Electron-phonon coupling in the correlated electron systems revealed by angle-resolved photoemission spectroscopy

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Electron-phonon coupling is one of the fundamental many-body interactions and has been discussed as the key to the enhancement of the superconducting temperature T_c in a wide variety of materials such as A-15 compounds, high-T_c cuprates, iron pnictides/chalcogenides, and hydrogen sulfide. The signature of electron-phonon interactions appears in the kink and spectral linewidth of the quasiparticle dispersion and can be investigated by angle-resolved photoemission spectroscopy.

Here we present the signature of electron-phonon coupling observed in the electronic states of $Ca_{2-x}Sr_xRuO_4$ (CSRO) [1] and $BaIr_2Ge_7$ [2]. CSRO shows a metal-insulator transition with a structural phase transition. In the region of small x, the bulk of CSRO is in the insulating phase at low temperatures. We have performed angle-resolved photoemission spectroscopy (ARPES) of CSRO (x = 0.06) and revealed that the surface is in a metallic state while the bulk is in an insulating state. The observed band dispersion of the surface metallic state exhibits kink structures with the energy scales of 35 and 60 meV. The distinct kink structures suggest a strong electron–phonon coupling compared with Sr_2RuO_4.

We also performed ARPES on $BaIr_2Ge_7$ with cage structures and observed the temperature dependence of the ARPES spectra near the Fermi level. We found that the width of the spectral peak shows a concave-downward behavior with temperature similar to the electrical resistivity. Considering the effect of anharmonic phonon modes, this behavior was well reproduced in our simulations. Our results suggest the existence of the weak anharmonic phonon modes in $BaIr_2Ge_7$.

REFERENCES

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