Drastic effect of the Mn-substitution in the strongly correlated semiconductor FeSb2

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Abstract:

We report the effects of Mn substitution, corresponding to hole doping, on the electronic properties of the narrow gap semiconductor, FeSb2, using single crystals of Fe1-xMnxSb2 grown by the Sb flux method. The orthorhombic Pnnm structure was confirmed by powder X-ray diffraction (XRD) for the pure and Mn-substituted samples. Their crystal structure parameters were refined using the Rietveld method. The chemical composition was investigated by wavelength-dispersive X-ray spectroscopy (WDX). The solubility limit of Mn in FeSb2 is $x_{\text{max}} \sim 0.05$ and the lattice constants change monotonically with increasing the actual Mn concentration. A drastic change from semiconducting to metallic electronic transports was found at very low Mn concentration at $x \sim 0.01$. Our experimental results and analysis indicate that the substitution of a small amount of Mn changes drastically the electronic state in FeSb2 as well as the Co-substitution does: closing of the narrow gap and emergence of the density of states (DOS) at the Fermi level.

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