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Scanning tunneling microscopy study of K-doped iron selenide superconductor film by MBE QI-KUN XUE, WEI LI, HAO DING, PENG DENG, KAI CHANG, SHUIHUA JI, Tsinghua University, KE HE, LILI WANG, XUCUN MA, Chinese Academy of Sciences, JIANG-PING HU, Purdue University, XI CHEN, Tsinghua University — The alkali-doped iron selenide superconductors have generated considerable excitements as well as confusions, regarding the delicate interplay between Fe vacancies, magnetism and superconductivity. We have grown high-quality $K_xFe_{2-y}Se_2$ thin film with (001) surface orientation on STO substrate by molecular beam epitaxy. The scanning tunneling microscopy (STM) measurement demonstrates that there are two superconducting phases: striped KFe_2Se_2 in adjacent to the phase with $\sqrt{5} \times \sqrt{5}$ Fe vacancy order and doped KFe_2Se_2 with Fe and K vacancies. Both phases have a superconducting gap of 9 meV. These findings elucidate the existing controversies on the role of $\sqrt{5} \times \sqrt{5}$ Fe vacancy order in superconducting $K_xFe_{2-y}Se_2$. Based on the atomic level information by STM, we will discuss the mechanism of the two different superconducting phases.

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