

23<sup>rd</sup> International Conference on

# Nanomaterials and Nanotechnology

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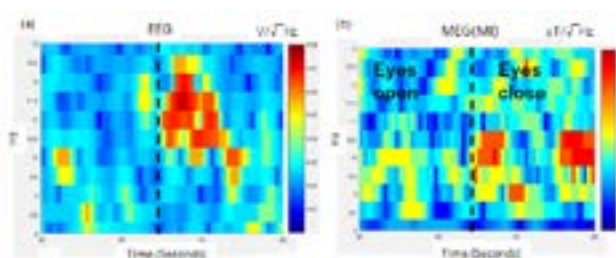


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### Real time magnetoencephalogram measurement using highly sensitive MI gradiometer

The brain activities have attracted considerable attentions in medical and healthcare area, and engineering application. Some disease and injuries can be diagnosed by analyzing the brain activities, such as tumors, epilepsy, and neural damage. Magnetoencephalogram (MEG) is a non-invasive technique for mapping and evaluating the functional activity of brain. According to the previous studies, the MEG has been demonstrated to have better spatial resolution than EEG. It is commonly measured by superconducting quantum interference devices (SQUIDs) which is the most reliable sensitive magnetometer for MEG measurement. However, the SQUIDs are still threatened by the need of cryogenic cooling liquids and a shielding room. Low cost and highly sensitive magnetic sensor systems for MEG measurement have been developed. In this study, we newly developed a peak to peak voltage detector type MI gradiometer (shortened: Pk-pk type MI gradiometer) using micro magnetic wires for MEG measurement. The spontaneous brain activity (Alpha rhythm) measurements are carried out on a female subject. The sensor head is placed 5 mm apart from the scalp of the subject, on the occipital region, at the point between O1 and O2 of the international 10-20 system. The subject lies with eyes open during the first 8 s of the recording (44s-52s). Then, the subject is instructed to close her eyes for the remaining 8 s of the recording (52s-60s). The time-frequency spectrograms of EEG recording and un-averaged Pk-pk type MI gradiometer recording are shown in Fig. 1(a) and (b). Of note is that both the Fig. 1(a) and Fig. 1(b) show a marked enhancement of alpha rhythm between first 8 s and remaining 8 s. As expected, the alpha rhythm signals simultaneously measured by EEG and MI sensor are significantly attenuated when the subject opens eyes, and intensified with eyes close.



### Recent Publications

1. Aydin Ü, Vorwerk J, Dümpelmann M, Küpper P, Kugel H, Heers M, Wellmer J, Kellinghaus C, Hauelsen J, Rampp S, Stefan H and Wolters C H (2015) Combined EEG/MEG can outperform single modality EEG or MEG source reconstruction in presurgical epilepsy diagnosis. PloS One doi:10.1371/journal.pone.0118753.
2. Faley M I, Dammers J, Maslennikov Y V, Schneiderman J F, Winkler D, Koshelets V P, Shah N J and Dunin-Borkowski R E (2017) High-Tc SQUID biomagnetometers. Superconductor Science and Technology 30: 083001.
3. Wang K, Cai C, Yamamoto M and Uchiyama T (2017) Real-time brain activity measurement and signal processing system using highly sensitive MI sensor. AIP Advances 7: 056635.

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4. Ma J and Uchiyama T (2017) High performance single element mi magnetometer with peak to peak voltage detector by synchronized switching. IEEE Transactions on Magnetics 53: 11.
5. Ciulla C, Takeda T and Endo H (1999) MEG characterization of spontaneous alpha rhythm in the human brain. Brain Topography 11(3): 211-22.

## Biography

Tsuyoshi Uchiyama is an Associate professor of Intelligent Device, Department of Electrical Engineering and Computer Science, Nagoya University Graduate School of Engineering. He completed his BSc in Material Science, MSc in Material Science and completed his PhD degree specialized in Magnetic Materials at Nagoya University.

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