Photoemission and magnetic circular dichroism studies of ferromagnetic semiconductors

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Diluted magnetic semiconductors (DMSs), which are key materials for spin electronics, belong to a class of so-called strongly correlated systems, in which electron-electron interaction plays an essential role in realizing their remarkable physical properties. Photoemission spectroscopy is a powerful technique to study the electronic structure and the origin of the ferromagnetism in DMSs, and therefore has been used to study the d orbital of the dilute transition-metal atoms, mostly Mn, and their hybridization with the host band states [1]. Soft x-ray absorption spectroscopy (XAS) and soft x-ray magnetic circular dichroism (XMCD) at the transition-metal 2p-3d absorption edges are useful techniques to study the valence and spin states as well as the structural environment of the transition-metal atoms. Furthermore, since XMCD has different sensitivities to the ferromagnetic and paramagnetic components as a function of temperature and magnetic field, it can be used to separate the different magnetic components and to study their individual electronic structures. The XMCD line shape of the ferromagnetic component gives unambiguous evidence for the intrinsic *versus* extrinsic origins of high-temperature ferromagnetic semiconductors. In this talk, results are presented for the prototypical DMS $Ga_{1-x}Mn_xAs$ [2] and the room-temperature ferromagnetic DMSs $Zn_{1-x}Co_xO$, $Ti_{1-x}Co_xO_2$ and $Zn_{1-x}Cr_xTe$.

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