CAN WE MAKE AN AXON FROM SEMICONDUCTOR MEMRISTORS?
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Memristor, a short for memory resistor, is the fourth fundamental circuit element whose instantaneous resistance depends not only on the voltage, but also on the history of the voltage applied to it. This recently discovered titanium dioxide thin film device has characteristics that are analogous to voltage-gated ion channels in biological membranes. In 1952, Alan Hodgkin and Andrew Huxley (HH) introduced an electrical circuit model that described the behavior of a neuron membrane. The electrical circuit consists of a capacitor which is due to phospholipid bilayer, three resistors that represent each ionic channel, and batteries that drive the ionic currents. The purpose of our research was to investigate the characteristics that are shared by both the biological membranes and the memristors. We introduce a minimal Hodgkin-Huxley model for DC applied stimulus in which the leakage channel, membrane capacitance, and potassium equilibrium voltage are absent. We conclude that spiking requires sodium and potassium channels in Hodgkin-Huxley model and, therefore, we predict that two or more distinct memristor species are necessary to mimic the electrical response of a neuron.

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