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Electronic Structure of $BaNi_2P_2$ Observed by Angle-Resolved Photoemission Spectroscopy

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Introduction

Recently, the iron-based superconductor $LaFeAsO_{1-x}F_x$ (T_c = 26 K) has been discovered [1] and the highest T_c of this system is ~ 55 K. The electronic structures of these compounds have been investigated by angle-resolved photoemission spectroscopy (ARPES) to elucidate the mechanism of superconductivity [2, 3].

$BaNi_2P_2$ has $ThCr_2Si_2$ structure as the same as (Ba, K)Fe_2As_2 (T_c ~ 38 K) and becomes superconducting below T_c ~ 3 K [4]. Recently, measurement of de Haas-van Alphen (dHvA) oscillation of $BaNi_2P_2$ has been performed and large Fermi surfaces and three-dimensionality of the hole surface have been identified [5].

Here, we report the results of ARPES measurements of $BaNi_2P_2$ and show the valence-band spectrum and Fermi surface.

Experimental Condition

Single crystals of $BaNi_2P_2$ (T_c ~ 3 K) were prepared by high-pressure synthesis. ARPES experiments were carried out using a SES-2002 analyzer at BL 28A. Measurements were performed at T ~ 10 K and photon-energy was $h\nu$ = 80 and 120 eV.

Results and Discussion

Figure 1 shows valence-band spectrum of $BaNi_2P_2$ using $h\nu$ = 80 eV and T = 10 K. The peak positions which may originate from Nickel-*d* states are in good agreement with the band calculation [5], and small energy shift may imply that $BaNi_2P_2$ shows weakly mass renormalization.

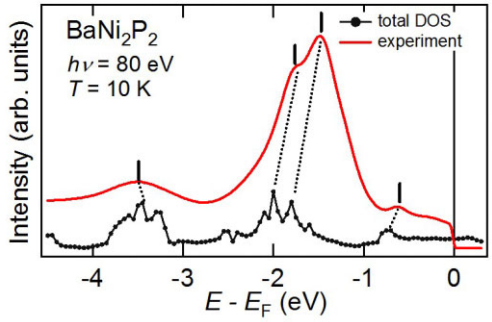

Figure 1: Valence-band spectrum integrated over the Brillouin zone measured using $h\nu$ = 80 eV. This result shows good agreement with band calculation [5].

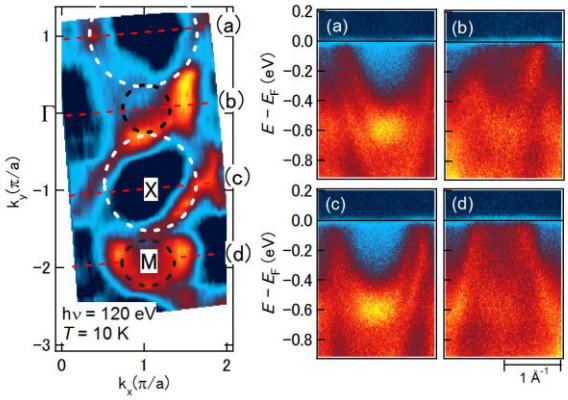

Figure 2: ARPES spectra observed at $h\nu$ = 120 eV and T = 10 K. The energy – momentum plots for cuts (a) – (d) in the left figure are shown in the right figures. White and black dashed circles show the electron-like and hole-like Fermi surfaces, respectively.

Figure 2 shows ARPES spectra of Fermi surface (integrated within ± 20 meV) and quasi-particle bands measured using $h\nu$ = 120 eV. As shown in Fig. 2 (a) and (c), white dashed circles of the left panel indicate large electron-like Fermi surface around the X. Also, black dashed circles are hole pockets around the M as shown in Fig. 2 (b) and (d). Further experimental studies are necessary to clarify the three dimensional Fermi surface which is anticipated from the result of dHvA.

Summary

We have performed ARPES measurements in $BaNi_2P_2$ and observed a large electron-like Fermi surface and hole pocket. Also, valence-band spectrum is in good agreement with the band calculation [5] and may also show the weakly mass renormalization.

References

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