(SD2021-057) Electro-optical mechanically flexible microprobes for minimally invasive interfacing with intrinsic neural circuits

Tech ID: 32505 / UC Case 2021-Z08-1

BACKGROUND

Microelectrodes are the gold standard for measuring the activity of individual neurons at high temporal resolution in any nervous system region and central to defining the role of neural circuits in controlling behavior.

Microelectrode technologies such as the Utah or Michigan arrays, have allowed tracking of distributed neural activity with millisecond precision. However, their large footprint and rigidity lead to tissue damage and inflammation that hamper long-term recordings. State of the art Neuropixel and carbon fiber probes have improved on these previous devices by increasing electrode density and reducing probe dimensions and rigidity.

Although these probes have advanced the field of recordings, next-generation devices should enable targeted stimulation in addition to colocalized electrical recordings. Optogenetic techniques enable high-speed modulation of cellular activity through targeted expression and activation of light-sensitive opsins. However, given the strong light scattering and high absorption properties of neural tissue optogenetic interfacing with deep neural circuits typically requires the implantation of large-diameter rigid fibers, which can make this approach more invasive than its electrical counterpart.

Approaches to integrating optical and electrical modalities have ranged from adding fiber optics to existing Utah arrays to the Optetrode or other integrated electro-optical coaxial structures. These technologies have shown great promise for simultaneous electrical recordings and optical stimulation in vivo. However, the need to reduce the device footprint to minimize immune responses for long-term recordings is still present.

TECHNOLOGY DESCRIPTION

The invention allows for high resolution electrical and optical interfacing with deep intrinsic neural circuits.

Researchers from UC San Diego and the Salk Institute describe a microcoaxial neural probe design that has a low electrical impedance channel in close proximity to a low loss optical channel. The probes can be fabricated as small as 8 μm and lengths up to several millimeters using microfiber optic waveguide cores or

CONTACT

Skip Cynar
scynar@ucsd.edu
tel: 858-822-2672.

OTHER INFORMATION

KEYWORDS

Optogenetic techniques, microelectrode, neural circuit, optical interface

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Medical**
  - Diagnostics
  - Disease: Central Nervous System
  - Research Tools

RELATED CASES

2021-Z08-1

even smaller diameters with nanofiber optic cores. The small size and mechanical flexibility allows the probes to be implanted with minimal immune responses.

This invention works by utilizing a low impedance electrical channel surrounding a small central fiber optic core that can than be directly inserted into neural tissue. The fiber optic cores can be bonded directly to single-mode fibers (SMFs) to create detachable, low-loss optical interfaces that can be directly connected to standard optogenetic hardware. The platform also allows straightforward fabrication routes to high-density arrays for long-term interfacing with minimal disturbance to the surrounding neural tissue.

APPLICATIONS

Neural interfacing, medical diagnostics, diseases treatment, neural research, humanmachine interfaces

STATE OF DEVELOPMENT

Working prototypes.

The in vivo data demonstrate the ability of EO-Flex probes to electrically record and optically modulate neural activity in the intact brain. Inventors have fabricated a novel multi-modal coaxial microprobes and demonstrate their ability to optically stimulate and electrically record from intrinsic neural circuits with minimal interference between the two modalities. The small footprint and high aspect ratio of the EO-Flex probes allow for minimally invasive interfacing with neural circuits. Further size reduction is possible with this coaxial design using smaller fiber optic cores, however, the tradeoff is an increase in optical losses and electrical impedance.

INTELLECTUAL PROPERTY INFO

Patent-pending.

UC San Diego is looking for commercialization partners to leverage this technology into products.

RELATED MATERIALS

▶ Spencer Ward, Conor Riley, Erin M. Carey, Jenny Nguyen, Sadik Esener, Axel Nimmerjahn, Donald J. Sirbuly. Electro-optical mechanically flexible coaxial microprobes for minimally invasive interfacing with intrinsic neural circuits bioRxiv 2020.09.16.300152; - 09/17/2020

University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345