Helium-free MEG recordings: Source localization of brain activity

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Abstract

Today almost all MEG systems are comprised with low-T_c superconducting quantum interference device (SQUID) sensors to detect extremely small magnetic fields generated by the human brain. Although this technique is well established, construction and handling requires special materials and precautions. Moreover, low-T_c SQUID systems require cooling with liquid helium, which is quite expensive and resources are limited.

With this study we tested the feasibility of MEG signal acquisition and source localization utilizing a single high-T_c SQUID with a square 16 mm magnetometer input coil cooled with liquid nitrogen (77 K). In one subject neuromagnetic evoked responses generated by auditory stimulation have been recorded at 16 different positions above the left temporal lobe. In addition, resting state neuromagnetic fields were recorded for subsequent time frequency analysis. All experiments took place in a magnetically shielded room. The results obtained with the high-T_c SQUID system are compared to data from the same subject using a commercial 248 channel whole-head MEG system (Magnes 3600 WH, 4-D Neuroimaging) equipped with conventional low temperature SQUIDs operating at liquid helium temperature (4.2 K). The time-frequency representation revealed by the high-T_c SQUID system as well as the source localization of the auditory evoked field are in good agreement with results obtained using the commercial low-T_c MEG system. The neuromagnetic correlates of the evoked fields measured by both systems were localized in the region of the left primary auditory cortex. The deviation between the two current source estimates was found to be 7 mm.

Our results confirm that neuromagnetic source localization is indeed possible utilizing high-T_c SQUIDs. We believe that our findings will have implications in further brain research and developments of multi-channel high T_c SQUID based MEG systems.

Keywords: High-T_c SQUID; Magnetoencephalography; Source localization