OPTOGENETICS

Optogenetics and Translational Medicine

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Optogenetic tools enable light-mediated control of cellular excitability and signaling in vivo. By manipulating biological processes, scientists can determine the roles played by these processes in intact biological systems, such as the brain. Such cellular-level control has greatly affected basic science. Here, we discuss how optogenetic tools might be translated into clinical impact through identification of new molecular and circuit-level targets and provide temporally precise interventions for defined biochemical or cellular events.

TOOLS FOR TARGETED CELLULAR CONTROL

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[illegible] *Caenorhabditis elegans* [illegible]

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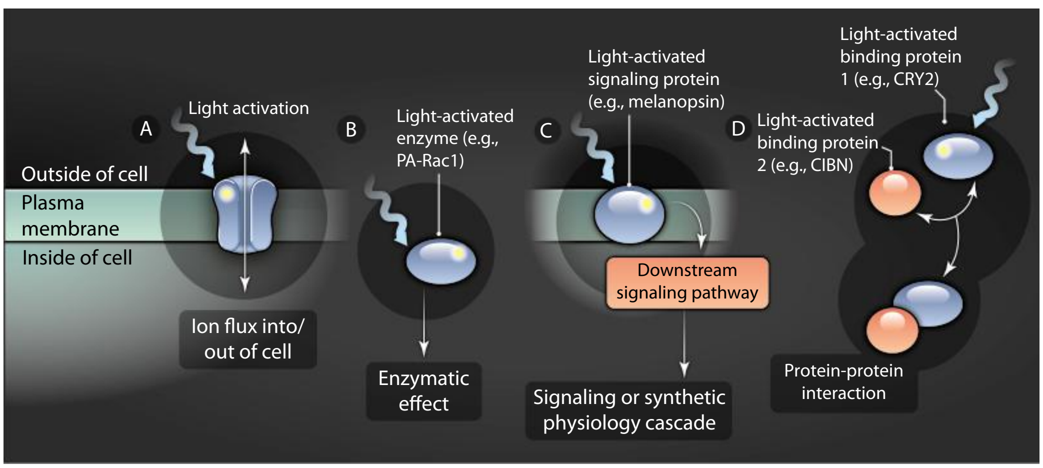

Fig. 1. Optogenetic molecular tools. Yellow dot indicates light-recipient protein domain. (**A**) Microbial opsins are seven-transmembrane proteins that translocate positively or negatively charged ions into or out of cells upon illumination. (**B**) Enzymes can be engineered to be light-gated by appending a light-actuated module to a protein. For example, a fusion between Rac1 and a LOV domain [photoactivatable Rac1 (PA-Rac1)] enables light control of cytoskeletal conformation. (**C**) Light-gated signaling pathways can enable complex physiology to be controlled by light. For example, G_q-coupled melanopsin enables optical control of G protein–signaling pathways. (**D**) Light-driven protein dimerization can bring cofactors in close proximity to one another to drive signaling.

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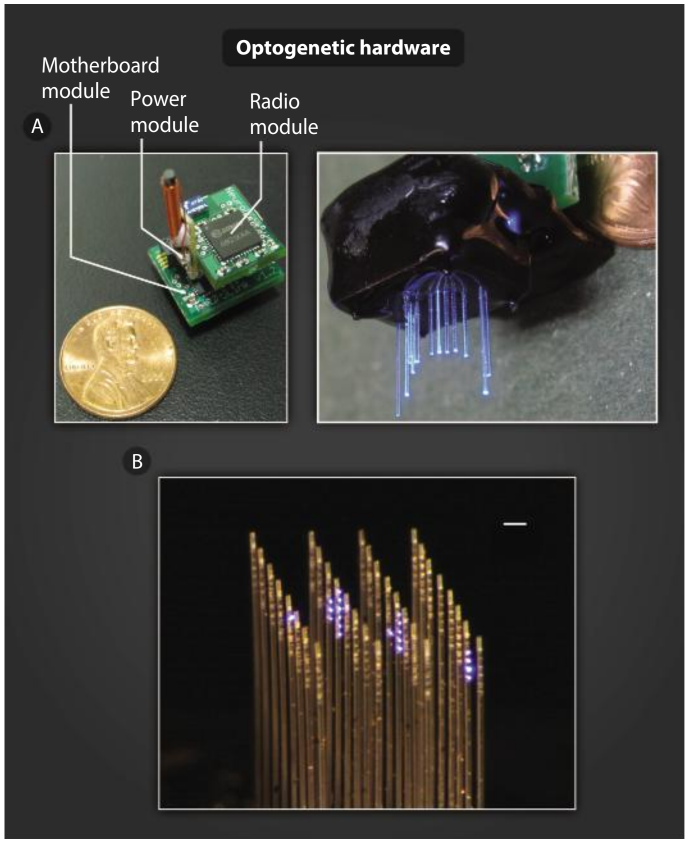
Optogenetic hardware
Motherboard module
Power module
Radio module
A
B

[illegible]

INSPIRING NEW TECHNOLOGIES

[illegible] *28* [illegible]

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