Since the theoretical predictions of room temperature ferromagnetism (RT-FM) in the wide band-gap semiconductor with \( p \)-type doping, the various oxide semiconductor materials have been extensively investigated as the host matrices for spintronic devices. With many hopeful reports on the observation of RT-FM in these oxide systems, recently some experimental results have suggested that there is a strong correlation between the enhancement of FM and the oxygen deficiency [1-3]. In this work, to resolve the occurrence of FM after vacuum annealing, we have investigated the magnetic behavior of Fe ions in TiO\(_2\) on atomic scale. Anatase Ti\(_{0.97}\)Fe\(_{0.03}\)O\(_2\) polycrystalline films were grown on thermally oxidized Si substrate by a sol-gel method. Precursor films were annealed in air first and further annealed in vacuum ambience. Air-annealed insulating film showed paramagnetic (PM) behavior at RT. However, when the film was further annealed in a vacuum, the RT-FM was observed with the magnetic moment of 0.42 \( \mu_\text{B} \)/Fe. The Hall effect studies suggest that the carriers of vacuum-annealed film are \( p \)-type, which turn out to be independent of the observed FM. Conversion electron Mössbauer spectra of air-annealed film at RT show a single doublet, suggesting that the Fe ions are PM. Isomer shift value (\( \delta \)) of the PM doublet is found to be 0.20 mm/s relative to the metallic Fe, which is consistent with the Fe\(^{3+}\) charge state. On the other hand, the absorption spectra after vacuum-annealing exhibit two doublets at RT, in which one is the same component of an annealed film and the other is new doublet (\( \delta=0.81 \) mm/s) corresponding to Fe\(^{2+}\) state. We note that, after vacuum-annealing, the RT-FM occurred simultaneously with the new Fe\(^{2+}\) doublet. This result seems to indicate that Fe ions created as a result of vacuum annealing are responsible for the observed FM in this system.