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Unraveling the electron pairing mechanism of FeSe by MBE and STM[1]

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Studies of high-transition-temperature superconductivity usually suffer from various imperfections in materials. Here we apply the state-of-the-art molecular beam epitaxy (MBE) to prepare controllably high-quality FeSe films on various substrates, and explore their superconducting properties using cryogenic scanning tunneling microscope [1,2]. Single impurities, twin boundaries as well as strain are found in the MBE-grown FeSe films on graphene, and invariably suppress the superconductivity [1, 3, 4]. Meanwhile, electronic nematicity and signatures of a bosonic mode, whose energy also decreases with strain [4], were identified. More significantly, we observed two disconnected superconducting domes at alkali-metal potassium (K)-dosed FeSe surface, stepping towards the mechanistic understanding of superconductivity in FeSe-derived superconductors. Our results are clarifying the secret of high-Tc superconductivity in FeSe-related superconductors, and by implications, in other unconventional superconductors, and guiding how to enhance Tc by interface engineering. References: [1] Can-Li Song et al., Science 332, 1410 (2011). [2] Q. Y. Wang et al., Chin. Phys. Lett. 29, 037402 (2012). [3] C. L. Song et al., Phys. Rev. Lett. 109, 137004 (2012). [4] C. L. Song et al., Phys. Rev. Lett. 112, 057002 (2014).

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