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Mössbauer Studies of Sn$_{1-x}$Fe$_x$O$_{2.5}$ powders prepared by a sol-gel method

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The diluted magnetic semiconductor Sn$_{1-x}$Fe$_x$O$_{2.5}$ (x=0.005, 0.01, 0.03) powders were prepared by a sol-gel method. The crystallographic and magnetic properties of Sn$_{1-x}$Fe$_x$O$_{2.5}$ powders were characterized by using X-ray diffraction, vibrating sample magnetometer, and Mössbauer spectroscopy. The crystal structure of the sample is determined to be tetragonal structure of P4/mmm by Rietveld refinement. The lattice constants are decreased with the increase of 57Fe doping ratio and the final Bragg factors $R_B$ and $R_F$ for all patterns were under 5%. The magnetization ($M_H$) and the coercivity ($H_C$) values for x=0.005 were 1.2×10$^{-5}$ emu/g and 167 Oe, while those for x=0.03 were 2.1×10$^{-5}$ emu/g and 408 Oe, respectively, which shows the ferromagnetic behaviour with increase of 57Fe doping ratio at room temperature.

Mössbauer spectra of Sn$_{1-x}$Fe$_x$O$_{2.5}$ (x=0.005, 0.01, 0.03) powders at room temperature show 1-sixtet and 2-doublets as shown in Figure 1. The area ratio of 1-sixtet is increased from 8.48 to 26.07 %, when the 57Fe doping ratio is increased from x=0.005 to x=0.03. It shows that the ferromagnetic behaviour increases with increase of 57Fe doping ratio, which consistent with the magnetization results. The Fe valence state was determined to be 3+ with the isomer shift ($\delta$) values.

![Mössbauer spectra of Sn$_{1-x}$Fe$_x$O$_{2.5}$ (x=0.005, 0.01, 0.03) powders at room temperature](image)

Figure 1: Mössbauer spectra of Sn$_{1-x}$Fe$_x$O$_{2.5}$ (x=0.005, 0.01, 0.03) powders at room temperature


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