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Room-temperature Ferromagnetism and the Related Electronic Properties of Sb-doped $TiO_{2-\delta}$

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As wide-band-gap semiconductors, transition-metal-doped TiO_2, SnO_2, and ZnO have recently been discovered to exhibit ferromagnetism with high Curie temperatures. Magnetic ordering in these oxides appeared to be sensitive to the existence of defects such as vacancies and interstitials as well as the doped magnetic ions[1]. Especially, in TiO_2, ferromagnetism was detected even in undoped samples [2]. Thus, it is worthwhile to study the physical properties of the defects in this oxide diluted magnetic semiconductor and their effects on the observed ferromagnetism.

In this work, the magnetic and electrical properties of $TiO_{2-\delta}$ and $TiO_{2-\delta}$:Sb thin films were investigated. Despite containing no magnetic element, these films exhibited ferromagnetic hysteresis at room temperature as shown in Fig. 1. These samples exhibited *n*-type character with the carrier density increasing with increasing Sb doping. The spin magnetic moment originated from the unpaired $3d^1$ configuration in Ti^{3+} ion, created to compensate the charge imbalance induced by formation of oxygen vacancy, is considered to be the main source for the non-zero magnetization in $TiO_{2-\delta}$. The alignment of the local magnetic moments is possible via formation of magnetic polaron (MP). The increase of ferromagnetic strength by Sb doping is attributable to an increase of MP density reflected by the increase of the carrier density.

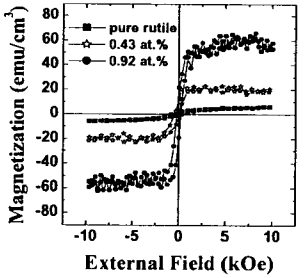

Fig. 1. Magnetic hysteresis data of rutile $TiO_{2-\delta}$:Sb (0.0, 0.43, and 0.92 at.%) films at room temperature.

REFERENCES

[1] M. H. F. Sluiter, Y. Kawazoe, P. Sharma, A. Inoue, A. R. Raju, C. Rout, and U. V. Waghmare, Phys. Rev. Lett. 94, 187204 (2005)
[2] N. H. Hong, J. Sakai, N. Poirot, and V. Brizé, Phys. Rev. B 73, 132404 (2006).

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Temperature Dependent Magnetization in $Cd_{0.98}Cr_{0.02}Te$

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Dilute magnetic semiconductor (DMS)have been the focus of considerable research due to the high potential for applications in spin-dependent semiconductor electronics however, convincing DMS behaviour at room temperature remains elusive.[1,2] The origin of ferromagnetism in Cr-based II-VI DMS have been explained by superexchange spin interaction between Cr-ions, but it is possible the ferromagnetic intermetallic Cr-Te compounds could play an important role in the ferromagnetic properties of Cr-based II-VI DMS. [3,4] Structural and magnetic properties of a $Cd_{0.98}Cr_{0.02}Te$ crystal grown by the vertical solidification method are reported, and show that the ferromagnetism with $\sim 0.025\mu_B$/Cr-atom is unlikely to be associated with impurity phases. From X-ray diffraction, scanning and transmission electron microscopy (STEM), and Raman scattering, it displayed a single phase zinc-blende structure with no existence of second phase such as NiAs-type CrTe, MnP-type CrTe, trigonal Cr_2Te_3, and monoclinic Cr_3Te_4 phases. Magnetic measurement in a temperature range of 5-450 K showed temperature-induced magnetic phase transition with a Curie temperature ~ 362 K.Intrinsic ferromagnetic properties is coupling between Cr atoms dissolved in the CdTe matrix. [5] The deviation between zero field cooling (ZFC)and field cooling (FC) might be caused by weakly interacting magnetic Cr or Cr-Te clusters. [6]

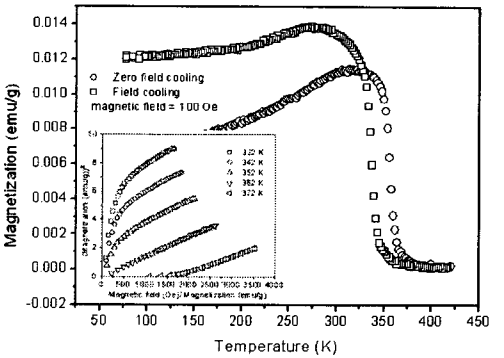

Fig. 1. Temperature-dependent magnetization curve under ZFC and FC. (Inset shows the Arrot plot for ZFC.)

REFERENCES

[1] D. Kumar, J. Antifakos, M. G. Blamire, and Z. H. Barber, Appl. Phys. Lett. **84**, 5004(2004).
[2] K. Y. Ko, Z. H. Barber, and M. G. Blamire, J. Appl. Phys. **100**, 083905(2006).
[3] J. Blinowski, P. Kacman, and J. A. Majewski, Phys. Rev. **B53**, 9524(1996).
[4] H. Saito, V. Zayets, S. Yamagata, and K. Ando, Phys. Rev. Lett. **90**, 207202(2003).
[5] K. Y. Ko and M. G. Blamire, Appl. Phys. Lett. **88**, 172101(2006).
[6] Q. Wang, Q. Sun, B. K. Rao, P. Jena, and Y. Kawazoe, J. Chem. Phys. **119**, 7124(2003).