The Fabrication of High Sensitive Spin valve sensor for Magnetic bead detection

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Manipulation and detection of magnetic beads on a semiconductor chip open up new perspectives for analysis of magnetically labeled specimens in biological and medical applications. In the past few years, giant magnetoresistive (GMR) structures like spin-valve or multilayers have been used for detection or identification of biomolecules using magnetic beads [1 ~ 3]. In addition, the development of this field was foreseen with high sensitive biosensor for single molecule detection and biosensor of smaller size. This work has studied to achieve the high sensitive spin-valve sensor which detects the stray field from a spherical-shaped superparamagnetic bead magnetized by external field. First of all, spin - valve structures of Ta(50)/NiFe(45)/CoFe(15)/Cu(26)/CoFe(40)/IrMn(150)/Ta(50) [unit of ( ) is Å] with 8 ~ 9 % magnetoresistive ratio were deposited on substrate Si/SiO_2(1500) by UHV magnetron sputter system Spin valve sensor was fabricated through photolithographic techniques and ion milling etching processes High linearity, low hysteresis operation was achieved by rotational behavior of free layer orthogonal to magnetization direction of pinned layer. The working of sensor was confirmed by obtained the output signal (3 mV, 15 mV and 30 mV respectively) as a function of sense current (1 mA, 5 mA and 10 mA respectively) under the external field parallel to magnetization direction of pinned layer. The sensitivity of the fabricated spin-valve sensor is about 0.3 %/Oe (sense current 10mA). Sensor saturation signal (ΔV) of 2 mV was obtained for 2.8 μm magnetic beads positioned over the spin valve sensor using an in-plane field and 10 mA sense current.

References

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