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Indium-Gallium-Zinc Oxide Photosynaptic Device with Alkylated Graphene Oxide for Optoelectronic Spike Processing

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Abstract : Recently, neuromorphic computing based on brain-inspired artificial neural networks (ANNs) has attracted huge amount of research interests due to the technological abilities to facilitate massively parallel, low-energy consuming, and event-driven computing. In particular, research on artificial synapse that imitate biological synapses responsible for human information processing and memory is in the spotlight. Here, we demonstrate a photosynaptic device, wherein a synaptic weight is governed by a mixed spike consisting of voltage and light spikes. Compared to the device operated only by the voltage spike, ΔG in the proposed photosynaptic device significantly increased from -2.32nS to 5.95nS with no degradation of nonlinearity (NL) (potentiation/depression values were changed from 4.24/8 to 5/8). Furthermore, the Modified National Institute of Standards and Technology (MNIST) digit pattern recognition rates improved from 36% and 49% to 50% and 62% in ANNs consisting of the synaptic devices with 20 and 100 weight states, respectively. We expect that the photosynaptic device technology processed by optoelectronic spike will play an important role in implementing the neuromorphic computing systems in the future.

Keywords : optoelectronic synapse, IGZO (Indium-Gallium-Zinc Oxide) photosynaptic device, optoelectronic spiking process, neuromorphic computing
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