Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Link between superconductivity and types of carriers in FeSe thin films ZHONGPEI FENG, KUI JIN, ZHONGXIAN ZHAO, JIE YUAN, BEIYI ZHU, XIAOLI DONG, FANG ZHOU, Chinese Academy of Sciences (CAS) — In iron-based superconductors, β-FeSe possesses the simplest tetragonal structure but attracts much attention due to its unusual properties. It exhibits a great boost of the superconducting transition temperature (T_c) in the monolayer form, under high pressure, via ion/cluster intercalations and electric field gating. There is a common consensus that the enhancement of T_c is accompanied with the evolution of electronic structure of the Fermi surface, that is, associated with the types of charge carriers. Although qualitative ARPES results have shown that the electron-like carriers play a key role in promoting the T_c, hitherto, a quantitative link between the carrier nature and the superconductivity has not been clarified. In this work, with our successful synthesis of a series of high quality β-FeSe thin films of tunable T_c^0‘s from 2 K to 14 K, we find by systematic transport measurements that the holes and electrons coexist in all the samples. While the concentration of electron-type carriers increases monotonically by about 6 times, the hole carrier density roughly holds a constant value. It implies an intimate relation between the electron carriers and the superconductivity. Moreover, our analysis on the monolayer FeSe samples of T_c ˜40 K points to a vanishing hole pocket. Our results thereby unveil that the T_c enhancement in FeSe is related to the increase in the electron density, which becomes more pronounced upon a sudden decrease in the hole density.

ZhongPei Feng
Chinese Academy of Sciences (CAS)

Date submitted: 18 Nov 2016 Electronic form version 1.4