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Paramagnetism of Fe defects in ZnO

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Semiconductors, which are ferromagnetic at room temperature, are strived after as potential multifunctional materials. For ZnO, room temperature ferromagnetism has been achieved by doping with 3d transition metals making potential dilute magnetic semiconductors. However, contradicting results have been obtained and neither the conditions for, nor the origin of the magnetism are as yet understood. Recent theoretical and experimental work have suggested the important role of lattice defects, while other authors have suggested unintentional precipitation, to be the source of the magnetism.

We have performed online 57Fe Mössbauer spectroscopy following implantation of 57Mn (T½ = 1.5 min.). Mössbauer spectroscopy is a powerful tool giving information on the valence state of the Fe, site symmetry and magnetic interactions on an atomic scale.

The Mössbauer spectra obtained after implantation into ZnO show magnetic sextets originating from iron in the ferric state. The formation kinetics of the ferric iron is shown to suggest formation of FeZn-O-VZn defects upon implantation. Measurements in external magnetic field show that these sextets are due to slow paramagnetic relaxations.

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