Docket #: S07-040

Optical Tissue Interface

Researchers from Prof. Karl Deisseroth's laboratory have developed techniques for specifically modulating the activity of excitable cells in vivo. This approach introduces light-responsive proteins to create photo-sensitive cells. Then fiber optic technology activates these proteins deep within tissues. The general methods can be used to selectively either stimulate or inhibit a variety of cells, including neurons, heart, and muscle cells, even when the target cells are embedded within a community of other cells. Because this invention offers a privileged channel of communication with specific cells, it offers precise control with less side effects on non-targeted cell populations.

Stage of Research:
The inventors have demonstrated this approach by using it to control motor function in the rat. They were able to optically stimulate targeted cells and also recruit downstream neurons in the motor pathway.

Continued Research
The inventors are actively improving the technology and adapting it to new applications.

Related Technologies:
The Deisseroth lab has identified a variety of rhodopsin-like proteins that can be used in neuromodulation. These are described in Stanford Dockets S05-170, S06-398, S08-105 and S08-348. In addition, Stanford Docket S07-203 describes a similar approach using a device that provides multiple sources of cellular control within one device.

Applications

- **Therapeutic** - stimulation or inhibition of specific cells to treat:
    - neurological or neuropsychiatric conditions, including Parkinson's disease, depression, and epilepsy

    - cardiac rhythm management
    - neuromuscular disorders
- **Research** - tools for elucidating function of excitable cells

Advantages

- **Specific** - light used to selectively modulate targeted cells only and not the surrounding milieu, lowering the chance of side effects
- **Temporally precise** - millisecond time scale
- **Minimizes tissue disruption:**
    - separates resistive heat-generating elements from the target tissue
    - once implanted, selective activation or inhibition of the photo-sensitive cells can be achieved non-invasively
- **Low risk of signal attenuation** - compared to existing electrical or magnetic technologies, fiber optic device is less susceptible to signal attenuation due to gliosis
- **Favorable depth penetration from light source**

Publications

- "Optical Deconstruction of Parkinsonian Neural Circuitry." Gradinaru V, Mogri M, Thompson KR, Henderson JM, Deisseroth K. *Science*, 2009.
- "An optical neural interface: in vivo control of rodent motor cortex with integrated fiberoptic and optogenetic technology." Aravanis A, Wang LP, Zhang F, Meltzer L, Mogri M, Schneider MB, Deisseroth K. *J. Neural Eng.* 2007 Sept; 4:S143-S156.
- "Circuit-breakers: optical technologies for probing neural signals and system" Zhang F, Aravanis AM, Adamantidis A, de Lecea L, Deisseroth K. s. *Nat Rev Neurosci.* 2007 Aug;8(8):577-81.
- US Patent Application: 12/185,624

Patents

- Published Application: 20090088680
- Published Application: 20160303396

- Published Application: 20160279267
- Issued: 9,238,150 (USA)
- Issued: 10,046,174 (USA)

Innovators

- Alexander Aravanis
- Karl Deisseroth
- Michael Schneider
- Feng Zhang
- Jaimie Henderson

Licensing Contact

Evan Elder

Senior Licensing Associate

Email