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Order/disorder of Fe-vacancy and superconductivity in Fe-chalcogenide superconductors[1]

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Having the simplest crystal structure among the Fe-based superconductors, the FeSe superconductor is the best candidate for investigating the mechanism of these new superconductors. How the properties of FeSe superconductor evolve from normal state to superconducting state and what is the parent phase of FeSe system are critical issues for resolving its superconducting mechanism. We have studied the properties of FeSe and K-Fe-Se superconductors in various forms, including polycrystal, single crystal, thin film, nanowire, and nanoparticle. We discovered several Fe-deficient Fe1-xSex phases, which exhibit Fe-vacancy ordering. The property of these phases evolves from an insulator to a metal gradually as Fe content increases. Our results provide unambiguous support to the picture that superconducting transition in FeSe and related compounds is closely related to the order to disorder transition of the Fe-vacancy.

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