Effect of non-magnetic Zn impurity in iron chalcogenide $K_{0.8}Fe_{2-\delta}Se_2$

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A series of Zn doped iron chalcogenide single crystal samples with nominal composition of $K_{0.8}Fe_{2.3-x}Zn_xSe_2$ ($0 \leq x \leq 0.03$) are prepared, and their transport and magnetic properties are investigated. Two sets of reflections are observed in the room temperature x-ray diffraction spectra, implying that the samples may be intrinsically inhomogeneous. The undoped sample with a nominal composition of $K_{0.8}Fe_{2.3}Se_2$ shows a large hump in resistivity around 180 K and then it is followed by a superconducting transition with T_c of 30 K. Slight Zn doping does not affect T_c, but remarkably increases the magnitude of resistivity. Meanwhile, the hump in resistivity is quickly shifted to lower temperatures with increasing Zn content. Meanwhile, the volume fraction of superconducting magnetic shielding which is derived from the susceptibility measurements decreases gradually with Zn doping, indicating that the proportion of superconducting phase decreases. The results suggest a scenario of phase separation in these samples. Namely the Zn impurity does not affect the superconducting phase, but it could enhance the volume proportion of the insulating phase.