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Evolution of High-Temperature Superconductivity from a Low-Tc Phase Tuned by Carrier Concentration in FeSe Thin Flakes[1] BIN LEI, JIANHUA CUI, ZIJI XIANG, CHAO SHANG, NAIZHOU WANG, GUOJUN YE, XIGANG LUO, TAO WU, ZHE SUN, XIANHUI CHEN, Univ of Sci Tech of China
— We report the evolution of superconductivity in an FeSe thin flake with systematically regulated carrier concentrations by the liquid-gating technique. With electron doping tuned by the gate voltage, high-temperature superconductivity with an onset at 48 K can be achieved in an FeSe thin flake with Tc less than 10 K. This is the first time such high temperature superconductivity in FeSe is achieved without either an epitaxial interface or external pressure, and it definitely proves that the simple electron-doping process is able to induce high-temperature superconductivity with Tc as high as 48 K. Intriguingly, our data also indicate that the superconductivity is suddenly changed from a low-Tc phase to a high-Tc phase with a Lifshitz transition at a certain carrier concentration. These results help to build a unified picture to understand the high-temperature superconductivity among all FeSe-derived superconductors and shed light on the further pursuit of a higher Tc in these materials.

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