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1. Highlights in 2007

(1) Spin detection in ferromagnet/semiconductor heterostructures using optical spin orientation

Spin filtering effect is one of the principal mechanisms of detecting electron spin at ferromagnet/semiconductor interfaces with a view to developing spintronic devices. In this study, a half-metallic epitaxial Fe_3O_4 ultrathin layer was grown on a GaAs(001) substrate and the spin filtering effect is examined under optical spin orientation conditions. The spin filtering effect obtained was becoming significant at forward bias, showing a successful detection of spin-polarized electrons using Fe_3O_4 ultrathin layers. The spin filtering efficiency, however, is rather small compared with that using an Fe thin layer, indicating that Fe_3O_4 at the interface is not likely to have half-metallic characteristics.

(2) Manipulation of ferromagnetic domain structures in ferromagnet/ferroelectrics heterostructures

Manipulation of magnetic bit information using electric voltage has been attracting attention due to a huge reduction of the consumption of electricity. The purpose of this study is to develop a means to control magnetic domain structures in ferromagnet/ferroelectrics heterostructures, relying on the magnetostriction effect at the interface. Samples used were Fe dots/ BaTiO_3 and Fe dots/ SrTiO_3 heterostructures, wherein we observed an enclosed magnetic domain structures in both samples. The most significant observation is a switching of the magnetic anisotropy of Fe seen at the structural phase transition temperature of BaTiO_3 , showing a sizable magnetostriction effect at the interface. Also, the results provide a promising basis to manipulating magnetic bit information using electric voltage instead of electric current.

(3) Spin injection into semiconductor quantum dots and magnetoresistance effect

Spin injection into semiconductor quantum dots is attracting interests due to fruitful phenomena such as Coulomb oscillation and spin accumulation, giving tremendous magnetotransport effects. In this study, we examined magnetoresistance effect in a lateral spin valve structure, where an InAs quantum dot is attached with two ferromagnetic wires. The magnetoresistance of the lateral structure oscillates with bias voltage due to a combined effect of Coulomb blockade and spin accumulation in the dot, and reaches a huge value of a few hundred %. A Kondo effect was also observed in this spin valve structure. This effect is very important to fabricate light emitting devices with optical circular polarization.

2. Articles (original article, comment/book)

1. D. Fu, H. Taniguchi, T. Taniyama, M. Itoh, and S. Koshihara: "Piezoelectric Properties of Lithium Modified Silver Niobate Perovskite Single Crystals", Appl. Phys. Lett. (in press).

2. K. Seki, H. Kura, T. Sato, and T. Taniyama: "Size Dependence of Martensite Transformation Temperature in Ferromagnetic Shape Memory Alloy FePd", *J Appl. Phys.* **103**(6) (2008) 063910 1-9.
3. S. Ray, P. Mahadevan, S. Mandal, C. S. Kuroda, T. Sasaki, T. Taniyama, and M. Itoh: "High temperature ferromagnetism in single crystal dilute magnetic oxide: an intriguing story of intrinsic disorder and magnetism in Fe-doped BaTiO₃", *Phys. Rev. B* **77**(10) (2008) 104416 1-6.
4. D. Fu, H. Taniguchi, T. Taniyama, M. Itoh, and S. Koshihara: "Origin of giant dielectric response in nonferroelectric CaCu₃Ti₄O₁₂: inhomogeneous conduction nature probed by atomic force microscopy", *Chem. Mater.* **20**(5) (2008) 1694-1698.
5. T. Taniyama, T. Mori, K. Watanabe, E. Wada, M. Itoh, H. Yanagihara: "Optically spin oriented electron transmission across fully epitaxial Fe₃O₄/GaAs(001) interfaces", *J Appl. Phys.* **103**(7) (2008) 07D103 1-3.
6. E. Wada, M. Itoh, and T. Taniyama: "Crossover of electron transmission mechanism and spin filtering effect at Fe/GaAs(001) interfaces", *J Appl. Phys.* **103**(7) (2008) 07A702 1-3.
7. K. Yoshino, A. Kinoshita, Y. Shirahata, and T. Taniyama: "Carrier induced magnetic anomalies in Mn-doped AgGaSe₂ magnetic semiconductor", *J Appl. Phys.* **103**(7) (2008) 07D103 1-3.
8. K. Yoshino, S. Oyama, M. Yoneta, and T. Taniyama: "Structural and magnetic characterization of Mn-doped ZnO films grown by spray pyrolysis method", *Mater. Sci. & Eng. B* **148**(1-3) (2008) 234-236.
9. S. Kimura, T. Tekeuchi, K. Okunishi, M. Hagiwara, Z. He, K. Kindo, T. Taniyama, and M. Itoh: "Novel ordering of an S=1/2 quasi one-dimensional Ising-like antiferromagnet in magnetic field", *Phys. Rev. Lett.* **100**(5) (2008) 057202 1-4.
10. K. Hamaya, M. Kitabatake, K. Shibata, M. Jung, M. Kawamura, S. Ishida, T. Taniyama, K. Hirakawa, Y. Arakawa, and T. Machida: "Oscillatory changes in the tunneling magnetoresistance effect in semiconductor quantum-dot spin valves", *Phys. Rev. B* **77**(8) (2008) 081302(R) 1-4.

11. K. Hamaya, M. Kitabatake, K. Shibata, M. Jung, M. Kawamura, K. Hirakawa, T. Machida, T. Taniyama, S. Ishita and Y. Arakawa: “Kondo effect in a semiconductor quantum dot coupled to ferromagnetic electrodes”, *Appl. Phys. Lett.* **91**(23) (2007) 232105 1-3.
12. K. Komatsu, H. Maki, T. Taniyama, and T. Sato: “Size and field effect on mesoscopic spin glass”, *J. Magn. Magn. Mater.* **310**(2) (2007) 1500-1502.
13. Y. Takeuchi, K. Komatsu, H. Maki, T. Taniyama, and T. Sato: “Spin-glass behavior in zero magnetic field using tunnel resistance”, *J. Magn. Magn. Mater.* **310**(2) (2007) 1503-1505.
14. S. Kimura, H. Yashiro, K. Okunishi, M. Hagiwara, Z. He, K. Kindo, T. Taniyama, and M. Itoh: “Field-induced order-disorder transition in antiferromagnetic $\text{BaCo}_2\text{V}_2\text{O}_8$ driven by a softening of spinon excitation”, *Phys. Rev. Lett.* **99**(8) (2007) 087602 1-4.
15. K. Hamaya, M. Kitabatake, K. Shibata, M. Jung, M. Kawamura, K. Hirakawa, T. Machida, T. Taniyama, S. Ishida, and Y. Arakawa: “Electric-field control of tunneling magnetoresistance effect in a Ni/InAs/Ni quantum-dot spin valve”, *Appl. Phys. Lett.* **91**(2) (2007) 022107 1-3.
16. D. Fu, M. Endo, H. Taniguchi, T. Taniyama, and M. Itoh: “ AgNbO_3 : A lead-free material with large polarization and electromechanical response”, *Appl. Phys. Lett.* **90**(25) (2007) 252907 1-3.
17. A. Harada, T. Taniyama, Y. Takeuchi, T. Sato, T. Kyomen, and M. Itoh: “Ferromagnetism at the surface of a LaCoO_3 single crystal observed using scanning SQUID microscopy”, *Phys. Rev. B* **75**(18) (2007) 184426 1-5.
18. T. Taniyama, K. Akasaka, D. Fu, M. Itoh, H. Takashima, and B. Prijamboedi: “Electrical voltage manipulation of ferromagnetic microdomain structures in a ferromagnetic/ferroelectric hybridstructure”, *J. Appl. Phys.* **101**(9) (2007) 09F512 1-3.
19. Z. He, T. Taniyama, M. Itoh, and Y. Ueda: “Flux growth and magnetic anomalies of $\text{Co}_3\text{V}_2\text{O}_8$ crystal”, *Crystal Growth and Design* **7**(6) (2007) 1055-1057.
20. Z. He, T. Taniyama, M. Itoh, J. Yamaura, and Y. Ueda: “Two magnetic phase transitions in quasi-one-dimensional system $\text{SrCo}_2\text{V}_2\text{O}_8$ ”, *Solid State Commun.* **141**(12) (2007) 667-670.

21. K. Hamaya, S. Masubuchi, M. Kawamura, T. Machida, M. Jung, K. Shibata, K. Hirakawa, T. Taniyama, S. Ishida, and Y. Arakawa: "Spin transport through a single self-assembled InAs quantum dot with ferromagnetic leads", Appl. Phys. Lett. **90**(5) (2007) 053108 1-3.

22. A. Harada, T. Taniyama, and M. Itoh: "Surface ferromagnetism of LaCoO₃ crystals", J. Magn. Magn. Mater. **310**(2) (2007) 2172-2173.

3. Presentation in international/domestic conferences

1. "Magnetic nanostructures and spintronics", Asia Nanotech Camp 2008 (ANC2008) (Tokyo, Japan), February 2008.

4. Others

T. Taniyama
Tokyo Tech Award for Challenging Research, October 2008.