Synaptic Devices and Neuron Circuits for Neuron-Inspired NanoElectronics (NINE)

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Abstract In order to achieve the efficiency of biological neural system, we have developed the building blocks (synaptic devices and neuron circuits) of spiking neural networks (SNNs). As synaptic devices, silicon-based floating-body synaptic transistors and nitride-based resistive memories are proposed and fabricated. These devices show very low energy consumption (a few pJ per synaptic event) and multi-level (gradual) operation. As neuron circuits, a few integrate-and-fire (I&F) circuits are developed. One of them generates both excitatory and inhibitory postsynaptic potential through dual current mirrors and the spike currents are integrated by a capacitor. Another uses a floating-body MOSFET for current integration. Both of them implement spike-timing-dependent plasticity (STDP) using a feedback signal with asymmetry in time.