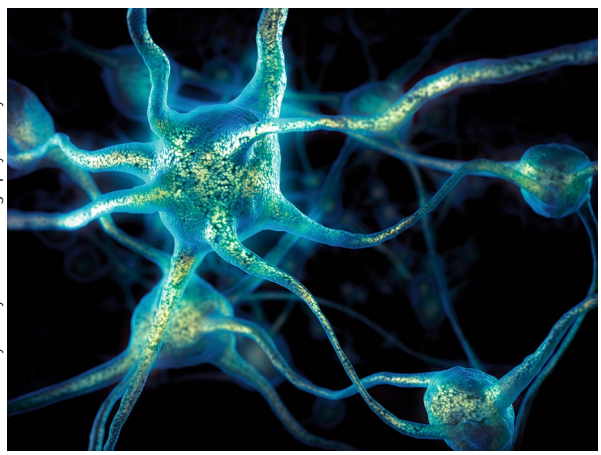
Nature Reviews Physics | https://doi.org/10.1038/s42254-020-0202-8 | Published online 15 June 2020

BIOTECHNOLOGY

Fuzzy graphene for neuron control

Neurons interact via electrical signals known as action potentials, and modulating the electrophysiology of targeted neurons is a key to understanding the brain on a cellular level. Most current methods require genetic modifications to make cells sensitive to light so they can be optically controlled or are imprecise and require high energies that can damage cells. Writing in *PNAS*, Sahil Rastogi and colleagues present a remote, non-genetic method to optically modulate neuronal activity by using nanowires of 'fuzzy graphene' to make precise contact with brain cells.



Credit: Oleksiy Maksymenko Photography / Alamy Stock Photo

Rastogi et al. take advantage of the fact that heating a cell membrane changes its capacitance, which elicits an action potential within the cell. To do this, they attach fuzzy graphene wires — silicon nanowires with out-of-plane graphene flakes — to individual cells. The surface area and density of the graphene flakes on the wires are tuned to increase the absorption of ultraviolet to near-infrared light, which the graphene converts into thermal energy.

The system has several advantages. The wavelengths at which light is absorbed are suitable for in vivo studies, as the light can penetrate deep into tissue without much absorption by water or haemoglobin. The high photothermal efficiency of the fuzzy graphene wires enables cell activity to be modulated using low laser energies to minimize damage. And because the fuzzy graphene adheres to the cell membrane without being absorbed by the cell it is also non-toxic and non-invasive.

Ankita Anirban

ORIGINAL ARTICLE Rastogi, S. K. et al. Remote nongenetic optical modulation of neuronal activity using fuzzy graphene. *Proc. Natl Acad. Sci. USA* https://doi.org/10.1073/pnas.1919921117 (2020)