Molecular Beam Epitaxy-Scanning Tunneling Microscopy of Iron-Based Superconductors

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We have grown thin films of iron-based superconductors (FeSe and K-doped FeSe) on graphene formed on 6H-SiC and $SrTiO_3$ substrates by molecular beam epitaxy (MBE). The MBE growth conditions for stoichiometric and single crystalline high-quality thin films have been established, which allows us to investigate the pairing mechanism and underlying magnetic order in great detail by using high energy-resolution scanning tunneling microscopy and spectroscopy (STM/STS). We show robust evidence for the gap function with nodal lines and two-fold symmetry in FeSe. In the case of K-doped FeSe, phase separation is observed. We show that the superconducting phase KFe2Se2 contains no iron vacancies, and the iron vacancies are always destructive to superconductivity. Application of MBE-STM in the study of unconventional superconductivity will also be discussed.

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