Probing long-range structural order in SnPc/Ag(111) by umklapp process assisted low-energy angle-resolved photoelectron spectroscopy

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Laser-based angle-resolved photoelectron spectroscopy is performed on tin-phthalocyanine (SnPc) adsorbed on silver Ag(111). Upon adsorption of SnPc, strongly dispersing bands are observed which are identified as secondary Mahan cones formed by surface umklapp processes acting on photoelectrons from the silver substrate as they transit through the ordered adsorbate layer. We show that the photoemission data carry quantitative structural information on the adsorbate layer similar to what can be obtained from a conventional low-energy electron diffraction (LEED) study. More specifically, we compare photoemission data and LEED data probing an incommensurate-to-commensurate structural phase transition of the adsorbate layer. Based on our results we propose that Mahan-cone spectroscopy operated in a pump-probe configuration can be used in the future to probe structural dynamics at surfaces with a temporal resolution in the sub-100-fs regime.

References:
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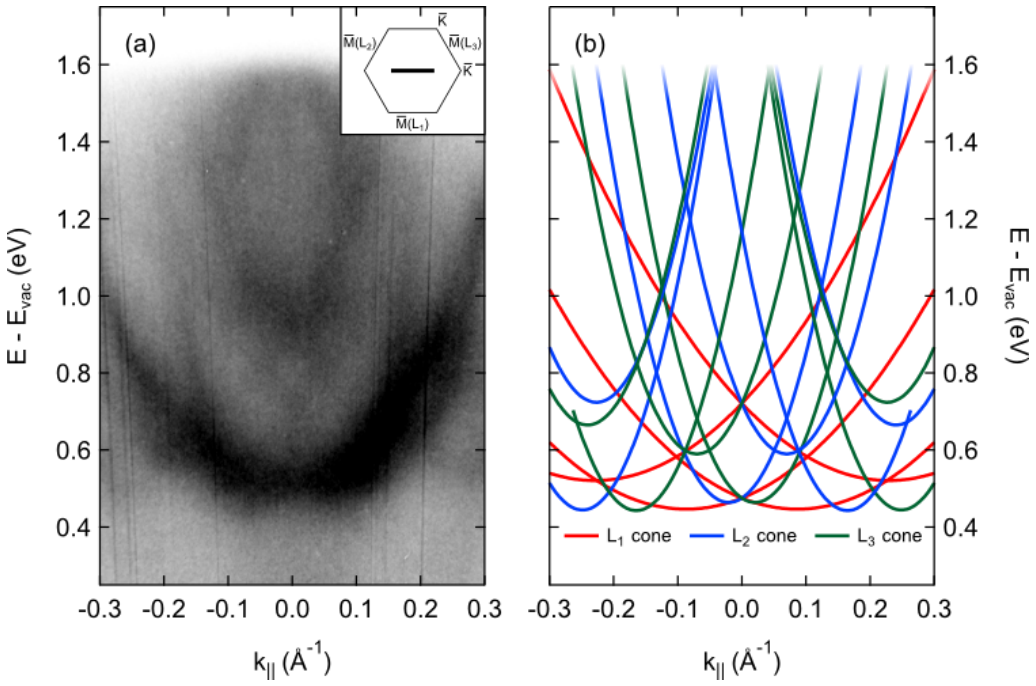

Figure 1: Mahan cone formation for 1.0 monolayer SnPc on Ag(111). (a) ARPES intensity map recorded with a photon energy of $h\nu$ = 5.9 eV and (b) calculated Mahan cones in Γ – K direction. Different colors in (b) depict the three possible origins M(L) of the Mahan cones [see Inset in Fig. (a)]