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

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ABSTRACT

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

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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>).

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Protocol status: Working
We use this protocol and it's working

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- 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).

