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Artificial Neurons Based on Memristors for Spiking Neural Networks

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Abstract : Neuromorphic computing based on spiking neural networks (SNNs) has emerged as a promising avenue for building the next generation of intelligent computing systems. Owing to its high-density integration, low power, and outstanding nonlinearity, memristors have attracted emerging attention on achieving SNNs. However, fabricating a low-power and robust memristor-based spiking neuron without extra electrical components is still a challenge for brain-inspired systems. In this work, we demonstrate a TiO_2-based threshold switching (TS) memristor to emulate a leaky integrate-and-fire (LIF) neuron without auxiliary circuits, used to realize single layer fully connected (FC) SNNs. Moreover, our TiO_2-based resistive switching (RS) memristors realize spiking-time-dependent-plasticity (STDP), originating from the Ag diffusion-based filamentary mechanism. This work demonstrates that TiO2-based memristors may provide an efficient method to construct hardware neuromorphic computing systems.

Keywords : leaky integrate-and-fire, memristor, spiking neural networks, spiking-time-dependent-plasticity
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