CD04

Optimization of Spin-valve Structure NiFe/Cu/NiFe/IrMn for Planar Hall Effect Based Biochips

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ABSTRACT

Magnetic label detection has been performed by using different spintronic platforms, among them the Planar Hall Effect (PHE) has recently been received great attentions thanks to its nano-Tesla sensitivity and high signal-to-noise ratio. PHE is based on the anisotropy magnetoresistance of ferromagnetic materials. The transverse voltage on a planar Hall cross depends on the orientation of the magnetization of the material with respect to the longitudinal current running through the material. Thus, the large PHE is usually observed in exchange bias based structures because they can ensure a sufficient uniaxial anisotropy with well defined single domain state to introduce a unidirectional anisotropy. The present paper deals with the PHE of Ta(5 nm)/NiFe(x)/Cu(1.2 nm)/NiFe(t)/IrMn(15 nm)/Ta(5 nm) spin-valve structures. In this structure, the free (x) and pinned (t) layer thicknesses are parameters which have to be optimized. Experimental investigations are performed for 50×50 μm^2 junctions with x = 4, 8, 10, 15, 20 nm and t = 2, 3, 6, 8, 9, 12 nm. The results show that the thicker free ferromagnetic layers enhances the PHE signal, whereas the thicker pinned ferromagnetic layers will lower the signal. Optimization is obtained with x = 20 nm and t = 2 nm, corresponding to a PHE sensitivity as high as 7.6 mΩ/Oe. It can be well applied for single Dynabeads® M-280 Streptavidin detection.

CD05

Voltage-induced Resistance Change in Spin-valve/PZT Systems

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Spintronics is mainly related to the magnetization switching phenomena, among which field-induced magnetization switching, thermally assisted switching and spin transfer switching are well described. The present study proposes another magnetization switching type, names as voltage-induced spin reorientation. This switching mechanism is realized the spin-valve-based Ta(5 nm)/$Ni_{80}Fe_{20}$(10 nm)/Cu(1.2 nm)/$Fe_{50}Co_{50}$(8 nm)/IrMn(15 nm)/Ta(5 nm)/PZT structure, where the magnetization in magnetostrictive CoFe layer can be rotated under strains. This nanostructure can be considered as a multiferroic material. Thanks to the magnetoelectric coupling between (ferro)magnetic (spin-valve) and ferroelectric (PZT) layers, and the inverse magnetostrictive effect (Villiary effect), the magnetization can be turned by applying an external electrical field (or an external voltage). This phenomenon is evidenced by the magnetization and magnetoresistance change obtained under an voltage (V_{PZT}) applied in the PZT layer (see Figure 1). This novel multiferroic architecture and magnetization switching mechanism is rather promising for advanced spintronics.

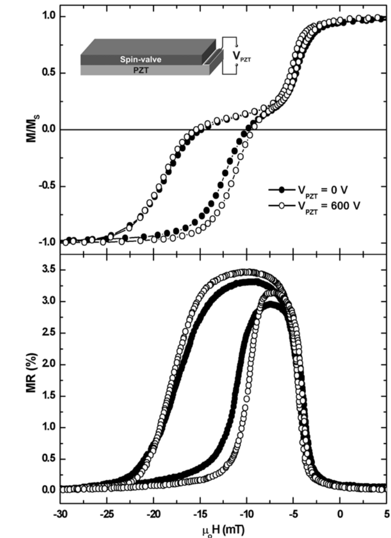

Fig. 1. Hysteresis loops (a) and magnetoresistance of Ta(5nm)/$Ni_{80}Fe_{20}$(10nm)/Cu(1.2nm)/$Fe_{50}Co_{50}$(8nm)/IrMn(15nm)Ta(5nm)/PZT.