Surface state on Fe(001)/Au(001) investigated by high-resolution angle-resolved spectroscopy

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The surface electronic states of Fe(001) have been experimentally studied using angle-resolved photoelectron spectroscopy (ARPES) since the early days of photoemission [1-3]. Fe(001) is considered a prototypical transition metal system and moreover, one of the key players in the spintronics research.

In this contribution we will present the high-resolution ARPES results that demonstrate the existence of the Fe(001) surface state in the Fe/Au(001) system. The electronic structure of Fe/Au(001) was mapped within the entire surface Brillouin zone, to demonstrate for the first time the exact location and extent of the surface state. The experimental results will be compared to the results of the relativistic slab calculations performed using density functional theory in the generalized gradient approximation.

The samples were prepared *in situ* in the preparation chamber of the Phelix beamline [4] at the Solaris synchrotron in Krakow. Before each measurement, the sample was remanently magnetized. The electronic structure was studied for the pristine Fe(001) surface, when the surface state was observed, and after adsorption of 3 Langmuir of O_2, when it is demonstrated to vanish. Moreover, by collecting the photoemission spectra with the photon energy between 60 eV and 160 eV it was shown that the surface state is observed only in a narrow photon energy window between 65 and 80 eV. The dispersion of the surface state was found to depend on the magnetization direction.

These new experimental results contribute to the existing knowledge on the properties of the Fe(001) surface states with relevance for the basic research as well as for spintronic effects, such as tunneling anisotropic magnetoresistance.

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