Nanoscale Memristor Device As Synapse In Neuromorphic Systems

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A memristor is a two-terminal electronic device whose conductance can be precisely modulated by charge or flux through it. Here we experimentally demonstrate a nanoscale silicon-based memristor device and show that a hybrid system composed of complementary metal□oxide semiconductor neurons and memristor synapses can support important synaptic functions such as spike timing dependent plasticity.

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Nanoscale Memristor Device as Synapse in Neuromorphic Systems Sung Hyun Jo, Ting Chang, Idongesit Ebong, Bhavitavya B. Bhadviya, Pinaki Mazumder, and Wei Lu* Department of Electrical Engineering and Computer Science, University of Michigan, Michigan 48109

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~~[PDF] Nanoscale memristor device as synapse in ...~~
The memristor device consists of a bottom tungsten nanowire electrode, a sputtered silicon layer (2~4 nm), a PECVD (plasma enhanced chemical vapor deposition) deposited amorphous silicon (a-Si) layer (2.5-4.5 nm), a co-sputtered silver and silicon layer (20-30 nm thick) and a top chrome/platinum nanowire electrode as schematically illustrated in Figure 1a in the main text.

~~Supporting Information Nanoscale Memristor Device as ...~~
In 2010, Lu et. al utilized Ag/Si memristors incorporated into crossbar synapse networks with CMOS based pre and post synaptic neurons to effectively demonstrate that changes in both pulse height and width from CMOS neurons caused corresponding changes in memductance of memristor synapse. This proved the memristor neuromorphic circuit exhibited behavior analogous to spike timing dependant plasticity, a process which governs strength of interconnects between neurons and vital to learning and ...

~~Review of nanoscale memristor devices as synapses in ...~~
In this paper we first describe how nanoscale synaptic devices can be integrated into neuro-computing architectures to build large-scale neural networks, and then propose a new hybrid memristor-CMOS neuromorphic circuit that emulates the behavior of real synapses, including their temporal dynamics aspects, for exploring and understanding the principles of neural computation and eventually building brain-inspired computing systems.

~~Integration of nanoscale memristor synapses in ...~~
pubs.acs.org/NanoLett ABSTRACT A memristor is a two-terminal electronic device whose conductance can be precisely modulated by charge or flux through it. Here we experimentally demonstrate a nanoscale silicon-based memristor device and show that a hybrid system composed of complementary metal-oxide semiconductor neurons and memristor synapses can support important synaptic functions such as spike timing dependent plasticity.

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Memristor bridge synapse circuits have been widely used to control weights in ANNs [34]; however, such bridge structures are based on at least four memristors, which has a negative effect on the circuit integration and their energy-saving ability.

~~Memristive-synapse spiking neural networks based on single ...~~
The recent advancement in memristor has provided a promising opportunity to advance the electronic synapse design, which is attributed to the unique properties of memristor including analog behavior, plasticity, non-volatile, nanoscale size, and low power 6,7,8,9,10. This has sparked a new wave of enthusiasm in developing brain-inspired computer and neuromorphic systems.

~~Investigation and Manipulation of Different Analog ...~~
Request PDF | Synapse design based on memristor | the memristor is a passive two-terminal electrical device where its conductance is accurately modulated either by the charge or the flux flowing ...

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In recent years, researchers have demonstrated the feasibility of various nanoscale electronic devices that emulate representative neuronal and synaptic functions, such as synaptic modifications, excitatory/inhibitory postsynaptic currents and memory consolidation3,4,5,6,7,8,9,10,11,12,13,14,15,16.

~~Ultrafast Synaptic Events in a Chalcogenide Memristor~~
Moreover, the device was used as a threshold neuron along with drift memristor synapse based on TaO x to emulate STDP learning rule. Because the conductance of the device gradually increases according to applied voltage and then abruptly decreases under no applied voltage, the device can be used as a threshold neuron.