kondo insulator, which possesses topologically protected nontrivial surface states inside the bulk hybridization gap. Experimentally, hybridization between localized 4*f* and conduction band states at sufficiently low temperatures is well established [2]. Yet, the observation of many basic properties is still controversial, which is in part due to the reconstruction/disorder of the cleaved surfaces of SmB_6. While low-temperature *in-situ* cleaving of SmB_6 single crystals mostly resulted in a variety of coexisting surfaces terminations [3], we concentrate on STS of non-reconstructed areas (see figure). At the surface, the Kondo effect is suppressed to lower temperatures as compared to the bulk material [4]. We show the development of the surface states at low temperatures and how it is locally suppressed around non-magnetic and magnetic impurities. The latter is indicative of the topological nature of these surface states.



B-terminated, non-reconstructed surface of pure SmB_6 of area 20 x 20 nm^2 with very low density of defects.

References:
[1] S. Wirth and F. Steglich, Nature Rev. Mat. **1** (2016) 16051.
[2] S. Rößler *et al.*, Proc. Natl. Acad. Sci. USA **111** (2014) 4798.
[3] S. Rößler *et al.*, Phil. Mag. **96** (2016) 3262.
[4] Lin Jiao *et al.*, Nature Commun. **7** (2016) 13762.