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Mössbauer studies for ^{57}Fe doped tin oxide with vacuum annealing

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$Sn_{0.995}{}^{57}Fe_{0.005}O_2$ polycrystalline has been prepared by a sol-gel method with vacuum annealing. The crystallographic and magnetic properties of $Sn_{0.995}{}^{57}Fe_{0.005}O_2$ were characterized by x-ray diffraction, vibrating sample magnetometer, and Mössbauer spectroscopy. The crystal structure of the sample was determined to be tetragonal with space group of $P4_2/mnm$, according to Rietveld refinement method, which well analyzed with Bragg factors R_B and R_F below 3%. The lattice constants were $a_0 = 4.7390$ and $c_0 = 3.1867$ Å.

The magnetization curve with 10 kOe at room temperature (RT) shows ferromagnetic behavior, which has the magnetic moment of 0.12 μ_B/Fe and the coercivity of 177 Oe. An analysis of Mössbauer spectrum at RT shows that $Sn_{0.995}{}^{57}Fe_{0.005}O_2$ powder has 2-doublets. The valence state was determined to be Fe^{3+} and Fe^{2+} of each doublet at RT with the isomer shift (δ) values. Otherwise, in case of 4.2 K spectrum, 1-doublet of Fe^{2+} state at RT was changed into 1-sextet as shown in Fig. 1, which consistent with the magnetization result. It could explain that Fe^{2+} doublet at RT induces the ferromagnetic behavior.

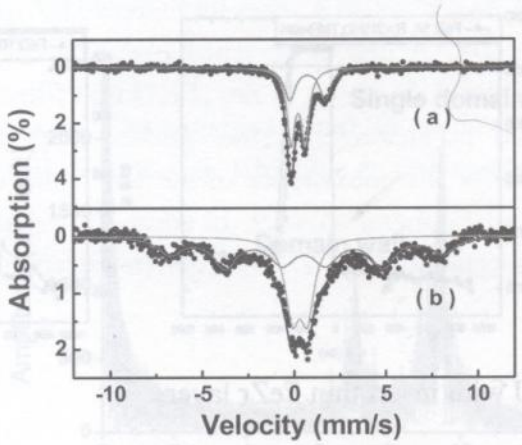

Fig1. Mössbauer spectra of Vacuum annealed $Sn_{0.995}Fe_{0.005}O_2$ powder at (a) RT and (b) 4.2K.