THz conductivity measurements of $Ba(Fe_{1-x}Co_x)_2As_2$ and $FeSe_{1-x}Te_x$ films

Y. Imai[a, e], D. Nakamura[a, e], F. Nabeshima[a, e], T. Katase[b], H. Hiramatsu[b], M. Hanawa[c, e], I. Tsukada[c, e], H. Hosono[b, d], and A. Maeda[a, e]

[a]Department of Basic Science, the University of Tokyo, Tokyo, Japan
[b]Materials and Structures Laboratory, Tokyo Institute of Technology, Yokohama, Kanagawa, Japan
[c]Central Research Institute of Electric Power Industry, Yokosuka, Kanagawa, Japan
[d]Frontier Research Center, Tokyo Institute of Technology, Yokohama, Kanagawa, Japan
[e]Transformation Research-Project on Iron Pnictides (TRIP), JST, Tokyo, Japan

We investigated the THz conductivity for thin films of iron-based superconductors, $Ba(Fe_{1-x}Co_x)_2As_2$ with different Co concentrations and $FeSe_{1-x}Te_x$. For the optimally doped $Ba(Fe_{1-x}Co_x)_2As_2$, we found a structure corresponding to superconductivity gap, 2Δ, whose magnitude is 2.8 meV at low temperatures, leading to $2\Delta/k_BT_c = 4.1$ [D. Nakamura *et al.*, arXiv: 0912.4351., Physica C, *in-press*]. This value is in good agreement with the smaller gap found in an ARPES measurement [K. Terashima *et al.*, PNAS **106** (2009) 7330.]. For the underdoped $Ba(Fe_{1-x}Co_x)_2As_2$ in which the coexistence of antiferromagnetic order with superconductivity was observed, we found the strong suppression of the carrier lifetime around the antiferromagnetic phase transition temperature ($T \sim 40$ K). However, the real part of the complex conductivity was not suppressed in this temperature region. We argue that this behavior is related to the response of carriers on the Dirac cone, which observed in $BaFe_2As_2$ [P. Richard *et al.*, Phys. Rev. Lett. **104** (2010) 137001.].