Docket #: S08-105

Redshifted Optogenetic Excitation: A Novel Tool for Fast Neural Control Derived from Volvox carteri

Temporally precise, noninvasive control of neural circuitry is a long-sought goal of neuroscientists and biomedical engineers. Stanford University researchers in the laboratory of Dr. Karl Deisseroth have identified a novel cation-conducting channelrhodopsin (VChR1) from the algae Volvox carteri that can be used to excite a neuronal population using yellow light. This invention will enable remote optical control of the electrical and ionic milieu of neurons and other excitable cells, which might facilitate the modulation of ion channels, signal transduction, neural coding, sensory and motor processing, neuropsychiatric dysfunction and interneuron modulation of circuit dynamics.

In previous work, inventors from this laboratory identified a protein [Channelrhodopsin-2 (ChR2)] that can be activated by blue light. This work is described in Stanford Docket S05-170. VChR1 and ChR2 could be used in combination to control two different populations of neurons.

Ongoing Research
The inventors continue to engineer new technologies to expand their ability to modulate brain activities for therapeutic and research purposes.

Applications

- **Screening** - high-throughput cell-based screening for drugs that affect signal transduction
- **Therapeutic**:
    - neuromodulatory therapeutics for the treatment of neurological disorders
    - drug dosing management in the context of diabetes and pain control

- **Research** - basic studies for understanding neural circuitry, including interactions between two populations

Advantages

- **Fast** - millisecond kinetics enables a thousand-times faster voltage control
- **Optical control** - does not require synthetic chemical substrates
- **Activation with yellow light** - can be combined with ChR2 (activated with blue light) to control two different populations of neurons
- **Specific** - allows genetic targeting so that specific neuron subclasses can be probed

Publications

- PCT Application: PCT/US2009/039949
- Zhang F, Prigge M, Beyrière F, Tsunoda SP, Mattis J, Yizhar O, Hegemann P, Deisseroth K. Red-shifted optogenetic excitation: a tool for fast neural control derived from Volvox carteri. *Nat Neurosci.* 2008 Jun;11(6):631-3. Epub 2008 Apr 23.Click here to read

Patents

- Published Application: WO2009131837
- Published Application: 20110105998
- Published Application: 20130244323
- Published Application: 20140358067
- Published Application: 20150297719
- Published Application: 20170143986
- Published Application: 20180311506
- Published Application: 20190336784

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