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Ultrahigh-resolution photoemission spectroscopy of superconductors using a VUV laser

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Photoemission spectroscopy has played important roles to study the electronic structures. For examples, the structures near the E_F of high temperature superconductors show the d_{x2-y2} symmetry of superconducting gap and an anisotropic pseudo gap. In this paper, we present ultrahigh-resolution photoemission spectra of heavy Fermion superconductors and skutterudite superconductors.

We constructed photoemission spectrometer using quasi-CW VUV laser with the highest energy resolution of 360μeV and the lowest measurement temperature of 2.7K. Due to the energy resolution and low temperature, observing superconducting gaps of the superconductors that have been impossible to observe superconducting state by the limitation of energy resolution and temperature so far becomes possible.

Here we measured *f*-electron superconductor $CeRu_2$ and skutterudite superconductor $LaRu_4P_{12}$ to study superconducting electron state and demonstrate the advantage of VUV laser photoemission spectroscopy. Among the *f*-electron superconductors, $CeRu_2$ has the highest T_c of 6.2 K. The symmetry of the order parameter as suggested from superconducting properties is controversial. Figure 1 shows the superconducting gap of $CeRu_2$. This is the first observation of superconducting gap of *f*-electron superconductor using photoemission spectroscopy. The superconducting spectrum is analysed with Dynes' function. We report the anisotropic superconducting gap of $CeRu_2$. On the other hand, $LaRu_4P_{12}$ shows the isotropic superconductor. The temperature dependence follows the BCS theory very well.

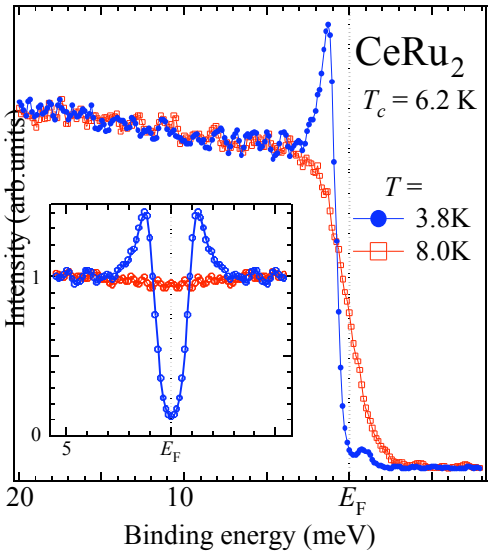

Fig.1 Superconducting gap of $CeRu_2$

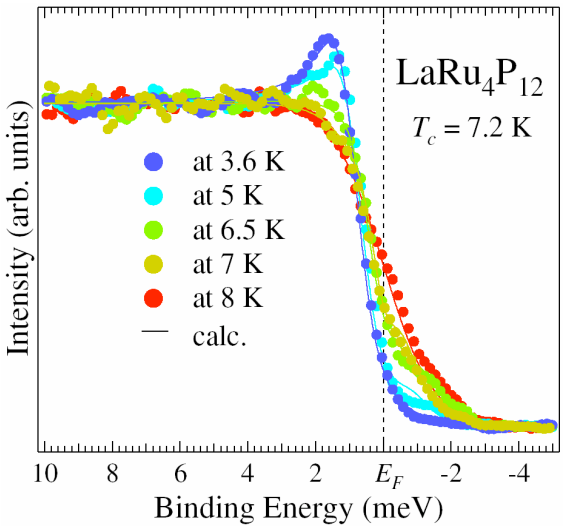

Fig.2 Superconducting gap of $LaRu_4P_{12}$