High TMR Ratio and High Signal Output of Array TMR Sensor Deposited on Chemical-Mechanical Polishing Cu Buffer Layer

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Measurement of biomagnetic field such as magnetocardiography (MCG) and magnetoencephalography (MEG) has high potential in medical diagnosis due to high spatial and time resolution. Measurement of these MCG and MEG was carried out using a tunnel magneto resistance (TMR) sensor which is a room temperature operation [1], but higher sensitivity is indispensable for medical application. The TMR sensor used in this study has electrically connected many elements configuration for 1/*f* noise reduction. In this case, it is conceivable that the TMR ratio decreases due to the parasitic resistance of the bottom electrode of the TMR sensor, and the signal output decreases. In this study, in order to reduce this parasitic resistance, we deposited TMR sensor on chemical-mechanically polished (CMP) 200 nm Cu then the effect on TMR ratio and signal was investigated

In order to reduce roughness, the Cu layer was polished by CMP after film deposition. A 500 nm Cu film was deposited and 300 nm was removed by CMP. As a result, we succeeded in reducing the Ra value from 2.3 nm to 0.3 nm. TMR multilayer film was deposited on this Cu layer using magnetron sputtering. The TMR sensors were connected series and parallel and the size of the integrated TMR sensors was 7.1×7.1 mm^2

Fig. 1 shows the *R-H* curves with 200 nm thick Cu layer and without. In the TMR sensor on the Cu layer, a high TMR ratio of about 1.5 times was measured as compared with the TMR sensor without the Cu. This result is considered due to the parasitic resistance of the bottom layer being reduced by the Cu layer. Magnetic field of 3.3 Hz and 1 μT was applied to the TMR sensor and the signal output was measured. For the sample without Cu, the signal output was 376 μV/μT/V. On the other hand, for the Cu layer contained sample, the signal output was improved as 463 μV/μT/V. It is considered that the signal output was improved by increasing the TMR ratio.

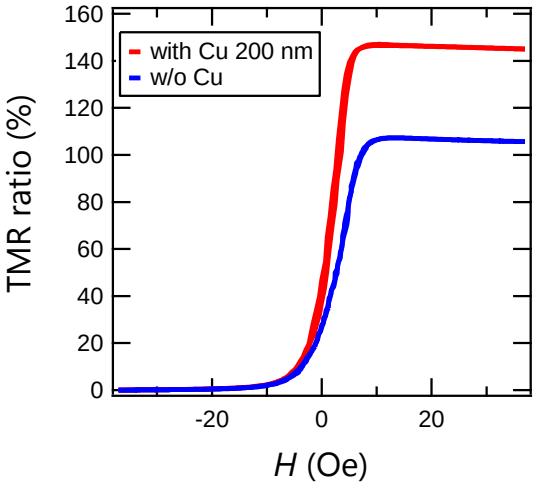

Fig. 1 Comparison result of *R-H* curve with and without Cu 200 nm.

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