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In Vitro FSCV Testing of Carbon Fiber Electrodes to Characterize Functional Operation in Dopamine Detection

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Helen Schwerdt^{1,2}, Ann M Graybiel³, Michael J Cima⁴

¹Department of Bioengineering, University of Pittsburgh;

²Aligning Science Across Parkinson's (ASAP) Collaborative Research Network, Chevy Chase, MD;

³McGovern Institute and Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology;

⁴Koch Institute for Integrative Cancer Research and Department of Materials Science, Massachusetts Institute of Technology



Helen N Schwerdt

University of Pittsburgh

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We use this protocol and it's working

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Abstract

Methods to measure performance characteristics of carbon fiber electrodes for neurochemical recording are described.

Guidelines

An integrated system of hardware and software capable of recording dopamine signals up to 16 channels simultaneously using fast scan cyclic voltammetry (FSCV) was built with off-the-shelf electronics and a PC based data acquisition system. Guidance on constructing this system, including the circuit board layout as well as the MATLAB software for visualizing dopamine recording in real-time can be found on the GitHub Repository (<https://github.com/hschwerdt/multifscv>).

- 1 Each carbon fiber (CF) electrode was tested *in vitro* in a beaker containing 0.9% sodium chloride saline to determine its functional properties (i.e., background current and noise) before soldering to another circuit board.
- 2 *In vitro* testing was performed in a Faraday cage to minimize electromagnetic interference (EMI) during test recording. A custom designed printed circuit board adapter was used to temporarily attach and connect up to 16 electrodes for testing in parallel, in some tests.
- 3 Electrodes were inserted into the beaker and connected to the FSCV headstage for recording current. An Ag/AgCl reference electrode was also inserted in the beaker to serve as a current return and voltage reference.
- 4 Electrodes were determined to be suitable for *in vivo* recording if they met both of the following 2 criteria: (1) current noise < 0.05 nA, and (2) magnitude of background current was in the range of 500 – 800 nA, which corresponds, respectively, to the limit of detection and the sensitivity to dopamine, as established previously.
- 5 In instances in which the magnitude of background current was above 800 nA, a steel razor blade was used to trim the tip of the exposed CF slightly and then the electrode was retested.
- 6 The trimming and test process was repeated until the final background current was in the target range of 500 – 800 nA.
- 7 Electrodes were determined to be nonfunctional and would not be trimmed if they met any of the following 2 criteria: (1) a mechanical break of the electrode along its shaft or etched tip that resulted in a measurement of background current less than 100 nA, or (2) a perforation of the electrode that resulted in current noise $\geq$ 0.05 nA or background current saturation (magnitude of background current at any potential $\geq$ 2000 nA).

Protocol references

Schwerdt, H. N. *et al.* Cellular-scale probes enable stable chronic subsecond monitoring of dopamine neurochemicals in a rodent model. *Commun Biol*, 1–11 (2018).