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Program
FERROMAGNETIC PROPERTIES OF ANATASE Ti$_{1-x}$Fe$_x$O$_{2.8}$ THIN FILMS GROWN BY SOL-GEL METHOD

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Magnetic and electronic properties of Fe-doped anatase TiO$_{2.8}$ thin films grown on Al$_2$O$_3$(0001) substrates by a sol-gel method have been investigated by vibrating-sample magnetometry (VSM), conversion electron Mössbauer spectroscopy (CEMS), and Hall effect measurements. Anatase Ti$_{1-x}$Fe$_x$O$_{2.8}$ thin films were found to exhibit ferromagnetism at room temperature by VSM. The saturation magnetic moment of the ferromagnetic films are $\sim$2 and $\sim$1.5 $\mu_B$ per Fe ion for $x$ = 2.4 and 5.8 at.%, respectively. The isomer shifts in CEMS measurements are 0.26-0.28 mm/s, indicating a ferric character. The Mössbauer spectra also revealed that Fe$^{3+}$ ions mostly substitute the octahedral Ti$^{4+}$ sites of Ti$_{1-x}$Fe$_x$O$_{2.8}$. The Ti$_{1-x}$Fe$_x$O$_{2.8}$ films exhibited poor electrical conductivity with p-type character. The ferromagnetism in the present Ti$_{1-x}$Fe$_x$O$_{2.8}$ films can be interpreted in terms of a direct ferromagnetic coupling between two neighboring Fe$^{3+}$ ions via an electron trapped in oxygen vacancy [1]. The reduction of the net magnetization by the increase of the Fe content in the film can be explained in terms of an antiferromagnetic superexchange interaction between two neighboring Fe$^{3+}$ ions via O$^{2-}$ ion.

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