Light-Triggered Memory Device with high photoresponsivity based on a Graphene – 2D Perovskite Heterostructure

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Recently, light-triggered memory devices (also known as photo-memristors) are attracting growing interest due to their ability to store optically programmed information and read it out via electrical current. In contrast to electrically driven three-terminal field-effect transistors, light-triggered memory devices leverage the high speed of optical signal transfer and non-contact programming. Particularly, their capability to store multibit or analog signals based on incident light intensity makes them promising candidates for hardware-based neuromorphic computing.

Here, we present a graphene-based light-triggered memory devices that integrates CVD-grown graphene with a spin-coated 2D perovskite thin film in a functional heterostructure within an interdigital contact geometry. Upon optical excitation, electrons are trapped in the 2D perovskite quantum well-like electronic structure, while holes are transferred to the graphene conducting layer, increasing the channel conductivity. An internal gain mechanism of the graphene – 2D perovskite heterostructure increases the photoconducting response of the device, leading to remarkable current increase in the range of tens of μA after short optical pulses of low light intensity. The increase in conductivity scales with the amount of incident light, enabling detection of multiple light pulses. Our device offers highly stable storage of optical signals with exceptionally high responsivities.

Figures

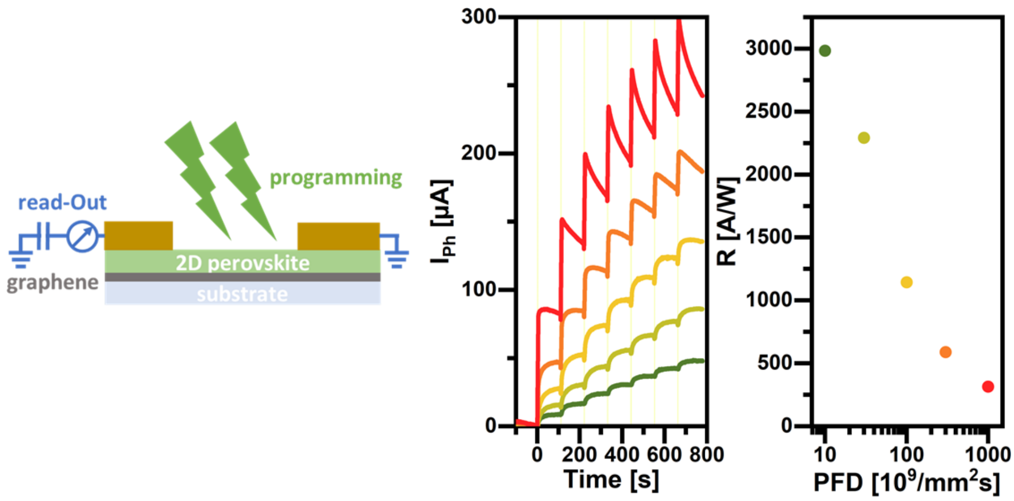

Figure 1: Concept of the graphene-based light-triggered memory device (left), increase in photocurrent with multiple light pulses (middle), and responsivity at different photon flux densities (right).