

超高感度磁気センサ用の直行磁化型強磁性トンネル接合素子のFlux効果 Flux concentrator effect in magnetic tunnel junctions of orthogonal magnetic configuration for ultrasensitive magnetic sensors

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The sensitivity of magnetic sensors has significantly increased than that of reading heads in hard disk drives (HDD), and research efforts are currently being used for biomedical applications. In the future, bio-magnetic sensors may also potentially contribute to the research and development of brain chip technology that directly connects the human brain to a computer. The advantage of magnetic sensors over conventional electrode detection is that the stray magnetic field of bio-signal is not influenced by dielectric constant distribution. However, the sensitivity and noise level of the magnetic sensor using magnetic tunnel junction (MTJ) is under development. Our aim in this study is to detect neurons firing signals using orthogonal-type MTJ with flux concentrators placed above and below orthogonal-MTJ. The orthogonal-MTJ has a perpendicular reference layer and in-plane sensing layer, the magnetic configuration is orthogonal. [Fig.1] We investigated the optimal structure of each size of junction and flux concentrator using an electromagnetic simulator and micromagnetics simulation. As a result, we found that orthogonal-MTJ with a flux concentrator can improve the sensitivity by about 1,000 times compared with orthogonal-MTJ without a flux concentrator.

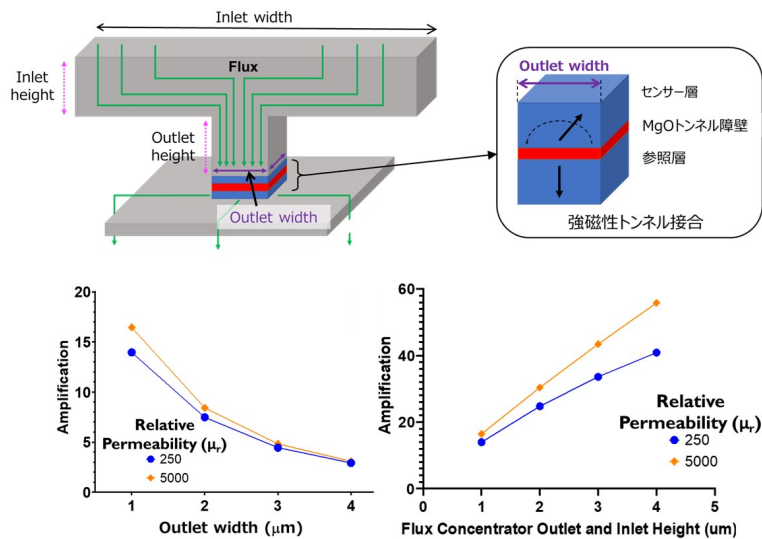


Fig.1 Structure of orthogonal-MTJ with top and bottom flux concentrator, and their amplification by design of top-flux concentrator

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