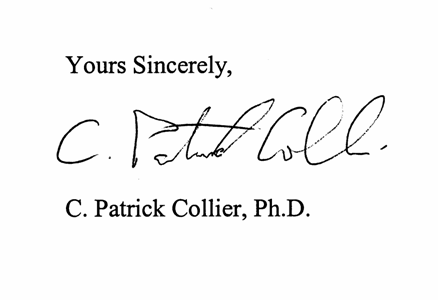
August 27, 2018

We are submitting to Journal of Visualized Experiments a manuscript by J. S. Najem, G. J. Taylor, N. Armendarez, R. J. Weiss, M. S. Hasan G. S. Rose, C. D. Schuman, A. Belianinov, S. A. Sarles, and C. P. Collier, entitled, “*Assembly and characterization of biomolecular memristors consisting of ion channel-doped lipid membranes*.” Here, we describe a protocol to assemble and characterize a biomolecular memristor (memory-resistor) obtained from an insulating lipid bilayer formed between two water droplets in oil. Brain-like neuromorphic computing networks have the potential to perform complex calculations in less time, with less energy, and in a smaller footprint than conventional computing technologies. Early neuromorphic circuits utilized analogue or software-controlled very-large-scale integration models, or hardware based on CMOS technology to perform brain-inspired operations. However, the brain is not a solid-state electronic device but, rather, a highly-interconnected and reconfigurable network of cells that communicate across nm-thick lipid membranes via chemically-selective proteins. As a result, the behaviors of state-of-the-art solid-state memristors are largely phenomenological and are thus intrinsically limited in their ability to emulate biological synaptic functions.

Here, we describe the process of assembling and characterizing biomolecular memristors consisting of a 5nm-thick lipid bilayer formed between lipid-functionalized water droplets in oil and doped with voltage-activated alamethicin peptides. This article focuses on key modifications of the droplet interface bilayer method essential for achieving consistent and optimal memristor performance. Specifically, we describe how to incorporate alamethicin peptides in lipid bilayer membranes, and the impact of each constituent on the overall response of the memristor. We also present protocols for characterizing memristors, including measurement and analysis of memristive current-voltage relationships obtained via cyclic voltammetry, and short-term plasticity and learning in response to step-wise voltage pulse trains.

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