MÖSSBAUER STUDIES OF SnO_2 POWDERS DOPED WITH DILUTE ^{57}Fe, PREPARED BY A SOL-GEL METHOD

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Diluted magnetic semiconductor (DMS) is prospected as new materials with both semiconductor and magnetic properties. It is found recently by Y. Masumoto et al that DMS transparent films of TiO_2 doped with Co show the ferromagnetic properties at room temperature [1]. Hi Min Lee et al reported that the ferromagnetic behavior of $Ti_{1-x}{}^{57}Fe_xO_2$ increase with the decrease of ^{57}Fe doping amount [2]. The deposited films of TiO_2 doped with Fe by PLD were studied by CEMS [3]. The

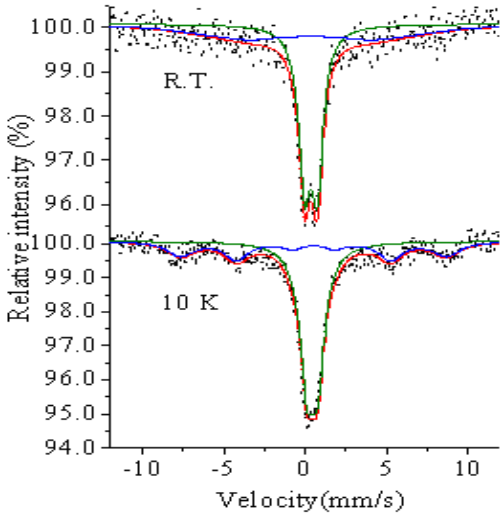

Fig 2. Mössbauer spectra of $Sn_{1-x}{}^{57}Fe_xO_2$(X=0.01) prepared by 500°C, for 2 hrs. (Measurement temp. : RT and 10 K)

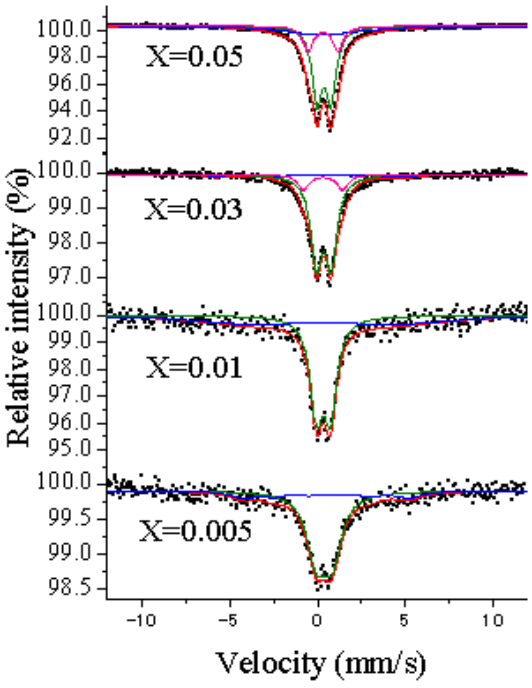

Fig1. RT Mössbauer spectra of $Sn_{1-x}{}^{57}Fe_xO_2$ prepared at 500°C for 2 hrs

deposited films of SnO2 doped with Fe also showed the ferromagnetic behavior [4]. However, the manifest was not always clear.

In order to confirm these phenomena, we prepared the powders of SnO_2 doped with various amount of ^{57}Fe by a sol-gel method. Various compositions of $Sn_{1-x}{}^{57}Fe_xO_2$ were obtained by mixing some ratio of Fe^{3+} nitrate solution and acetylacetonate Sn^{4+} complex in the ethylene glycol and citric

acid solution. The solutions were evaporated, ashed at around 200 ^{o}C, and finally annealed at 500 ^{o}C, 600 ^{o}C, and 650 ^{o}C, respectively. These $Sn_{1-x}{}^{57}Fe_xO_2$ (x=0.005, 0.01, 0.03 and 0.05) were measured by XRD, VSM, and Mössbauer spectrometry.

The prepared powder samples were confirmed to be a rutile structure, but iron compounds were not detected by XRD. Mössbauer spectra of $Sn_{1-x}{}^{57}Fe_xO_2$ prepared at 500 ^{o}C were shown in Fig. 1. A small amount of broad sextets were observed in MS spectra of $Sn_{1-x}{}^{57}Fe_xO_2$ in addition to paramagnetic components. The relative intensity seems to be strong with the decrease of the amount of doped Fe. Mössbauer spectrum at 10 K shows clearly the magnetic components.

The magnetic sextet was observed in MS spectra of samples prepared at 650 ^{o}C, but the magnetic behavior weakened because of antiferromagnetic α-Fe_2O_3, produced due to the phase separation at high temperatures.

References:

[1] Y. Mastumoto et al., *Science,* 291 (2001) 854.
[2] Hi Min Lee et al., *TRANSACTION ON MAGNETICS,* 39 (2003) 2788.
[3] K. Nomura et al., *ICAME05 proceeding*, in press.
[4] J.M.D.Coey et al., *Appl. Phys. Lett.*, 84 (2004) 1332.

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