ARPES of two-dimensional modulated structures

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Thanks to its energy and momentum selectivity, modern ARPES is a rather unique probe of quasiparticle dispersion and dynamics in complex materials. Here I will briefly discuss the results of recent ARPES experiments, which show some interesting aspects of the electronic properties of modulated two-dimensional systems.

- In the layered materials *1T*-TaS_2 and *1 T*-$TaSe_2$ the interplay of temperature-dependent charge-density-waves (CDW) and electronic correlations yields a bandwidth-controlled metal-insulator (M-I) transition. Interestingly, whereas the whole bulk crystal becomes insulating for $T<T_{MI}$ in *1T*-TaS_2, the transition is limited to the surface region in *1T*-$TaSe_2$. ARPES reveals the breakdown of the Fermi surface and the disappearance of the coherent quasiparticle weight at the transition (Fig. 1), but also the signatures of a hidden periodicity, which we interpret as evidence for short-range magnetic fluctuations [1]. The local changes in the electronic states is confirmed by STM/STS data [2].

- The periodic modulation of the atomic positions observed in selected epitaxial overlayers may considerably affect the dispersion of the interface states. I will discuss the "moiré" superstructure observed for an ordered monolayer of Pb grown on Ag(111). The effect is negligible for the in-plane p_{xy} bands, but dramatic for the perpendicularly oriented p_z states. These data confirm that the strength of the coupling to the modulation, rather than its mere periodicity, is the crucial factor determining the electronic structure of modulated phases [3].

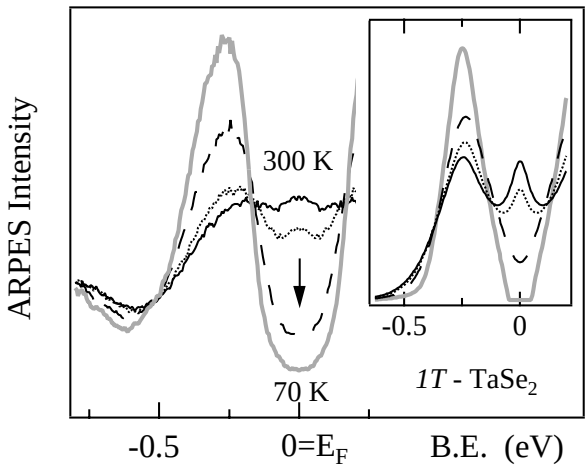

Figure 1. ARPES spectra of *1T*-$TaSe_2$ collected at various temperatures across the M-I transition the Fermi surface, and then symmetrized around E_F. The inset shows the results of a DMFT calculation.

[1] L. Perfetti et al., Phys. Rev. Lett. **90**, 166401 (2003); Phys. Rev. B **71**, 153101 (2005).

[2] S. Colonna et al., Phys. Rev. Lett. **94**, 036405 (2005);

[2] Ch. Ast et al., to be published.