Electron correlation strength in FeTe$_{1-x}$Se$_x$

L. C. C. Ambolode II$^1$, M. Horio$^1$, H. Suzuki$^1$, S. Ideta$^1$, T. Yoshida$^{1,3}$, A. Fujimori$^{1,3}$, K. Ono$^2$, H. Kumigashira$^2$, L. Liu$^1$, T. Mikami$^1$, T. Kakeshita$^{1,3}$, S. Uchida$^{1,3}$, D. H. Lu$^4$, M. Hashimoto$^4$, S. -K. Mo$^5$, Z. Hussain$^5$, Z. -X. Shen$^{4,5}$

$^1$Department of Physics, University of Tokyo, Tokyo 113-0033, Japan

$^2$Photon Factory, IMSS, KEK, Ibaraki 305-0801, Japan

$^3$JST, TRIP, Tokyo 102-0075, Japan

$^4$Stanford University, California, USA

$^5$ALS, California, USA

ambolode@wyvern.phys.s.u-tokyo.ac.jp

FeTe is expected to have the strongest electron correlation among the iron-based superconductors and the electron correlation may show strong orbital dependence [1-2]. FeSe on the other hand shows only moderate electron correlation and its orbital dependence comparable to other iron-based superconductors [1]. Alloying FeTe with FeSe may give us insight on how the electron correlation and the orbital dependence change with doping. To investigate this issue, we have performed resonance and angle-resolved photoemission spectroscopy (ARPES) experiments on FeTe$_{1-x}$Se$_x$ (x = 0, 0.1, 0.4, 1).

The ARPES spectra of FeTe$_{1-x}$Se$_x$ (x = 0, 0.1, 0.4) show that spectral weight around Γ and M is mostly located at near-$E_F$ region. Near the Fermi level, several band dispersions are clearly observed around the Γ point. At the binding energy of about 0.3 – 1 eV, Fe-3$d$ $z^2$ orbital band can also be observed. We have deduced orbital dependent mass renormalization factor for these bands and the values are consistent with those of the DMFT calculation [1], in contrast to the previous ARPES study [2].

The Fe-3$d$ partial density of states (PDOS) obtained from resonance photoemission experiment show two distinct features near the Fermi level in FeTe and FeTe$_{0.6}$Se$_{0.4}$ while only one merged structure has been observed in FeSe. The energy position of the strongest peak shifts towards the Fermi level with increasing Se composition. The shift of the peak position with Se substitution is qualitatively consistent with the ARPES result and the DFT calculation [3]. This peak structure can be attributed to the $dz^2$ orbital band.

