Optimization the Thickness of the Free and Pinned Layers in a Spin-Valve Structure for High-field Sensitivity Planar Hall Effect Based Biochips

Tran Quang Hung*, Bui Dinh Tu[1], Sunjong Oh, Nguyen Huu Duc[1],
Jong-Ryul Jeong and CheolGi Kim

Department of Materials Science and Engineering, Chungnam National University, Daejeon 305-764, Korea
[1]Department of Nano Magnetic Materials and Devices, Faculty of Physics Engineering, College of Technology, Vietnam National University,144 Xuan Thuy Road, Cau Giay, Hanoi, Vietnam.

Planar Hall effect (PHE) sensor using spin-valve structure has received much attention in biochip application due to its prominent advantages such as: high sensitivity, high signal-to-noise ratio, thermal stability, etc.,. In this approach, we study the effect of the thickness of ferromagnetic (FM)-free and FM pinned layer in spin-valve structure on the role of the field sensitivity of the PHE sensor. The sensors with junction size of 50 × 50 μm2 using spin-valve thin films Ta(5)/NiFe(x1)/Cu(1.5)/NiFe(x2)/IrMn(15)/Ta(5) with x1 = 4, 8, 10, 12, 16 and x2 = 2, 3, 6, 8, 9, 12 (nm) were fabricated successfully. The results show that the sensitivity of a PHE sensors is proportional to the thickness of FM free layer and inversely proportional to the thickness of FM pinned layer. The enhancement of the field-sensitivity is assumed by the enhancement of the active current passed through the FM free layer. The obtained results are explained well by using the Stoner-Wohlfarth energy, the theoretical calculations are in good agreement with experimental results.

Corresponding Author: C. G. Kim, E-mail address: cgkim@cnu.ac.kr