구두발표 IV-3

GaAs기판위에성장시킨스핀밸브구조에서의선택적자기수송
(Spin selective transport at the spin valve structure grown on GaAs substrates)

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Many efforts have focused on the utilization of spin as well as the charge of electron, and remarkable results have been reported in semiconductor (SC) associated with ferromagnet (FM), i.e., ferromagnetic semiconductor and FM/GaAs. We have attempted to demonstrate spin selection using optically pumped carriers as a spin emitter in hybrid structure without substructure of quantum well at room temperature[1]. The electrons in FM/GaAs structure are excited by circularly polarised light having energy above 1.43 eV (the energy gap of GaAs), and these electrons are polarised to spin up and spin down due to the transition selection rule of SC up to 50 % theoretically[2]. The spin selective transport of spin-polarised electrons from the SC to the FM layer is depend directly on the magnetic orientation of the FM, which has been shown that the ballistic transport through Schottky barrier is easy of access at the parallel alignments between the spin and moment orientation. We have reported significant results of spin selection at room temperature in FM/*n*-GaAs structures, where FM is Fe and NiFe. In case of single layer FM, although magnetic circular dichroism (MCD) (~0.6% in Fe with thickness of 5nm) is estimated negligible,the problem of evaluating spin selection without MCD effect still remains[3]. Indeed, it is ambiguous to define helicity dependent photocurrent (I_{heli}) as a function of magnetic field, because helicity dependent photocurrent ,as well as MCD, tracks the magnetization of FM layer.

In this presentation, we report the spin-dependent transport of the optically pumped electrons from *n*-GaAs substrate to spin-valve (SV) layers associated with Schottky barrier. It should be considered that spin-valve structure is one of the candidates which enable us to investigate electron transport in conduction band such as thermionic and tunneling process, depending on the orientation of magnetization in FM layers. There are two kinds of electrons used in this experiment. Under linearly polarised laser beam, the photoexcited electrons are not polarised and it is similar to CPP (current perpendicular to plane) measurement without optically pumped electrons as a current source. The magneto-CPP measurement can be accounted for spin-coupled interface resistance as well as the interface resistances in series for electrons optically pumped in GaAs substrate. From the magneto-CPP as a function of magnetic field, we can see that the photoexcited electrons in conduction band of GaAs dominantly move from GaAs to FM layer without an external bias. Under circularly polarised laser beam manipulated by the photoelastic modulator (PEM) (which makes the left-hand and right-hand circular polarised electrons in GaAs), these polarized electrons can first be filtered at Shottky barrier depending on the configuration of the first magnetic layer and then SV effect follows with respect to the relative magnetic configurations of both FM layers. Consequently, the measured helicity dependent photocurrents can be attributed to Schottky tunneling, ballastic transport and SV effect.

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[2] Pierce D T and Meier F, Phys. Rev. B 13 , 5484 (1976).
[3] J. A. C. Bland, S. J. Steinmueller, A. Hirohata, W. S. Cho, Y. B. Xu, C. M. Guertler, G. Wastlbauer, A. Ionescu, T. Trypiniotis, S. N. Holmes J. Phys D-Appl Phys., 36, 2204 (2003).