Docket #: S21-455

Structure-Guided ChRmine mutants (hs, rs and hs/rs) for red-shifted and high-speed optical activation

Stanford researchers have solved the Cryo-EM structure of a powerful new optogenetic actuator, ChRmine, and have successfully used structure guided design to create three new proteins: rsChRmine, hsChRmine and hs/rs ChRmine, conferring red-shifted, high-speed and a combination speed+ red-shifted performance, respectively.

ChRmine, is a light-gated cation-conducting channelrhodopsin, with desirable properties for optogenetic applications including large photocurrents, red-shifted action spectrum, and extreme light-sensitivity. Optogenetics is a technique where genes for light-sensitive proteins are introduced into target brain cells in order to monitor and control their activity precisely using light signals. The new high speed, red shifted ChRmines created by Stanford researchers marks a notable breakthrough in blue shoulder reduction of channelrhodopsins, a challenge that the field has been contending for over fifteen years. These modified ChRmines have wide and invaluable application as research tools, brain imaging technology as well as non-invasive therapeutics.

Stage of Development
In vivo experiments in mice have demonstrated optogenetic control

Applications

- Optogenetic research tool
- Ocular diseases
- Spinal cord
- Pain management

- Cardiac (tachycardia)

Advantages

- Timescale of vertebrate-neuron membrane time-constants
- Non-invasive light sources like LEDs
- Increased safety for therapeutic use

Publications

- Kishi, K. E., Kim, Y. S., et al. (2022). Structural basis for channel conduction in the pump-like channelrhodopsin ChRmine. . Cell, 185(4), 672-689

Patents

- Published Application: WO2023141625
- Published Application: 20250115656

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