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Observation of a new possible superconducting state and anomalous insulating state in surface K-dosed ($\mathbf{Li_{1-x}Fe_xOH}$)FeSe MINGQIANG REN, YAJUN YAN, JUN ZHAO, TONG ZHANG, DONGLAI FENG, Fudan Univ, DEPARTMENT OF PHYSICSFUDAN UNIVERSITY, SHANGHAI 200433, CHINA TEAM — By using scanning tunneling microscopy/spectroscopy, we studied the evolution of electronic structure and superconductivity of ($\mathbf{Li_{1-x}Fe_xOH}$)FeSe **via surface potassium (K) dosing. We found that the Γ-centered electron band, which was 70meV above Fermi level (E_F), can be tuned to cross E_F by K dosing, and contributes a new electron pocket at Γ When such Lifshitz transition happens, the superconducting gap on M-centered electron pocket is slightly suppressed. With further K dosing, a new superconducting-like gap gradually opens on the Γ electron pocket, and forms a dome like doping behavior. After that, the system eventually evolves into an insulating phase with gradually depleted density of states near E_F. Our results provide more detailed phase diagram of FeSe in the deep electron doping region. The novel Fermi surface with electron pockets at both Γ and M points will provide more clues to understand superconductivity of Fe-based superconductors.**

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