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ARPES study of $K_{0.5}CoO_2$ in its metallic state

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After the discovery of superconductivity in $Na_{0.35}CoO_2 \cdot 1.3H_2O$[1], a very rich phase diagram of Na_xCoO_2 was revealed [2]. In this phase diagram, $Na_{0.5}CoO_2$ is unique in the sense that it shows two successive transitions, an antiferromagnetic (AF) transition at 88 K (T_{c1}) and a metal–insulator transition at 53 K (T_{c2}) [2,3]. However, the origin of these transitions has not been clarified yet. An isostructural system $K_{0.5}CoO_2$ is also known to show (probably) the same transitions at a little lower temperatures (T_{c1} of 60 K and T_{c2} of 20 K) [3] although there have been few studies on the K system. In spite of the lower T_c's, however, the K system has one advantage that x can be set to 0.5 more accurately than the Na system so that one can investigate the intrinsic nature of the transitions. In this presentation, we focus on the electronic structure of $K_{0.5}CoO_2$ in the metallic phase probed by high–resolution angle–resolved photoemission spectroscopy at a low temperature [4]. The observed Fermi surface of $K_{0.5}CoO_2$ was a large hexagonal one around the Γ point only, with no hole pockets on the Γ–K lines which was typically predicted by band–structure calculations with local–density approximation (LDA). We also found that a modulation of the Fermi velocity, which was the largest at M point and the smallest at K point, was again opposite to the prediction by LDA band theory [5]. In spite of this conflicting with LDA band theory, our results are both in agreement with what was observed in Na_xCoO_2.

References

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