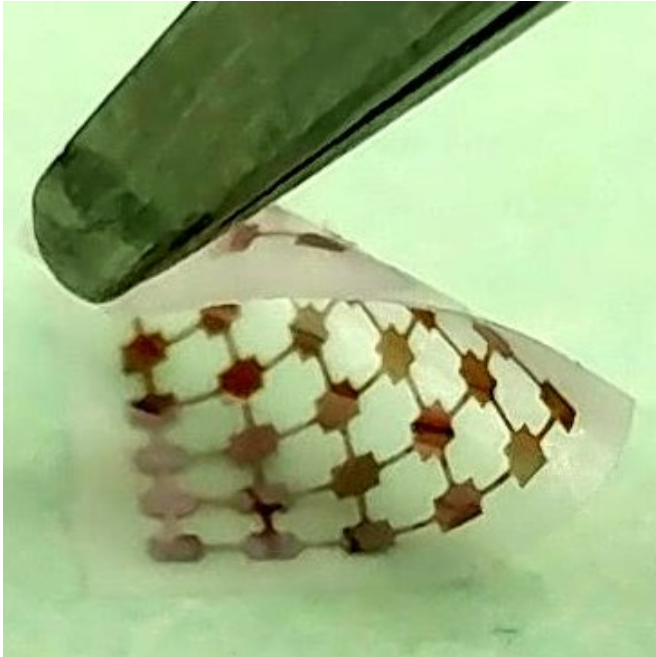


Researchers lay out how to control biology with light—without genetics

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A flexible silicon mesh can adapt to the soft surface of the brain for stimulating neural activity. Credit: Jiang et al/University of Chicago

Over the past five years, University of Chicago chemist Bozhi Tian has been figuring out how to control biology with light.

A longterm science goal is devices to serve as the interface between researcher and body—both as a way to understand how cells talk among each other and within themselves, and eventually, as a treatment for [brain](#) or [nervous system disorders](#) by stimulating nerves to fire or limbs to move. Silicon—a versatile, biocompatible material used in both solar panels and surgical implants—is a natural choice.

In a paper published April 30 in *Nature Biomedical Engineering*, Tian's team laid out a system of [design principles](#) for working with [silicon](#) to control

biology at three levels—from individual organelles inside cells to tissues to entire limbs. The group has demonstrated each in cells or mice models, including the first time anyone has used light to control behavior without [genetic modification](#).

"We want this to serve as a map, where you can decide which problem you would like to study and immediately find the right material and method to address it," said Tian, an assistant professor in the Department of Chemistry.

The scientists' map lays out best methods to craft [silicon devices](#) depending on both the intended task and the scale—ranging from inside a cell to a whole animal.

For example, to affect individual brain cells, silicon can be crafted to respond to light by emitting a tiny ionic current, which encourages neurons to fire. But in order to stimulate limbs, scientists need a system whose signals can travel farther and are stronger—such as a gold-coated silicon material in which light triggers a chemical reaction.

The mechanical properties of the implant are important, too. Say researchers would like to work with a larger piece of the brain, like the cortex, to control motor movement. The brain is a soft, squishy substance, so they'll need a material that's similarly soft and flexible, but can bind tightly against the surface. They'd want thin and lacy silicon, say the design principles.

The team favors this method because it doesn't require genetic modification or a power supply wired in, since the silicon can be fashioned into what are essentially tiny solar panels. (Many other forms of monitoring or interacting with the brain need to have a [power supply](#), and keeping a wire running into a patient is an infection risk.)

They tested the concept in mice and found they could stimulate limb movements by shining light on

brain implants. Previous research tested the concept in neurons.

"We don't have answers to a number of intrinsic questions about biology, such as whether individual mitochondria communicate remotely through bioelectric signals," said Yuanwen Jiang, the first author on the paper, then a graduate student at UChicago and now a postdoctoral researcher at Stanford. "This set of tools could address such questions as well as pointing the way to potential solutions for nervous system disorders."

More information: Yuanwen Jiang et al, Rational design of silicon structures for optically controlled multiscale biointerfaces, *Nature Biomedical Engineering* (2018). DOI: [10.1038/s41551-018-0230-1](https://doi.org/10.1038/s41551-018-0230-1)

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