AT21

Charge Transport Behaviors of Vertically Aligned GaN:Mn Nanorods on n-Si Substrate as P-N Junction Diode

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GaN-based electronic and optoelectric devices have required high-quality, p-type doping, and engineering band gap for their huge potential application. However, GaN thin films have limted crystal quality and homoseously p-type doping. Recently, one-dimensional nanostructures were attraced new building blocks beacuse they have a number of advantages over thin films such as thermodynamic stable features, defect free, and single crystalline. Several groups have successfully synthesized p-type GaN nanowires (NWs), where Mg is used as the p-type dopants [1]. To improve the functionalites of p-GaN, we have previously used Mn as p-type dopants since transition metal doped GaN has ferromagnetism above room temperature based on theoretical studies [2]. We reported on prepartion of single crystalline Mn-doped GaN NWs and their ferromagnetism with Curie temperatures above room temperature, magnetoresistances near room temperature, spin-dependent, and p-type character [3]. Based on our results, in this study, we explore the growth of GaN:Mn nanorods on CMOS compatibile n-Si substrate. These NRs were grown vertically on n-Si substrate with Ni as catalyst and has a diameter of 100 nm and a length of 700 nm ~ 1 μm. These NRs were perfectly single-crystalline nature, without defects or secondary phases. The average Mn concentration was c.a. 2.5 at%, and Mn dopant was found to be distributed homogeneously within the nanowire lattice. To confirm p-type of GaN:Mn NRs, we fabricate n-Si substrate/GaN:Mn NRs junction as p-n diode. We will discuss electric and magnetoelectric transport properties and Mn charge transport properties versus temperature and applied magnetic fields in detail.

This research was supported in part by a grant from the program of the National Research Laboratory of the Korean Ministry of Science and Technology (R0A-2007-000-20075-0)

REFERENCES

[1] Z. Zhong, F. Qian, D. Wang, and C. M. Lieber, Nano Lett. 3, 343 (2003).
[2] H. Ohno, Science 281,951 (1998).
[3] H. J. Choi et al., Adv. Mater. 17, 1351 (2005).

AT22

Magnetizations Reversal Characteristics of GaMnAs Ferromagnetic Semiconductor

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Ferromagnetic semiconductors based on III-V compounds offer new possibilities for investigation of interesting physical phenomena. Recent developments in the transport properties of GaMnAs have been attracted on a fundamental aspect of magnetization reversal process. GaMnAs thin films consist of 4-fold in-plane easy axes are fundamentally on account of a compressive lattice mismatch induced by the strain under a low temperature. It is interesting that anisotropy magnetization of GaMnAs is subjected to change depending on strain, Mn concentration and temperature. In the work, we investigated the magnetoresistance (MR) of GaMnAs Hall bar as a function of anisotropy magnetization and domain wall motion.

100 nm thick film of $Ga_{0.95}Mn_{0.05}As$ grown by the low-temperature molecular beam epitaxy on semi-insulating GaAs substrate was used to make Hall bar. The planar Hall (PH) resistances and longitudinal MR was measured in order to analysis magnetization reversal process as a function of anisotropic magnetization and magnitude of applied magnetic field. The PH and MR can be understood in term of the domain wall propagation inside 100 μm wide Hall bar. A characteristic feature of MR and PH is resulted from the magnetization reversal of individual magnetic domain under a given sweeping range and direction of applied magnetic field. The results are taken into account the magnetization reversal characteristics of the GaMnAs thin films.

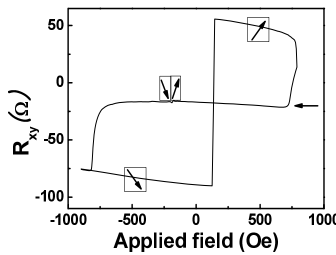

Fig. 1. Planar Hall resistance of GaMnAs as a function of intermediate domain states.