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High-resolution Flexible Neural Implant

Optogenetics uses light stimulation to control the excitation, inhibition, or signaling pathways of optically excitable cells and provides a powerful tool to diagnose and treat, as well as understand, numerous neurological and psychiatric diseases and disorders. Modified neurons can be activated or silenced by different light frequencies. However, the neural stimulations needed for this require a permanent opening in the cranium which puts patients at risk for serious infection. Additionally, conventional approaches suffer from low resolution, high power consumption and limited targeting of specific neural regions.

Researchers at Arizona State University have developed a high resolution, untethered, flexible cortical implant device having an active matrix thin-film transistor array (TFT) for simultaneous, chronic in vivo stimulation and recording of neural tissue. The TFT array uses OLED technology to selectively and simultaneously stimulate, silence, and/or record biopotentials from small groups of neurons on either the cortical surface or deep within the brain. The OLED pixel array is fully addressable so that individual pixels can be turned on to selectively excite small groups of neurons. The OLED display can be mated with the cortical surface or a narrow sliver of the OLED display can be injected deep into the brain. Additionally, this device requires less power than conventional systems and the power source is integrated into the system.

This device has great utility in diagnosing, treating, and understanding neurological and psychiatric diseases and disorders.

Potential Applications

- Selectively and simultaneously stimulate, silence, and/or record biopotentials from small groups of neurons on either the cortical surface or within the deep brain:
- Diagnose, treat and understand neurological/psychiatric diseases and disorders, including but not limited to: epilepsy, stroke, seizures, paralysis, depression, schizophrenia, Parkinson’s disease, Alzheimer’s disease, etc.
- Would be particularly advantageous in seizure control and suppression

Benefits and Advantages

- Eliminates the need for a permanent opening in the cranium
- Allows direction and selective localized illumination of neural tissues
- The surface-mounted device conforms to uneven or folded surface structures for direct optical stimulation
- Reduces the number of connections
- Can excite isolated small regions of neural tissue
- Requires less power than conventional optogenetic devices
- Could quiet the neurological regions affected by a seizure to prevent spread to a larger portion of the cortex
- Utilizes a tissue-like biocompatible plastic substrate
- The flexible array can conform to the surface structures of the cerebral cortex or form at the crevice that separates the forebrain into the left and right cerebral hemispheres

For more information about the inventor(s) and their research, please see Dr. Blain Christen's departmental webpageDr. Goryll's departmental webpageDr. Muthuswamy's departmental webpageDr. Allee's departmental webpage