The origin of magnetic interactions in Diluted Magnetic Semiconductors (DMS) is attracting a great attention as a basic problem on magnetism[1-2]. This subject is still an issue of controversy. In all of these works, the observed ferromagnetism has been attributed to interactions between the magnetic impurities, but the main source has never been associated to magnetically ordered defects. We have reported the different types of magnetic source in case of Fe doped SnO$_2$ powder [3], and the phonon density of states of rutile type structures [4]. Defects in DMS can also contribute to saturation magnetization. Here we have made the thin films of SnO$_2$ implanted with $^{57}$Fe and characterized them by $^{57}$Fe and $^{119}$Sn conversion electron Mössbauer spectrometry (CEMS).

Thin films of Sn$_{1-x}$Fe$_x$O$_{2.8}$ were implanted at room temperature with $1x10^{17}$ Fe ions/cm$^2$ and at 300$^\circ$C with $5x10^{16}$ and $1x10^{17}$ Fe ions/cm$^2$. In both case, the acceleration energy was 100 keV. From TRIM calculations of implantation conditions of $1x10^{17}$ Fe ions/cm$^2$ we expected the iron profiles peaked at about 40 nm with a maximum Fe concentration of some 10 at. %. Only $5x10^{16}$ ions/cm$^2$ of the Mössbauer isotope $^{57}$Fe were implanted while the balance was implanted with $^{57}$Fe ions in the case of the $1x10^{17}$ions/cm$^2$ implantation.

The implanted Fe ions exist as Fe(II) and Fe(III) in SnO$_2$ films, which partially also are reduced into Sn(II) on the implanted surface layer. The as prepared sample at room temperature and post-annealed samples did not show Kerr effect, but the sample implanted with $1x10^{17}$ Fe ions/cm$^2$, while heated at 300$^\circ$C, showed Kerr effect although the magnetic sextets were not observed in $^{57}$Fe CEM spectra. The Kerr effect disappeared after post-annealing. It suggests that the number of magnetic defects decreases by absorption of oxygen.

For $5x10^{16}$ $^{57}$Fe ion implanted samples, magnetic components with broad peaks were clearly observed, but not for $1x10^{17}$ Fe ion implanted sample. This suggests that diluted Fe ions may induce the dilute antiferromagnetism or the paramagnetic relaxation because the Kerr effect was not observed.