CD06

Sensitivity Dependence of Planar Hall Effect Sensor on the Free Layer of the Spin-valve Structure

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Planar Hall effect (PHE) sensor using spin-valve structure has received much attention in biochip application due to its prominent advantages such as; domain stabilization, constraining the magnetization in coherent rotation, prevention of Barkhausen noise associated with magnetization reversal, high sensitivity and dynamic range due to the magnetic field created by the pinned ferromagnetic (FM) layer acting on the free layer with closed fringes. In this approach, we study the effect of the thickness of FM free layer in spin-valve structure on the sensitivity and the amplitude of PHE voltage profiles of sensor. The sensors with junction size of 50×50 μm^2 using spin-valve thin films Ta(5)/NiFe(x)/Cu(1.5)/NiFe(3)/IrMn(15)/Ta(5) with x = 4, 8, 10, 15, 20 (nm) were fabricated successfully. The obtained PHE voltage profiles in Fig. 1 show that the sensitivity of PHR sensors increases due to the increased thickness of FM free layer. The sensitivity of about 7.3 (μV/Oe) can be obtained as the thickness of FM free layer increases up to 20 nm. The change of sensitivity occurred due to the current shunting effect from other layers. The obtained results are explained well by using the Stoner-Wohlfarth energy and the theoretical calculations are in good agreement with experimental results. Moreover, the results of detecting Dynabead® M-280 illustrate that our PHR sensor is a good candidate for high resolution biochip.

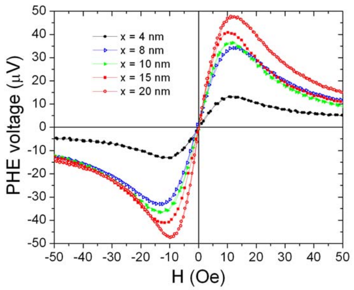

Fig. 1. PHE voltage profiles of spin-valve structure with different thicknesses of FM free layer.

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CD07

Manipulation of Magnetic Beads by Magnetic Fields of Narrow Metallic Wires for Use in Biosensors

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We investigated a means to manipulate small magnetic beads using the magnetic fields of current-carrying wires. Narrow metallic wires were fabricated with optical lithography and vacuum deposition methods. As we applied 20-40 mA of current, the magnetic beads could be collected on the wire. Depending on the magnitude of the currents, the velocity of the beads was 2-20 μm/s. In addition to the motion of the beads by the interaction with the fields, we also observed drift of the beads caused by the local heating of the wire and the resulting temperature gradient. We also demonstrated transfer of beads between wires by switching the current between the wires. We consider that this simple device can be used to transfer the beads to the locations of the sensors and that it can increase the reaction probability between beads and magnetic sensors.

Index Terms-Biosensor, Magnetic Bead, Manipulation, Microfluidics