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Effects of oxygen vacancies on the ferromagnetism in Fe-doped anatase TiO₂

Hi Min Lee, Chul Sung Kim*

Department of Physics, Kookmin University, Seoul 136-702, Republic of Korea

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Abstract

Effects of oxygen vacancies on the magnetic properties of anatase Fe-doped TiO₂ compound have been investigated. The air-annealed sample shows a small magnetic moment at room temperature, whereas the magnetic moment at same temperature is strongly enhanced for the sample post-annealed in vacuum ambience. Mössbauer spectra of air-annealed sample show that the magnetically ordered sextet and paramagnetic doublet coexist in all temperature ranges (4.2–295 K), where all Fe ions are not metallic but in the +3 state substituting for Ti. After vacuum annealing, an additional doublet appeared with large quadrupole splitting, which is consistent with Fe²⁺ state. This result suggests that the enhancement of magnetic moment after vacuum annealing is attributable to the moment by the spin–orbit coupling of Fe²⁺ ions.

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