MMM

ABSTRACTS

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ER-04. Magnetic and transport characteristics on high Curie temperature ferromagnet of Mn-doped GaN. *T. Sasaki*[1], S. Sonoda[2], Y. Yamamoto[1], K. Suga[3], S. Shimizu[2], K. Kindo[3] and H. Hori[1]. *1. Materials Science, JAIST, Tatsunokuchi, Ishikawa, Japan; 2. ULVAC JAPAN, Ltd., Chigasaki, Kanagawa, Japan; 3. KYOKUGEN, Osaka University, Toyonaka, Osaka, Japan*

The growth of (Ga,Mn)N films on sapphire substrates were carried out by using of MBE system. Figure 1 shows the temperature dependency of saturation magnetization from 1.8 K to 750 K. The magnetization process above room temperature is typical ferromagnetic (F-) magnetization curve. The Curie temperature of this sample is estimated to be 940 K from the data in Fig.1 by molecular field approximation theory. Anomalous behavior below ~10 K in Fig.1 looks like coexistence of F- and Para magnetic phases. The clear hysteresis loop in Fig.1 supports the F-magnetic characteristics. The temperature dependencies of electric resistance and carrier concentration in Fig.2 were measured to investigate the relation between the F-magnetism and carrier. The clear coincidence of anomalous region below ~10 K in both of data in Fig.1 and 2 may suggest the low carrier concentration makes increase of paramagnetic component and "high T_C F-magnetism" is mainly produced by majority carrier of conduction electron.

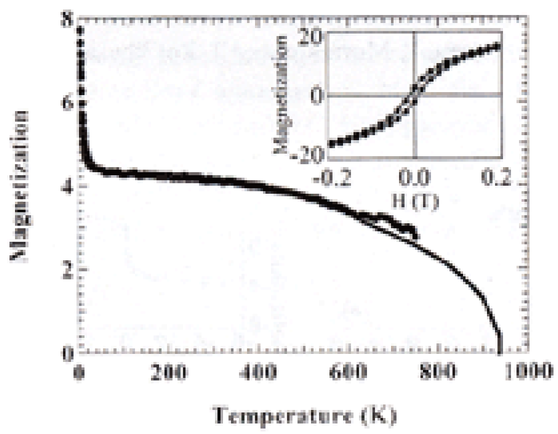


Fig.1 The temperature dependency of saturation magnetization of (Ga,Mn)N . Inset is hysteresis loop at 1.8K for (Ga,Mn)N.

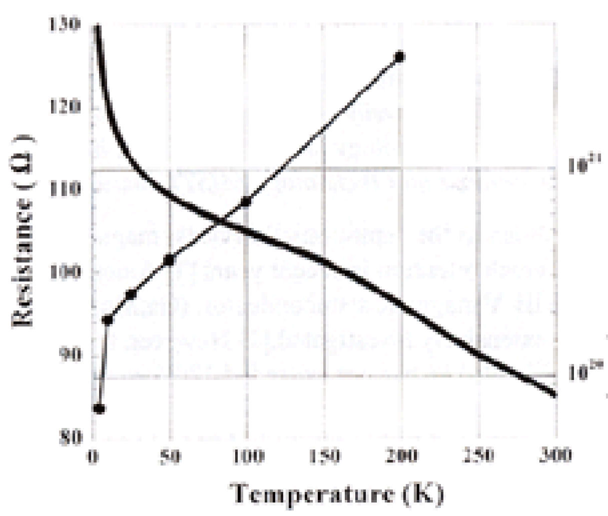
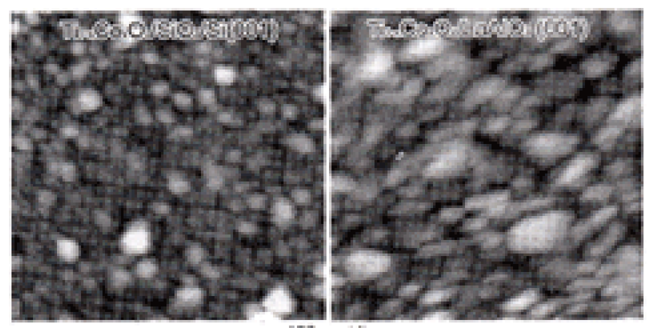


Fig.2 The temperature dependency of resistance and carrier concentration of (Ga,Mn)N.

ER-05. Growth of Nonmagnetic Semiconductors Ferromagnetic in Cobalt-Doped Anatase Titanium Thin Films. *I.B. Shim*[1], S.Y. Choi[2] and C.S. Kim[1]. *1. Physics, Kookmin University, Seoul 136-702, South Korea; 2. Materials Engineering, Yonsei University, Seoul 120-794, South Korea*

Titanium dioxide has three kinds of crystal structure, rutile, anatase, and brookite, composed of Ti ions having octahedral coordination. Anatase structure is not as thermodynamically stable as rutile, the pure anatase phase with high crystallinity is difficult to obtain in a non-high vacuum techniques. Hetero-epitaxial and polycrystalline anatase $Ti_{1-x}Co_xO_2$(0.0 ≤x ≤1.0) thin films were prepared by soft chemical processing on $LaAlO_3$ (001) and thermally oxidized silicon substrates and the crystallinity and magnetic properties was investigated. XRD spectrum of the $Ti_{1-x}Co_xO_2$ films on $LaAlO_3$(001) substrate shows (004) and (008) peaks of hetero-epitaxy anatase without any impurity phase. The full-wide at half maximum of the (004) peak rocking curve is 0.24 °while that of anatase film fabricated on SiO_2/Si(100) substrates is polycrystalline. Microstructural characterization on $Ti_{1-x}Co_xO_2$ thin film employing FE-SEM and AFM showed island type grains in 20 nm in size and the surface roughness of typical thin films was 7 nm [Figure 1]. Magnetic response was measured as a function of magnetic field strength for the x=0.07 film on $LaAlO_3$ (001) at temperature range of 2 to 300 K. Sharp, square hysteresis loops, indicating a well-ordered ferromagnetic structure, appeared in the magnetization versus magnetic field curves when magnetic field was applied in the plane of the film. This result clearly indicates that the anatase $Ti_{1-x}Co_xO_2$ thin films fabricated on $LaAlO_3$ (001) by soft chemical process have crystal quality equivalent to high-vacuum technique and these thin films are advantageous not only for practical application to magnetic device but also for physical basic studies on electro-magnetic properties $Ti_{1-x}Co_xO_2$ films.



ER-06. Epitaxial Growth of Zinc-blende CrAs/GaAs Multilayer. *M. Mizuguchi*[1,2], H. Akinaga[1], T. Manago[2], K. Ono[3], M. Oshima[3] and M. Shirai[4]. *1. JRCAT/AIST, Tsukuba, Japan; 2. JRCAT/ATP, Tsukuba, Japan; 3. Univ. of Tokyo, Tokyo, Japan; 4. Osaka Univ., Osaka, Japan*

Zinc-blende (zb) CrAs is a notable material because it has been predicted by ab-initio calculations that the zb-CrAs has a half-metallic band structure, and that the ferromagnetic state is most stable in terms of the total energy[1]. We have already succeeded in growing zb-CrAs thin film (2 nm) on GaAs, and observed ferromagnetic behaviors at room temperature[2]. However, unknown spots appear in the RHEED pattern of CrAs with the nominal thickness over 3 nm. This fact indicates that zb-CrAs does not keep the crystal structure over the thickness of 3 nm under the present growth condition. The critical thickness should be increased to obtain functional devices utilizing half-metallic properties of zb-CrAs.In this contribution, we report that zb-CrAs/GaAs multilayers were grown by MBE. The surface structure was observed by RHEED. Superlattice structures were grown on a GaAs (001) surface after the growth of a GaAs buffer layer to realize the flat GaAs surface. The thicknesses of the GaAs spacer layer and the zb-CrAs magnetic layer were varied, and epitaxial relationship was investigated. It was clarified that crystallographic properties changed depending on the layer thickness. Magnetic properties of these multilayers and effects of post-annealing will be discussed in detail.

[1] M. Shirai, T. Ogawa, I. Kitagawa, and N. Suzuki, J. Magn. Magn. Mater. 177-181, 1383 (1998).
[2] H. Akinaga, T. Manago, and M. Shirai, Jpn. J. Appl. Phys. 39, L1118 (2000).

ER-07. NOVEL MAGNETIC-SEMICONDCUTOR HETEROSTRUCTURES FOR IMPROVED KNOWLEDGE OF SPINTRONICS. *L.F. Cohen*[1], R.A. Stradling[1], J. Giapintzakis[2] and C. Grigorescu[3]. *1. Blackett Laboratory, Imperial College, London, United Kingdom; 2. Superconductivity and Magnetism, IESL - FORTH, Heraklion, Greece; 3. Phsics Department, National Institute for Research and Development for Optoelectronics, Bucharest, Romania*

A large European consortium (19 partners) has been funded to study in parallel ferromagnetic semiconductors and magnetic metal - semiconductor heterostructures as novel materials for electronic and optoelectronic applications. In this presentation an overview of certain aspects of semiconductor-magnetic metal programme will be given. In particular the very successful