

Electronic structure of Fe(001) with symmetry breaking due to the magnetization direction

E. Młyńczak,¹ L. Plucinski,² and C. M. Schneider²

¹*Jerzy Haber Institute of Catalysis and Surface Chemistry,
Polish Academy of Sciences, Poland*

²*Peter Grünberg Institut PGI, Forschungszentrum Jülich, Germany*

Interplay of the exchange interaction and the spin-orbit interaction introduces subtle modifications to the electronic band structure of a ferromagnet that lower the symmetry of the system with respect to the nonrelativistic case. This effect brings prominent consequences, such as the emergence of the magnetocrystalline anisotropy, intrinsic anomalous Hall effect, or anisotropic magnetoresistance. In this contribution, we will discuss the experimental results obtained for thin Fe(001) films epitaxially grown on Au(001) using high resolution angle-resolved photoelectron spectroscopy as well as spin- and k-space resolved photoemission microscopy. We have observed clear modifications of the electronic band structure of Fe(001) near the Fermi level, depending on the magnetization direction. We will show opening/closing of the spin-orbit gaps within the bulk electronic structure [1], as well as substantial shifts in energy and momentum of the quantum well states [2]. The quantized states that we observed can be responsible for the oscillations of the magnetic anisotropy in Fe(001) thin films with periods of about 5 and 9 monolayers. The experimental results will be confronted with the photoemission simulations performed starting from the initial band structure described by the GW method and taking into account intrinsic broadening of the final state along the wavevector perpendicular to the sample surface.

References:

- [1] E. Młyńczak et al. Phys. Rev. X 6, 041048 (2016)
- [2] E. Młyńczak et al. Phys. Rev. B 103, 035134 (2021)