Angle-Resolved Photoemission Spectroscopy Study of Misfit Cobaltate $Bi_2Ba_{1.3}K_{0.6}Co_{2.13}O_y$

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Structural periodicity is a crucial factor for the stability of crystalline solid. Misfit-structure compounds, where layers with different space group symmetries stack together, causing incommensurability in the lattice structure. The central mystery associated with the stability of the misfit compounds is still unsolved. Angle-Resolved Photoemission Spectroscopy (ARPES) is proven to be a powerful tool to investigate the electronic structure of materials. Misfit Cobaltate $Bi_2Ba_{1.3}K_{0.6}Co_{2.13}O_y$ was studied by ARPES at NSRRC 21B1 U9- (CGM) beam line.

In the previous study, the evolution of Fermi surface(FS) was observed through the variation of photon energies. With the lower photon energies, the FS is a hexagonal type hole pocket centerd at point, corresponding to the $[CoO_2]$ layer; while under the higher photon energies, the FS is four-fold symmetry hole pocket centered at the corner of Brillouin zone, corresponding to the [BiO/BaO] layers.

The $[CoO_2]$ layer FS and the [Bio/BaO] layers FS seem to cross each other without obvious bending. This could be attributed to the very weak coupling between these layers along the c-axis. The coupling between the the low-lying states near EF in the misfit layers are very weak. Because they are usually more extended than the states at higher binding energies, the bonding between the high-lying states at different misfit layers are expected not to mix either. To further confirm that this is not just by accident, eg. due to some symmetry effects of the low-lying state, valence band spectra were taken along the Γ-K direction for different kZ through the use of three different photon energies (see Fig. 1) at NSRRC beamline 21B1.

Within the range of EF to EB=8eV, six bands were clearly observed, each band shows nearly nondispersive character. Furthermore, under different photon energies, corresponding to different kz , all six bands' dispersion do not change, which indicates the kz nondispersive character. This result confirms the coupling between layers is weak and the bond between them is not covalent bond.

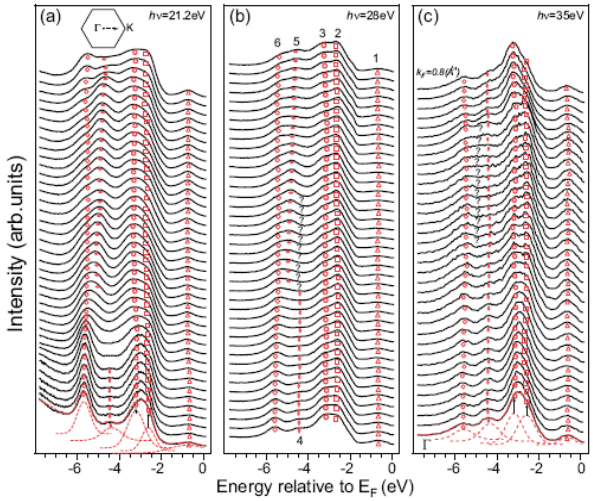

Figure 1. Valence band structure along the Γ-K direction taken with (a) 21.2 eV, (b) 28 eV, and (c) 35 eV photons respectively. Different symbols were used to label the positions of the observed six bands, which are estimated through the fittings as exemplified by the dashed curves.

In conclusion, we studied Misfit cobaltites $Bi_2Ba_{1.3}K_{0.6}Co_{2.13}O_y$ by ARPES. The nondispersive valence band structure along the k_z direction confirms that $[CoO_2]$ layer and [BiO/BaO] layers are weakly coupling, and the bonding between them is not covalent bond but ironic bond.