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Magnetic Properties of $Sn_{1-x}Fe_xO_2$ Thin Films and Powders Grown by Chemical Solution Method

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Iron-doped $Sn_{1-x}Fe_xO_2$ (x = 0.0, 0.05, 0.1, 0.2, 0.33) thin films on Si(100) substrates and powders were prepared by a chemical solution process. The x-ray diffraction (XRD) patterns of the $Sn_{1-x}Fe_xO_2$ thin films and powders showed a polycrystalline rutile tetragonal structure. Thermo gravimetric (TG) - differential thermal analysis (DTA) showed the final weight loss above 430 °C for all powder samples. According to XRD Rietveld refinement of the powders, the lattice parameters and unit cell volume decreased with increasing Fe content. The magnetic properties were characterized using a vibrating sample magnetometer (VSM) and Mössbauer spectroscopy. The thin film samples with x = 0.1 and 0.2 showed paramagnetic properties but thin films with x = 0.33 exhibited ferromagnetic properties at room temperature. Mössbauer studies revealed the Fe^{3+} valence state in the samples. The ferromagnetism in the samples can be interpreted in terms of the direct ferromagnetic coupling of ferric ions via an electron trapped in a bridging oxygen deficiency, which can be explained using the *F*-center exchange model.

Keywords : chemical solution method, $Sn_{1-x}Fe_xO_2$, Mössbauer spectroscopy