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Technology Offer

f-Chrimson and vf-Chrimson, two ultrafast variants of the red-light activated channelrhodopsin Chrimson

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Background

The development of the cation channel channelrhodopsin-2 (ChR2) from *Chlamydomonas reinhardtii* by Prof. Ernst Bamberg and his colleagues and its application to light-induced modulation of neurons paved the way for the field of optogenetics.

Over time the light-gated cation channel channelrhodopsin-2 (ChR2) has become an indispensable tool in neuroscience. Based on the pioneering work on ChR2 new variants have emerged, differing in their spectrum of light absorption, their kinetic properties and the type of electrochemical response. Nowadays light-sensitive opsins are applied to control neural activity not only in the context of research but also in clinical approaches (including neural networks e.g. of the eye, ear, heart, brain).

Technology

Scientists from the Max-Planck-Institute of Biophysics in Frankfurt report that fast gating can be conferred to ChRs by helix 6 (helix F) mutation and demonstrate the application of fast red-shifted ChRs driving high spiking rates, enabling neural stimulation with very high firing frequencies and the temporal fidelity with low thresholds for stimulus intensity and duration. Efficient virus-mediated delivery and expression of a fast Chrimson mutant, designated f-Chrimson, in spiral ganglion neurons (SGNs) of mice, show that single-channel optical cochlea implants enable near-physiological spike rates and spike timing in SGNs and restore auditory nerve activity in deaf mice.

f- Chrimson is of particular interest to the neurosciences due to its easy application, the red-shifted action spectrum and high membrane expression. The analysis of fast spiking interneurons of the cerebral cortex demonstrated that they enable the remote optical control of even the fastest neurons at their intrinsic physiological limits. Importantly, there was no evidence for neuron loss several months after injection resulting in little to no risk of phototoxicity given the red-shifted action spectrum of f-Chrimson. f-Chrimson is a promising candidate for future clinical optogenetic restoration of sensory functions such as restoration of vision.

Patent Information

Priority application was filed in June 2016 (WO2017207761). Nationalization in EP, US, CN, KR and JP.

Literature

Mager, T., Lopez de la Morena, D., Senn, V. et al. High frequency neural spiking and auditory signaling by ultrafast red-shifted optogenetics. Nat Commun 9, 1750 (2018). https://doi.org/10.1038/s41467-018-04146-3

Max-Planck-Innovation GmbH
Amalienstr. 33
80799 München
www.max-planck-innovation.de

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Contact

Dr. Mareike Göritz
Senior Patent- & License Manager
Chemist
Phone: +49 (0)89 / 29 09 19 - 32
eMail: goeritz@max-planck-innovation.de

Max-Planck-Innovation GmbH
Amalienstr. 33
80799 München
www.max-planck-innovation.de