TEMPORAL INFORMATION PROCESSING FOR IN-SENSOR COMPUTING BASED ON AMORPHOUS IGZO PHOTOTRANSISTOR

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On facing the massive and unstructured data processing, it is imperative to emulate artificial neural networks with new physical hardware architectures in addition to software-based approaches, to overcome the barrier of the von Neumann bottleneck. By mimicking the human visual sensing system, the optoelectronic devices, which can perform data compression and reduce the network size through the reconstruction of input signals, are promising to develop the neuromorphic in-sensor computing for minimizing the time latency as well as improving the energy efficiency. In this work, we demonstrate an amorphous indium-gallium-zinc-oxide (a-IGZO) phototransistor with ZrO_x high-k dielectric layer with distinct responses to various optical stimulation inputs. Due to the persistent photoconductivity (PPC) effect of a-IGZO after lighting, our device is able to exhibit synaptic functions via the application of 405 nm light spikes, such as paired-pulse facilitation (PPF) and short-term memory (STM). Furthermore, in order to perform the temporal optical signals processing, the a-IGZO phototransistor is stimulated by four-timeframe temporal pulse streams composed of 405 nm light spikes and it expresses the different temporal responses. The distinct output photocurrent response reveals that the a-IGZO phototransistor can be applied to distinguish the time-series input light signals. Accordingly, the a-IGZO phototransistor have a promising potential for processing optical temporal information and can possibly be implemented for visual in-sensor computing techniques.

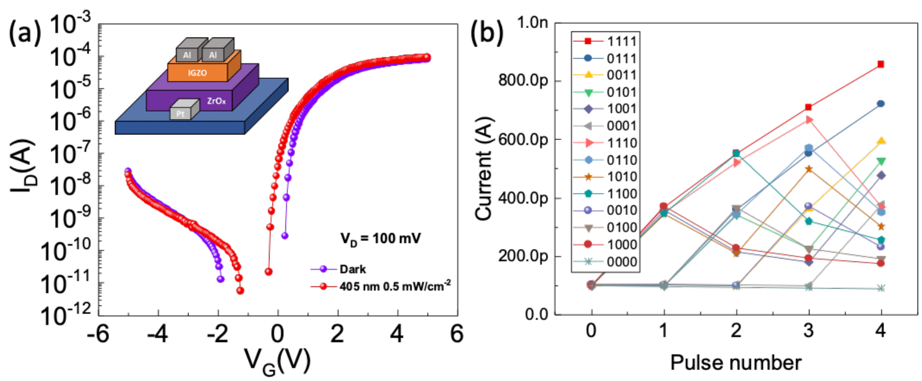

Figure 1 – (a) I_D-V_G transfer characteristics of a-IGZO phototransistor measured in the dark or under light illumination at wavelength of 405 nm. The inset is the schematic illustration of the a-IGZO phototransistor. (b) Photocurrent response of phototransistor by the distinct temporal optical input signals.