ELECTRONIC STRUCTURE AND ELECTRON DYNAMICS IN NOVEL TWO-DIMENSIONAL MATERIALS

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Changing the dimensionality of a material results in significant modifications of its electronic properties. This is even the case if the parent material already has a layered structure with little interaction between the layers, as in the case of graphene and single-layer transition metal dichalcogenides.

Here we explore the properties of novel two-dimensional materials such as single layers of MoS_2, WS_2 and TaS_2 by scanning tunnelling microscopy angle-resolved photoemission spectroscopy (ARPES). The layers are grown epitaxially on Au(111), Ag(111) and graphene. For the semiconducting materials (MoS_2, WS_2), strong band gap renormalizations are observed due to the interaction with the substrate. For the metallic layers (TaS_2), we can study the effect of low dimensionality on electronic instabilities such as charge density waves and superconductivity.

While the static electronic properties of novel two-dimensional materials can be studied by standard ARPES, investigations of the ultrafast carrier dynamics require both time- and angular resolution and thus time-resolved (TR)-ARPES. There is, moreover, the technical requirement of high photon energies since the interesting part of the aforementioned materials' electronic structure (i.e. the (gapped) Dirac cone) is placed at the two-dimensional Brillouin zone boundary. Recently, it has become possible to probe states at such high *k* by TR-ARPES, thanks to the arrival of ultrafast high harmonic laser sources.

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