

Investigation of the Ferromagnetic Properties of ^{57}Fe doped Tin(IV) Oxide Based on Mössbauer Spectroscopy

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Diluted magnetic semiconductor $\text{Sn}_{1-x}\text{Fe}_x\text{O}_2$ ($x = 0.005, 0.01, \text{ and } 0.03$) powders were prepared by using a sol-gel method. The crystal structure was found to be a rutile tetragonal structure with space group $P4_2/mnm$. From vibrating sample magnetometer measurements at room temperature, we observed an enhanced ferromagnetic behavior with increasing ^{57}Fe concentration. Mössbauer spectra were taken at various temperatures ranging from 4.2 K to room temperature. Room temperature Mössbauer spectra show a ferromagnetic phase with a sextet and a paramagnetic phase with a doublet, and an increasing area ratio of the ferromagnetic phase with increasing ^{57}Fe concentration. The isomer shift (δ) value was about 0.30 mm/s within the temperature range considered here, indicating that the Fe valence state was ferric. Interestingly, Mössbauer spectra for the $x = 0.01$ and 0.03 samples at 4.2 K showed 2-sextets and 1-doublet while the spectrum for the $x = 0.005$ sample at 4.2 K only shows 1-sextet and 2-doublets.

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