Recent Progress of Biomagnetic Field Sensors with Ferromagnetic Tunnel Junctions

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The discovery of large tunnel magneto-resistance (TMR) effect at room temperature (RT) in magnetic tunnel junctions (MTJs) spurred intensive investigation of MTJ applications for spintronics devices. For sensor application, high sensitivity, low power consumption, small device size and low cost make it prime candidate of the next generation magnetic field sensor such as a bio-magnetic field sensor [1,2]. It needs individual MTJs with a large sensitivity over 10%/Oe and 100 x 100 integrated MTJs to achieve enough output signal and S/N ratio. Here, sensitivity is defined as TMR-ratio/2Hk, where Hk is anisotropy field of the free layer. SQUID is currently the most sensitive of the magnetic sensor and is used for the measurement of biological fields. The sensor with MTJs has much advantage, in particular, the device can operate without liq. He, that is, the sensor can be used at room temperature. Therefore, we expect that the device can have wide application. We prepared the biomagnetic field measurement sensor with a magnetic tunnel junction (MTJ) microfabricated in series and parallel in order to reduce device noise and a magnetic field sensor module incorporating various circuits such as a bridge, an amplifier, a filter, etc., for improving the S / N ratio was fabricated. Using this module, a cardiac magnetic field was successfully measured. In addition, by canceling the environmental noise using two sensor probes, it was shown that a signal can be detected even outside the magnetic shield. In this presentation, we show the detailed characteristics of this sensor. The necessary technical challenges toward its realization and the feasibility in the future are discussed

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Reference

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