

[Print this Page](#)

Presentation Abstract

Program#/Poster#: 388.12/GG107

Title: Light-proof neural recording electrodes

Location: South Hall A

Presentation Time: Monday, Oct 19, 2009, 10:00 AM -11:00 AM

Authors: ***A. N. ZORZOS**, A. DIETRICH, G. TALEI FRANZESI, B. CHOW, X. HAN, C. G. FONSTAD, E. S. BOYDEN;
MIT, Cambridge, MA

Abstract: In recent years we have developed optogenetic reagents for neuroscience, starting with channelrhodopsin-2 (ChR2) and *N. pharaonis* halorhodopsin (Halo/NpHR), as well as other novel and useful reagents to be described at this conference (Arch, spHalo, and Mac), that enable neural circuits to be activated and silenced with different colors of light. Amongst other reasons for the importance of these technologies, it is now possible to record spiking activity concurrently with optical neuromodulation without the fast artifact that commonly results from electrical stimulation. However, it has been widely reported that metal electrodes undergo a slow artifact under exposure to light while immersed in brain tissue (or saline), resulting in electrical signals in the range of Hz to tens of Hz, thus obscuring the recording of local field potentials or electroencephalography signals. This phenomenon is consistent with a classical photoelectrochemical finding, the Becquerel effect, in which illumination of an electrode placed in saline can produce a significant voltage on the electrode.

Accordingly we set out to devise and test strategies for 1) coating metal electrodes to make them insensitive to light when immersed in the brain, and 2) developing linear microfabricated arrays of light-proof electrodes, for high-density recording of neural spikes and field potentials (in the style of the "Michigan probe"). For both of these strategies, we turned to the transparent conducting material indium tin oxide (ITO). For the coating protocol: dipping 50 μm -diameter nichrome wire in ITO nanoparticles of 20 nm diameter (resuspended to a concentration of 25% in isopropanol) ten times, each time followed by sintering at 500°C for 30 minutes in air, resulted in wires that responded to light with optical artifacts 10x lower than normal nichrome, while retaining an impedance similar to electrodes used for

neural recordings. For the linear arrays: dense linear arrays of electrodes were fabricated from ITO-coated substrates using conventional MEMS-based methods, yielding linear probes with many (e.g., 40) recording sites, while maintaining a thin, tissue damage-minimizing (e.g., $150 \times 150 \mu\text{m}$) cross section. The electrodes have an impedance (measured in saline, at 1 kHz) of 1 megaohm, with no detectable light artifact.

We will test the use of such electrodes to perform artifact-free neural recordings during optical neuromodulation, enabling the systematic analysis of real-time neural dynamics via causal neural control tools. For translational efforts, such devices as described here may be important for optimizing optical neural control for treatment of intractable brain disorders.

Disclosures: **A.N. Zorzos**, None; **A. Dietrich**, None; **G. Talei Franzesi**, None; **B. Chow**, None; **X. Han**, None; **C.G. Fonstad**, None; **E.S. Boyden**, None.

Keyword(s):
multielectrode recording
optogenetic
neuroengineering

Support: A.Z. was supported by an NSF Graduate Fellowship.

E.S.B. acknowledges support from the: NIH Director's New Innovator Award (DP2 OD002002-01) NSF, NSF (0835878 and 0848804), McGovern Institute Neurotechnology Award, Department of Defense, NARSAD, Alfred P. Sloan Foundation, Jerry Burnett Foundation,

SFN Research Award for Innovation in Neuroscience, MIT Media Lab, Benesse Foundation, and Wallace H. Coulter Foundation

[Authors]. [Abstract Title]. Program No. XXX.XX. 2009 Neuroscience Meeting Planner. Chicago, IL: Society for Neuroscience, 2009. Online.

2009 Copyright by the Society for Neuroscience all rights reserved. Permission to republish any abstract or part of any abstract in any form must be obtained in writing by SfN office prior to publication.