Soft Magnetic Materials 19
Torino, 6-9 September, 2009
www.smm19.eu

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Soft Magnetic Materials 19
Conference Program and Book of Abstracts

Mössbauer Studies of $Sn_{1-x}{}^{57}Fe_xO_{2-\delta}$ powders prepared by a sol-gel method

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The diluted magnetic semiconductor $Sn_{1-x}{}^{57}Fe_xO_{2-\delta}$ (x=0.005, 0.01, 0.03) powders were prepared by a sol-gel method. The crystallographic and magnetic properties of $Sn_{1-x}{}^{57}Fe_xO_{2-\delta}$ 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 *P42/mnm* by Rietveld refinement. The lattice constants are decreased with the increase of ^{57}Fe doping ratio and the final Bragg factors R_B and R_F for all patterns were under 5 %. The magnetization (M_s) and the coercivity (H_c) values for x=0.005 were 1.2×10^{-2} emu/g and 167 Oe, while those for x=0.03 were 2.1×10^{-2} emu/g and 408 Oe, respectively, which shows the ferromagnetic behaviour with increase of ^{57}Fe doping ratio at room temperature.

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

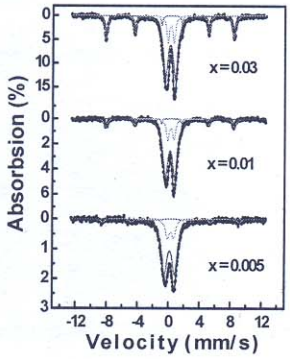

Figure 1 : Mössbauer spectra of $Sn_{1-x}{}^{57}Fe_xO_{2-\delta}$ (x=0.005, 0.01, 0.03) powders at room temperature

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[2] K. Nomura, C. A. Barrero, J. Sakuma, and M. Takeda, Phys. Rev. B 75, 184411 (2007).

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