Study of interaction between Rashba-type surface states and quantum well states by two-dimensional photoemission band-mapping

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Spin regulation in solids has been one of the central issues in researches of magnetisms and spin transport. Nowadays, such studies have extended to nanometer-scale structures for developing nanospintronics. Electronic states of $\sqrt{3}\times\sqrt{3}$-ordered surface phase of Bi/Ag(111) are spin-polarized due to the Rashba effect[1]. Recently, these spin-split surface states(SS) have been reported to induce spin-splitting of quantum well states(QWS) in a ultrathin Ag film on Si(111), which indicates a new style of controlling spins in nonmagnetic nanostructure[2.3].While such previous researches have focused on spin-dependent interaction of the QWS subbands with two SS bands, there exist actually four spin-split SS bands. Moreover the QWS bands have interactions also with Si substarate bulk bands. Therefore, it is indispensable to examine whole electronic structure of this complicated system to make proper arguments. In the present research, we have conducted high-resolution two dimensional band mapping on clean and $\sqrt{3}\times\sqrt{3}$ Bi-covered 15 ML-Ag(111) film on Si(111) 7×7 by photoemission spectroscopy at ELETTRA – VUV beamline. We will present the comprehensive band structures with features of umklapp scattering process, the SS-QWS hybridization, and the QWS-Si bulk band interactions. Our magnetic transport data on the same system will be also discussed in term of the photoemission Fermi surface.

Reference:[1] C.R. Ast et al., Phys. Rev. Lett. 98, 186807(2007). [2]K. He et al., Phys. Rev. Lett. 101, 107604(2008). [3]E. Frantzeskakis et al., Phys. Rev. Lett. 101 196805(2008).