

Mössbauer Studies of ^{57}Fe -Doped Anatase TiO_2

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Abstract— $\text{Ti}_{1-x}\text{Fe}_x\text{O}_2$ compounds were fabricated using the chemical solution method, and the crystal structure and ferromagnetic properties were investigated as a function of doped ^{57}Fe concentration. X-ray diffraction patterns showed a pure anatase single phase, without any segregation of Fe into particulates within the instrumental resolution limit. Magnetic properties were characterized by vibrating sample magnetometer and Mössbauer spectroscopy with a $^{57}\text{Co}(\text{Rh})$ source. With varying ^{57}Fe concentration, we could observe unusual magnetic phenomena in these materials. Doping ^{57}Fe into the TiO_2 nonmagnetic semiconductor formed magnetic properties, but the gradual increase of ^{57}Fe concentration decreased rapidly the ferromagnetic properties rather than enhanced the ferromagnetic properties. This result reveals an interesting feature, there is a critical limit of ^{57}Fe concentration to get ferromagnetic properties at room temperature.

Index Terms—Anatase, diluted magnetic semiconductor (DMS), ferromagnetic, Mössbauer spectroscopy.