A high-performance compact magnetic shield for optically pumped magnetometer-based magnetoencephalography

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For optically pumped magnetometer (OPM) based magnetoencephalography (MEG) application, without using liquid helium and its associated dewar device, the large and expensive magnetically shielded room (MSR) for traditional MEG could be replaced by a compact shield [1]. In the present work, an novel, economic and compact cylindrical shield was designed and built to meet the low-field working requirement of OPM in detecting human brain neuronal activities. The performance of the compact shield was evaluated and further compared with that of a commercial MSR. Our results showed that the residual magnetic fields and background noise of the compact shield were lower than or comparable to that of the MSR; The remnant field in the shield is found to be 4.2 nT, a factor of 13000 smaller than the geomagnetic field which is applied to the transverse direction of the shield and the longitudinal shielding factors measured using a known alternating-current magnetic field are approximately 191, 205 and 3130 at 0.1 Hz, 1 Hz and 10 Hz, respectively; in addition, the evoked dynamic waveforms in the human auditory cortex that were recorded separately in these two shields demonstrated consistency. Our findings suggested that a compact shield is feasible for OPM-based MEG applications with high performance and low cost.

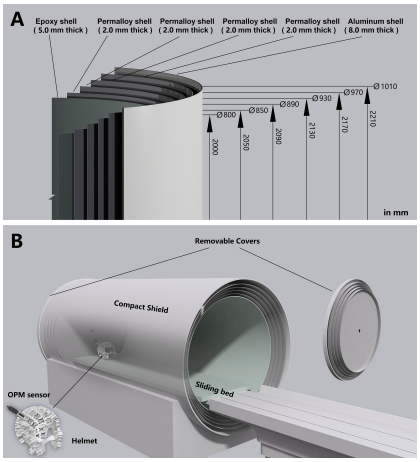

Figure 1.(A) Schematic diagram of the design of the current multi-layer shielding; (B) The appearance of the cylindrical shield with removable covers and a sliding bed.

[1] A. Borna, T. R. Carter, J. D. Goldberg, A. P. Colombo, Y. Y. Jau, C. Berry, J. McKay, J. Stephen, M. Weisend and P. D. D. Schwindt, A 20-channel magnetoencephalography system based on optically pumped magnetometers, Phys. Med. Biol., **62**, 8909 (2017).