UD05

Effects of silicon overlayers on the magnetic properties of ultrathin Co/Ir(111) films

Y.C. Liou[1], C.M. Chen[2], J.S. Tsay[1,2]*

[1]Department of Physics, National Chung Cheng University, Chia-Yi 621, Taiwan, ROC
[2]Department of Physics, National Taiwan Normal University, 88, Section 4, Ting-Chou Road, Taipei 116, Taiwan

*Corresponding author: jstsay@phy.ntnu.edu.tw, Phone: +886 2 29346620 155, Fax: +886 2 29326408

The necessity of three-dimensional stacks in high-density integrated circuits in order to reduce the size of devices makes the research of semiconductors on metal important [1]. Effects of silicon overlayers on the magnetic properties of ultrathin Co/Ir(111) films thinner than 4 monolayers (ML) in an ultrahigh vacuum condition were studied. For silicon deposition on cobalt films, the Auger transition of Co LMM shifts to lower kinetic energies due to the interaction of Si and Co. Depth profiling measurements show the formation of Co silicides. For submonolayer silicon overlayer, the coercivity of the films increases as revealed using surface magneto-optic Kerr effect technique because of the impediment of domain wall motion by the introduced defects at the Si/Co interface. Since Co silicides are nonferromagnetic [2], further deposition of silicon layer results in the decrease of the remanent Kerr intensity. For 2 ML Co/Ir(111), 1 ML silicon overlayer is enough to vanish the ferromagnetism. From systematical investigations for Si/Co/Ir(111) with Si thinner than 3 ML, the formation of Co silicides and the interfacial defects dominate the behaviours of magnetic phases.

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UD06

Ferromagnetism and Anomalous Hall Effect of TiO_2-based superlattice films for Dilute Magnetic Semiconductor applications

Juan Jiang[1], Nak-Jin Seong[2], Young-Hun Jo[3], Myung-Hwa Jung[3], Jun-Mo Yang[4] and Soon-Gil Yoon[1]*

[1] Department of Materials Science Engineering, Chungnam National University, Daejeon 305-764, Korea
[2] BK21 Education Center for Advanced Intelligent Components and Materials, Chungnam National University, Daeduk Science Town, Daejeon 305-764, Korea
[3] Quantum Materials Research Team, Korea Basic Institute, Daejeon, 305-333, Korea
[4] National Nanofab Center, Eoeun-Dong, Yuseong-gu, Daejeon, 305-764, Korea

* Corresponding author: sgyoon@cnu.ac.kr, Phone: +82 42 821 6638, Fax: +82 42 822 3206

For use in spintronic materials, dilute magnetic semiconductors (DMS) are under consideration as spin injectors for spintronic devices[1]. TiO_2-based DMS doped by a cobalt, iron, and manganese et al. was recently reported to show ferromagnetic properties, even at temperatures above 300K and the magnetic ordering was explained in terms of carrier-induced ferromagnetism, as observed for a III-V based DMS. An anomalous Hall effect (AHE) and co-occurance of superparamagnetism in reduced Co-doped rutile $TiO_{2-\delta}$ films have also been reported[2]. Metal segregation in the reduced metal-doped rutile $TiO_{2-\delta}$films still remains as problems to solve the intrinsic DMS properties.

Superlattice films have been proposed to get dilute magnetic semiconductor (DMS) with intrinsic room-temperature ferromagnetism. For a TiO_2-based DMS superlattice structure, each layer was alternately doped by two different transition metals (Fe and Mn) and deposited to a thickness of approximately 2.7 Å on r-Al_2O_3(1102) substrates by pulsed laser deposition. The r-Al_2O_3(1102) substrates with atomic steps and terrace surface were obtained by thermal annealing. Samples of $Ti_{0.94}Fe_{0.06}O_2$(TiFeO), $Ti_{0.94}Mn_{0.06}O_2$(TiMnO), and $Ti_{0.94}(Fe_{0.03}Mn_{0.03})O_2$ show a low remanent magnetization and coercive field, as well as superparamagnetic features at room temperature. On the other hand, superlattice films (TiFeO/TiMnO) show a high remanent magnetization and coercive field. An anomalous Hall effect in superlattice films exhibits hysisteresis loops with coercivities corresponding to those in the ferromagnetic Hysteresis loops. The superlattice films composed of alternating layers of $Ti_{0.94}Fe_{0.06}O_2$ and $Ti_{0.94}Mn_{0.06}O_2$ exhibit intrinsic ferromagnetic properties for dilute magnetic semiconductor applications.

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