Mapping of electronic structure in the momentum microscope

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Knowledge of the detailed electronic structure in the entire Brillouin zone and in the whole valence-band regime is a prerequisite for understanding new effects at surfaces. This information is obtained with unprecedented efficiency by an energy- and momentum-resolving photoelectron emission microscope (momentum microscope) that detects constant-energy intensity distributions of electrons emitted into the full hemisphere.
We mapped the complete valence-band structure which is accessible by unpolarized He I radiation for the paradigmatic systems Cu(111) and Cu(001).
The measurements provide simultaneous access to extended parts of the photoelectron momentum space beyond high-symmetry regions and, thus, serve as a testing ground for theoretical photoemission from bulk and surface states. For example, agreement of the experimental and theoretical intensity distributions in the entire phase space is obtained only by improving the treatment of the *d*-bands which are unsatisfactorily described within the local density approximation.
In addition, we observed characteristic interference effects of photoelectron waves scattered in the surface barrier of Cu(001) and we mapped the dispersion of the unoccupied part of the Shockley surface state on Cu(111) by multi-photon-photoemission in our momentum microscope.