Electrocorticography microdisplay for high precision intraoperative brain mapping

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Functional mapping during brain surgery is crucial for identifying and preserving brain regions responsible for vital functions while removing pathological tissues. Traditionally, these procedures rely on verbal interactions between the neurosurgeon and electrophysiologist, leading to inefficiencies in making surgical decision. Moreover, the electrode grids used for measuring brain activity and delineating pathological from functional brain regions suffer from low resolution and poor conformality to the brain surface.

This presentation introduces an intracranial electroencephalogram (iEEG)–microdisplay, featuring freestanding arrays of 2048 GaN micro light-emitting diodes (micro-LEDs) laminated on the back of 1024-channel micro-electrocorticography (ECoG) grid. [1, 2] Through a series of experiments conducted in rat and pig models, we demonstrate that these iEEG-microdisplays enable real-time, high-resolution recording and display of cortical activities by showing spatially corresponding light patterns directly on the brain's surface.

Additionally, the iEEG-microdisplay effectively identified and visualized cortical landmarks and pathological activities. Using a dual-color iEEG-microdisplay, we successfully co-registered functional cortical boundaries with one color while visualizing the propagation of epileptiform activities with another color. These findings suggest that iEEG-microdisplay has significant potential to enhance the monitoring of pathological brain activity in clinical settings.

References

1. Tchoe, Youngbin, et al. "Human brain mapping with multithousand-channel PtNRGrids resolves spatiotemporal dynamics." *Science translational medicine* 14.628 (2022): eabj1441.
2. Tchoe, Youngbin, et al. "An electroencephalogram microdisplay to visualize neuronal activity on the brain surface." Science translational medicine 16.744 (2024): eadj7257.