Docket #: S06-398A

Genetically-Targetable Optical Inactivation of Excitable Cells

The inventors have developed a light-driven chloride pump (NpHR or Halo) for temporally precise optical inhibition of neural activity with ordinary yellow light. The inventors have also demonstrated that NpHR can be used to correct aberrant neural activity in the millisecond timescale.

NpHR is compatible with ChR2, an optical excitation technology (see Stanford Docket S05-170), in that the two opposing probes operate at similar light powers but with well-separated action spectra. NpHR and ChR2 can be used simultaneously to create bidirectional optical control of neural activity with blue and yellow light.

Additional optical control of neural circuitry using NpHR is described in Stanford Docket S06-398.

Applications

- **Research:**
  - basic studies for understanding neural circuitry
  - in animal models to identify control points for neurological and psychiatric diseases
- **Drug screening** - for drugs that affect hyperpolarization-activated channels
- **Therapeutic** - optically activated prosthetics for bidirectional control of neurons or neural inhibition as a potential alternative to tissue ablation or surgery

Advantages

- When combined with the engineered ChR2, the NpHR/ChR2 system enables rapid bidirectional control of neurons on the timescale of milliseconds, thus

enabling emulation or alteration of the neural code. These fast genetically based, neural-spike-controlling technologies powerfully augment existing tools for interrogating neural systems.

Publications

- "Multiple-color optical activation, silencing, and desynchronization of neural activity, with single-spike temporal resolution." Han X, Boyden ES., *PLoS ONE.* 2007 Mar 21;2(3):e299.
- "Multimodal fast optical interrogation of neural circuitry" Feng Zhang, Li-Ping Wang, Martin Brauner, Jana F. Liewald, Kenneth Kay, Natalie Watzke, Phillip G. Wood, Ernst Bamberg, Georg Nagel, Alexander Gottschalk & Karl Deisseroth. *Nature* 446, 633-639 (5 April 2007)
- PCT Patent Application: "System for Optical Stimulation of Target Cells" (PCT/2008/050745)

Patents

- Published Application: WO2008086470
- Published Application: 20100145418
- Published Application: 20130295635
- Published Application: 20140309705
- Published Application: 20150259670
- Published Application: 20160194624
- Published Application: 20160331995
- Published Application: 20170348545
- Published Application: 20190105510
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Innovators

- Edward Boyden
- Karl Deisseroth

- Feng Zhang

Licensing Contact

Evan Elder

Senior Licensing Associate

Email