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Observation of the Multi-channel Kondo Effect in Iron-based Superconductor

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In many of FeAs compounds, it is believed that the antiferromagnetic spin-fluctuation induced by the Fermi-surface nesting mediates the Cooper pairing with the extended s-wave symmetry (s±) with which the gap function has different sign in the hole and the electron pockets centered at the Γ and the M points, respectively. However the charge or orbital fluctuation enhanced by the intersite correlation can open an alternative channel for Cooper pairing with different types of spin and space-inversion symmetry. Particularly in Sr2VO3FeAs, the intersite interaction is enhanced by the hybridization between the FeAs and the VO3 layers, with which the nesting condition for AF spin-fluctuation is substantially destroyed. Even in the case, the stoichiometric Sr2VO3FeAs compound shows Tc above 30K, indicating that the pairing mechanism is not attributed to AF spin-fluctuation, but rather charge or orbital fluctuation enhanced by the interlayer coupling.
In order to understand the effect of the interlayer coupling between FeAs and VO3 layers on electronic structure and superconductivity, we use the scanning tunneling microscopy (STM) measurements on Sr2VO3FeAS single crystals that allows atomic scale examination of this system below and above the transition temperature. As a consequence, we observe the Fano resonance in the dI/dV spectrum measured on VO3 layers, which indicates the coexistence of the uncompensated local moment and the itinerant quasiparticles in it. The itinerant quasiparticles make a highly dispersive electron pocket near the Γ-point, which is clearly shown in our quasiparticle interference (QPI) image. The coexistence of the Fermi liquid and the uncompensated local spin is the low-energy characteristics of the multi-channel Kondo lattice models, which show a variety of interesting phenomena such as orbital-selective metal-insulator transition and non-Fermi liquid behavior, as well as unconventional superconductivity.

Keywords: iron-based superconductor, scanning tunneling microscopy, quasiparticle interference image, Fano resonance, multi-channel Kondo lattice model