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Phase Diagram and High Temperature Superconductivity at 65K in the Single-Layer FeSe Films Revealed by ARPES[1]

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The discovery of the iron-based superconductors in 2008 not only provides another venue to understand the origin of high-Tc superconductivity but also a new playground to explore novel superconductors with higher superconducting transition temperature. The latest report of possible high temperature superconductivity in the single-layer FeSe films grown on SrTiO3 substrate is both surprising and interesting [1]. In this talk, we report the electronic structure and phase diagram of the single-layer FeSe films by angle-resolved photoemission spectroscopy (ARPES) [2,3]. Our high-resolution ARPES results show that it has a simple Fermi surface topology consisting only of electron pockets near the zone corner without indication of any Fermi surface around the zone center. In addition, our observation of large and nearly isotropic superconducting gap in this strictly two-dimensional system rules out existence of node in the superconducting gap. We also established a phase diagram in this single-layer FeSe films by an annealing procedure to tune the charge carrier concentration over a wide range. By optimizing the annealing process, we observed evidence of a record high Tc of $\sim$ 65K in the single-layer FeSe films. The wide tunability of the system across different phases, and its high-Tc, make the single-layer FeSe film ideal not only to investigate the superconductivity physics and mechanism, but also to study novel quantum phenomena and for potential applications.

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[2] D. F. Liu et al., Nature Communications. 3, 931 (2012)
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[1]Work done in collaboration with J.He, W.Zhang, L.Zhao, D.Liu, X.Liu, D.Mou, Y.Ou, Q.Wang, Z.Li, L.Wang, Y.Peng, Y.Liu, C.Chen, L.Yu, G.Liu, X.Dong, J.Zhang, C.Chen, Z.Xu, X.Chen, X.Ma, Q.-K.Xue, and X. J. Zhou in IOP, CAS, and Tsinghua Univ., Beijing