

Tiny implantable tool for light-sheet imaging of brain activity

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Optical microscope image of the implantable shanks (141 micron pitch) of a light sheet neural probe. Light is emitted by nanophotonic gratings on the shanks to form light sheets. Credit: Sacher et al., doi 10.1117/1.NPh.8.2.025003.

Tools that allow neuroscientists to record and quantify functional activity within the living brain are in great demand. Traditionally, researchers have used techniques such as functional magnetic resonance imaging,

but this method cannot record neural activity with high spatial resolution or in moving subjects. In recent years, a technology called optogenetics has shown considerable success in recording neural activity from animals in real time with single-neuron resolution. Optogenetic tools use light to control neurons and record signals in tissues that are genetically modified to express light-sensitive and fluorescent proteins. However, existing technologies for imaging light signals from the brain have drawbacks in their size, imaging speed, or contrast that limit their applications in experimental neuroscience.

A technology called light-sheet fluorescence imaging shows promise for imaging [brain activity](#) in 3D with high speed and contrast (overcoming multiple limitations of other imaging technologies). In this technique, a thin sheet of laser light is directed through a brain tissue region of interest, and fluorescent activity reporters within the brain tissues respond by emitting fluorescence signals that microscopes can detect. Scanning a light sheet in the tissue enables high-speed, high-contrast, volumetric imaging of the brain activity.

Currently, using light-sheet fluorescence brain imaging with nontransparent organisms (like a mouse) is difficult because of the size of the necessary apparatus. To make experiments with nontransparent animals and, in the future, freely moving animals feasible, researchers will first need to miniaturize many of the components.

A key component for the miniaturization is the light-sheet generator itself, which needs to be inserted into the brain and thus must be as small as possible to avoid displacing too much brain [tissue](#). In a new study reported in *Neurophotonics*, an international team of researchers from the California Institute of Technology (U.S.), University of Toronto (Canada), University Health Network (Canada), the Max Planck Institute of Microstructure Physics (Germany), and Advanced Micro Foundry (Singapore) developed a miniature light-sheet generator, or a photonic

neural probe, that can be implanted into a living animal's brain.

The researchers used nanophotonic technology to create ultrathin silicon-based photonic neural probes that emit multiple addressable thin sheets of light with thicknesses

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