Imaging spin detector for 3D time-of-flight momentum microscopy

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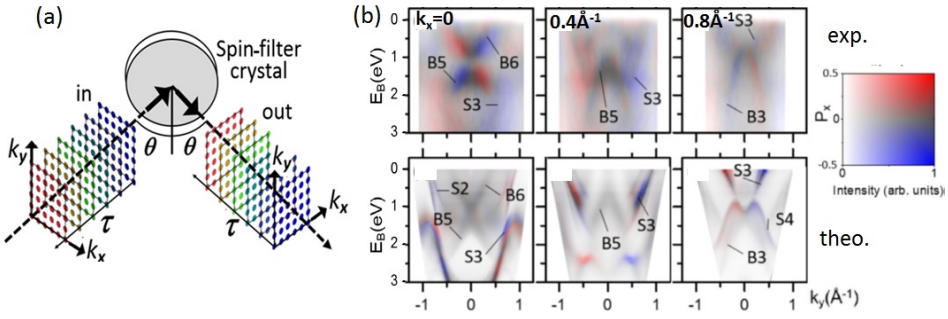
We report on photoemission results using a multichannel imaging spin detector in 3D time-of-flight (ToF) momentum microscopy. ToF momentum microscopy is a unique tool for the investigation of the spin-resolved electronic structure of materials [1,2]. The method allows to detect the parallel k_x and k_y momentum component, and energy via ToF.

An imaging spin detector that can transport a full image opens a unique opportunity for fast spin resolved band-structure mapping. The working principle of the detector is based on spin-dependent low-energy electron diffraction from single crystalline surfaces. Specular reflection under off-normal incidence is used for spin-filtering of the k_x and k_y momentum coordinates, the energy "coordinate" is encoded in the time of flight, cf. Fig. a. The 3D acquisition scheme allows to resolve $>10^5$ (k_x, ,E_B) data points simultaneously. One very attractive spin-filter is Ir (100) passivated by a pseudomorphic (1×1) Au overlayer. This system provides high polarization sensitivity, up to 80 %, and more than 12 months of lifetime in ultrahigh vacuum [3]. Recently, the capability of vectorial spin detection has been demonstrated [4], exploiting the possibility to switch between the perpendicular and in-plane spin component by azimuthal rotation of the spin-filter crystal.

The spin-filter has been used for the study of the spin-polarization texture of surface bands at low photon energies (10 m NIM at BESSY II, Berlin) and bulk bands using soft X-rays (beamline P04 at PETRA III, DESY Hamburg). Fig. 1b shows some selected sections of the low-energy spin distribution measured for Ir(111) at hv=16 eV. The status of the development and recent examples will be presented.



(a) Scheme of 3D spin filtering. (b) Cuts through 3D spin-texture array of Ir(111) taken at hν=16 eV (from [2]).

References

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