DT05

Spin Valve Ring Sensors for Superparamgnetic Bead Detections

Jeong Dae Suh*, Sang Don Jung, and Myung Ae Chung
Neural Interface Research Team, Electronics and Telecommunications Research Institute,
138 Gajeongno, Yuseong, Daejeon, 305-350, Rep. of Korea
*Corresponding author: Jeong Dae Suh, e-mail: jdsuh@etri.re.kr

Detection of biomolecular interaction is extremely important issue in medical and biosensor research and development field. During the last few years, biomolecules detection using magnetic beads as biomolecule labels showed a new opportunity for biological and medical diagnostic device applications [1, 2]. In the magnetic label based biosensor device applications, detection of the single superparamagnetic bead is one of the key issues. Recently, several on-chip magnetic sensors such as giant magneto-resistance sensors and spin valve sensors with strip line geometries have been demonstrated as a biosensor for the single magnetic bead detections [3, 4]. However quantifiable magnetic bead detection was rarely reported. On the other way, ring type sensors were attracted for the use of magnetic memory, logic, and digital magnetic bead detections [5, 6]. In this study, we report the results for superparamagnetic beads detection by using ring type magnetic spin valve biosensors. Here, we describe the design and performance of our magnetic ring sensors for single magnetic bead detection. We have quantifiably detected the presence of single magnetic beads with size of 2.8 um on the ring type spin valve magnetic sensors. Our results suggest that the ring type magnetic sensors can be expected to for magnetic biochip system with high sensitivity and selectivity.

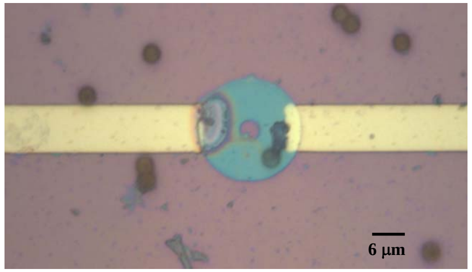

Fig. 1. Ring Type Spin Valve Sensors for Quantifiable Magnetic Beads Detection. Dark spheres are magnetic beads with 2.8 µm diameter.

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DT06

Measurement of MCG in Unshielded Environment Using a Second-order SQUID Gradiometer

C. S. Kang[1,2], Y. H. Lee[1]*, H. Kwon[1], J. M. Kim[1], K. K. Yu[1], K. Kim[1], H. K. Lim[1], Y. K. Park[1], and S. G. Lee[2]
[1]Medical Metrology Center, Korea Research Institute of Standards and Science, Deajeon 305-340, Korea
[2]Department of Applied physics, Korea University, Jochiwon 339-700, Korea
*Corresponding author: Author2 Lee, e-mail: yhlee@kriss.re.kr

We fabricated a low-T_C second-order superconducting quantum interference device (SQUID) gradiometer to measure magnetocadiography (MCG) in unshielded environments. The second-order gradiometer cosisted of the pick-up coil and the SQUID. The pick-up coil is formed with two single-turn coils and one double-turn coil. The three coils are connected in order of single, double, and single-turn coil. The coupling polarity of two side coils is opposite to the center coil. The SQUID is based on double relaxation ocillation SQUID (DROS), which consists of a hystretic signal SQUID, a referene junction, and shunted a relaxation circuit with a resistor and an inductor [1]. Since the DROS has 10 times larger flux-to-voltage transfer coefficient ($\sim 1mV/\Phi_0$) than the conventional SQUID, SQUID could be operated with a simple flux-locked loop circuit [2]. The pick-up coil and the SQUID were fabricated on the independent wafers and connected superconductively using a Nb wire. The overall size of the second-order gradiometer is 94 × 12 mm with a baseline of 35 mm. The average field noise was about 8 $fT/\sqrt{Hz}$ at 100 Hz, when operated the second-order gradiometer in shieled or unshieded environment [3]. The noise level is low enough to measure MCG signals in the unshielded environment. Finally,

we measure the MCG in shielded and unshielded environments by using the second-order gradiometer and compared the signal characteristics measured in both environments.

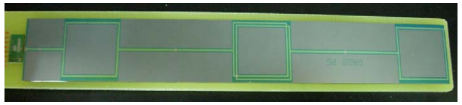

Fig. 1. Overall image of the second order gradiometer.

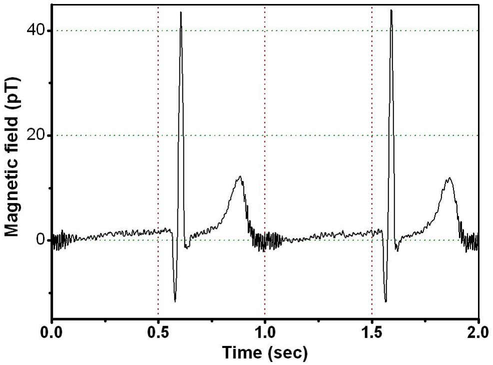

Fig. 2. The MCG signal in unshielded environment.

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