Interface-induced superconductivity and strain-dependent spin density waves in FeSe/SrTiO3 thin films

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The record superconducting transition temperature (Tc) for the iron-based high-temperature superconductors (Fe-HTS) has long been 56 K. Recently, in single-layer FeSe films grown on SrTiO 3substrates, indications of a new record of 65 K have beenreported. Using in situ photoemission measurements, we substantiate the presence of spin density waves (SDWs) in FeSe films—a key ingredient of Fe-HTS that was missed in FeSe before—and we find that this weakens with increased thickness or reduced strain. We demonstrate that the superconductivity occurs when the electrons transferred from the oxygen-vacant substrate suppress the otherwise pronounced SDWs in single-layer FeSe. Beyond providing a comprehensive understanding of FeSe films and directions to further enhance itsTc, we map out the phase diagram of FeSe as a function of lattice constant, which contains all the essential physics of Fe-HTS. With the simplest structure, cleanest composition and single tuning parameter, monolayer FeSe is an ideal system for testing theories of Fe-HTS.

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