Mimicking intelligence: Materials and devices for neuromorphic circuits

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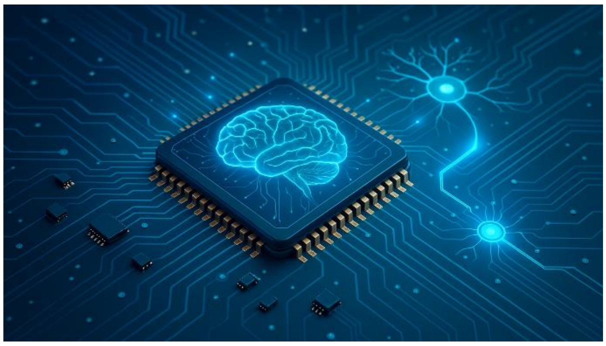
The potentiation and depression of synaptic conductivity regulate the plasticity and adaptability of synapses. In this discussion, we examine the general dynamic characteristics of ionic or electronic current conduction in memristors, which underpin the fundamental principles of synaptic activity. Key model requirements for memristors or chemical inductors to achieve conductance adaptation in response to incoming stimuli are outlined. We also propose various criteria, such as hysteresis and rectification, to achieve these properties. Additionally, we describe a range of diagnostic methods that link nonlinear time responses, the nonlinear cycling of current-voltage curves, and the linear frequency responses from impedance spectroscopy to evaluate adaptation properties.[1,2] The frequency domain analysis of memristors and more generally, of conducting systems with memory features of some kind, provides essential information about the dynamic behaviour of the system. The impedance response of a memristor can be represented as a linear circuit made of resistances, capacitors, and inductors, with voltage-dependent elements. The equivalent circuit properties also establish the criteria for a Hopf bifurcation that produces spiking of artificial neurons. [3]



Reference

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