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Observation of a new possible superconducting state and anomalous insulating state in surface K-dosed (Li$_{1-x}$Fe$_x$OH)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 (Li$_{1-x}$Fe$_x$OH)FeSe via surface potassium (K) dosing. We found that the $\Gamma$-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 $\Gamma$. 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 $\Gamma$ 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 $\Gamma$ and M points will provide more clues to understand superconductivity of Fe-based superconductors.

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