EC07

An Experimental Study of Stable Operating Condition on a High Sensitivity

Kunihisa Tashiro[1,2], Atsuya Kakiuchi[1]*, Ken-ich Moriizumi[1], and Hiroyuki Wakiwaka[1,2]
[1]Shinshu University, Wakasato 4-17-1, Nagano 380-8553, Japan
[2] Spin Device Technology Center, Shinshu University, Japan

An induction gradiometer(IG), based on definition of inductance, is promising sensor which has the ability of detecting weak magnetic fields from extremely low frequencies to those is the audible range (0.01 Hz ~ 10 kHz) [1]-[3]. The authors presented an IG for magnetocardiograph, which showed a few mV for a magnetic field of 100 pT, 1 Hz [3]. Due to power line noises and electrical interferences, however, the waveform of the target signal cannot observe by an oscilloscope. In this paper, we consider stable operating condition on a high sensitivity induction gradiometor. Because the gains of the current-to-voltage converter (I-V) and the instrumentation amplifier (IA) are larger than previous condition, the electronics can not operate stably. In order to solve the environment, we construct a faraday cage whose size is 1.8 m × 1.8 m × 2 m. We evaluate electric noises in our laboratory environment using a battery powered oscilloscope and a typical voltage probe. Mean value of the observed voltage is 20 mVp-p and maximum value of that is over 200 mVp-p. Fig. 1 shows the experimental setup. The detection coil and one turn coil has 10 mm distance. The electronics is consists of IV, BEFs(60Hz, 180Hz), HPF(0.15 Hz), and IA. The ground points of the electronics are connected to the faraday cage. Fig. 2 shows an experimental result. The transfer ratio of the IG is 1.5 V/nT. A small input current of 0.1 mAp-p, 1 Hz is fed to one turn coil. We demonstrate to observe the weak magnetic field using an oscilloscope.

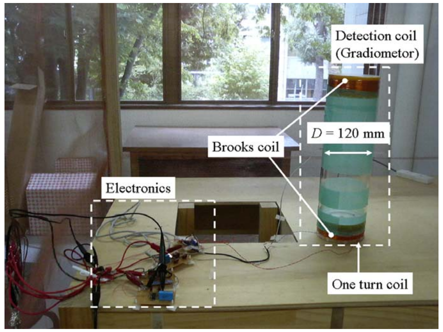

Fig. 1. Experimental setup.

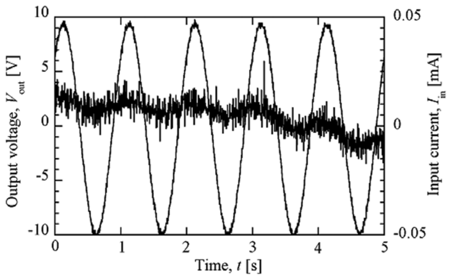

Fig. 2. Experimental results.

REFERENCES
[1] K. Tashiro, J. Magn. Soc. Jpn., 30, pp. 439-442, 2006.
[2] K. Tashiro, Proc. IEEE Sensor 2006, pp. 939-942, 2006.
[3] A. Kakiuchi al., SEAD20, 22C3-3 (4pages), 2008. in Japanese.

EC08

Angle Sensors Based on Oblique Giant Magneto Impedance Devices

Dohun Kim, Jiwon Na, and Won Young Jeung*
Functional Materials Research Center, Korea Institute of Science and Technology
*Corresponding author: e-mail: wyjeung@kist.re.kr

Abstract
As one of various applications of magnetic sensors, the measurement of external magnetic field orientation using Giant Magneto Impedance (GMI) sensors has been performed. In order to obtain a linear response, method of applying bias field to two identical GMI sensors and amplifying the voltage difference of the sensors is used. [1] Figure 1 shows schematic diagram of the GMI angle sensor and measurement setup. Soft magnetic alloys of $Co_{30}Fe_{34}Ni_{36}$ was electroplated on a CoFeNi sputtered Si wafer. V-shaped microwire patterns were formed using conventional photolithography process. The angle between two GMI sensors was varied from 10 to 60 degrees. For sensor performance characterization, Stanford Research Systems SR844 High frequency Lock-in Amplifier was used as both RF signal source and RMS voltage detector.

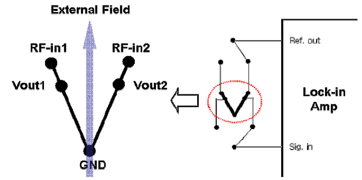

Fig. 1. Schematics of angle sensor element and measurement setup.

Based on the result of previous work [2], the impedance profile between ±10 Oe was set as operating region. External magnetic field was generated by rectangular AlNiCo permanent. The reference direction was defined as the external magnetic field lying exactly between two GMI devices. As the orientation of magnetic field deviates from the reference direction, variation of field component along each device introduces voltage changes. It was found that, by taking difference between left and right arm of the V-shaped device, the mutual nonlinearity can be significantly reduced. Figure 2 shows voltage response of each device and final output voltage for angle sensor of which left and right arm are at 50 degrees. The fabricated angle sensor has linear range of approximately 80 degrees and overall sensitivity of about 20 mV. It is expected that linear response directly to the external field direction considerably simplifies subsequent electronic circuitry.

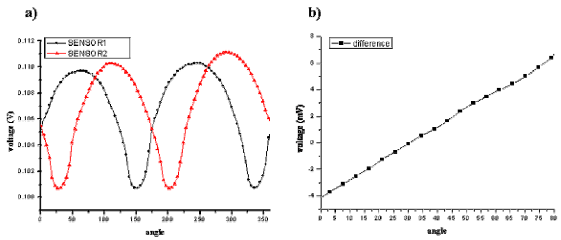

Fig. 2. Signal output of a) left and right arm of V-shaped angle sensor, b) final voltage difference.

REFERENCES
[1] Magnetoimpedance and magnetoinductance in Magnetic Sensors and Magnetometers"P. Ripka and L. Kraus, , P. Ripka, Ed. Norwood, MA: Artech House, 2001, pp. 350-358.
[2] Variation in the Magneto-Impedance (MI) Effect According to the Shape of Patterned CoFeNi Alloys" H.K.Kim, et al. Journal of Magnetics, 13, 65 (2008).