Evolution of the magnetic, thermodynamic, and transport properties of $FeSe_xTe_{1-x}$ single crystals with increasing Se concentration

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In our recent research on the mobility analysis of carriers in FeTe thin films [I. Tsukada *et al.*, J. Phys. Soc. Jpn. **80**, 023712 (2011)], it is suggested that itinerancy of both electrons and holes is crucial for the occurrence of superconductivity. To get more insight into this issue, we investigate the evolution of the magnetic, thermodynamic, and transport properties of $FeSe_xTe_{1-x}$ single crystals in detail. Single crystals of $FeSe_xTe_{1-x}$ ($x = 0 - 0.4$) are grown by Bridgman method. The parent FeTe crystal is antiferromagnetic metal with $T_N = 65$ K as was already reported. $FeSe_xTe_{1-x}$ crystals with $x = 0.1 - 0.3$ show spin glass behavior at low temperatures and no bulk superconductivity is observed, which would be due to excess Fe in the grown crystals. $FeSe_{0.4}Te_{0.6}$ shows bulk superconductivity with $T_c \sim 15$ K. The Hall coefficient (R_H) of FeTe is almost temperature independent except that the sign changes from positive to negative at T_N with decreasing temperature. For samples with $x = 0.1 - 0.3$, R_H is also positive and T-independent at high temperatures, but increases with decreasing temperature at low temperatures, while R_H in superconducting $FeSe_{0.4}Te_{0.6}$ goes to negative below 30 K. This would suggest that the contribution of electrons on charge transport increases with increasing Se concentration.