BL-28A/2016G079

Angle-resolved photoemission study on $(Sr,La)_2IrO_4$

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1 Introduction

5*d* electron system is acquiring attention of the condensed matter field as a system where the energy scale of spin-orbit coupling is as large as those of Coulomb interaction and transfer integral, to produce possible novel phenomena. Among them, Sr_2IrO_4 has been regarded as a promising candidate for superconductor since it has been proposed that the insulating behavior of the sample is originating from the splitting of J_{eff}=1/2 band due to strong correlation [1]. The sample is isostructural to one of cuprates La_2CuO_4 and shows an antiferromagnetic order below T_N = 240 K. The emergence of superconductivity in doped system has been predicted by theoretical studies [2] although there has been no corresponding experimental report so far. Nevertheless, it has been reported that K-doped sample surface shows peculiar electronic structure with anisotropic excitation gap [3] reminiscent of pseudogap in cuprates. The existence of similar electronic state has been also reported recently in the cleaved sample surface of $Sr_{2-x}La_xIrO_4$ [4]. Further detailed investigation of this pseudogap-like state in electron-doped iridates has been highly anticipated.

In this work, we have performed angle-resolved photoelectron spectroscopy on $Sr_{2-x}La_xIrO_4$ (x = 0, 0.08). We have measured electronic structure at temperatures both below and above T_N of crystals, in order to find out how the pseudogap reacts by raising temperature.

2 Experiment

Single crystals of Sr_2IrO_4 and $Sr_{1.92}La_{0.08}IrO_4$ were synthesized by flux method.

ARPES mesurements were perfomed at BL-28A, Photon Factory. The energy resolution was set at 30 meV. We used circulary polarized light of hν = 100 eV to excite photoelectrons. The Fermi energy of the sample was referenced to that of gold which had electronic contact with samples.

3 Results and Discussion

We show in Fig. 1(a) ARPES intensity plot $Sr_{1.92}La_{0.08}IrO_4$ as a function of two dimensional wave vector at binding energy of 50 meV, taken at T = 100 K. We have observed electron-like dispersion centered at Γ point, which forms the circle-shaped remnant Fermi surface. As shown in Fig. 1(f), the leading edge of photoemission energy distribution curve (EDC) lies below E_F, indicating the presence of an excitation gap near the X point at T = 100K in $Sr_{1.92}La_{0.08}IrO_4$. This excitation gap seems to be closed by raising temperature up to T = 260 K, although spectra has broadened (Fig. 1(c) and 1(e)) considerably partially because of possible aging. Further study with higher vacuum should be necessary to conclude the temperature dependence of excitation gap in doped iridates.

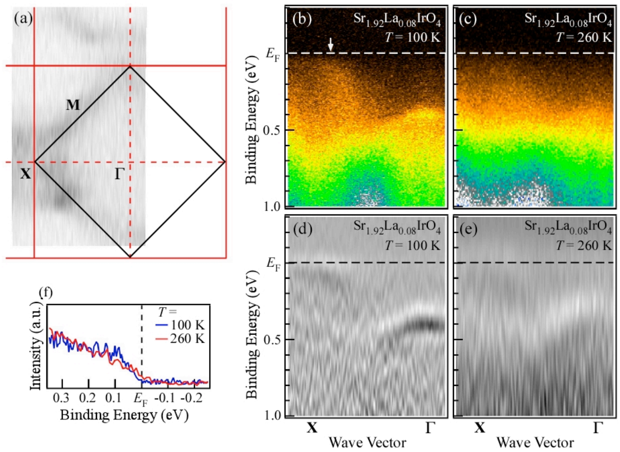

Fig. 1: (a) ARPES intensity plot of $Sr_{1.92}La_{0.08}IrO_4$ as a function of two dimensional wave vector at binding energy of 50 meV, taken at T = 100 K. (b) ARPES intensity plot along ΓX direction at T = 100 K. (c) same as (b) at T = 260 K. (d) and (e) second derivative of (b) and (c). (f) EDCs taken at k-point indicated by an arrow in (b).

References

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