Pulse-driven Non-volatile Perovskite Memory with Photovoltaic Read-out Characteristics

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Abstract

A $GdFe_{0.8}Ni_{0.2}O_3$ (GFNO)/$SrTiO_3$ (STO) perovskite device is demonstrated as a pulse-controlled non-volatile memory free from an electrical-stressing read-out process. With pulse voltage the GFNO presented permanent downward/upward polarized states that featured a greater energy density and a higher energy efficiency than the un-poled state. The two polarized states led to opposite carrier migrations across the GFNO/STO interface, resulting in the adjustment of device's depletion region which was reflected by the photovoltaic short circuit current density (Jsc). We further demonstrated that modulating the duration and direction of continuous pulse voltage was an effective method for controlling the Jsc, and thereby achieving non-destructive, light-tunable non-volatile memory performances at which the Jsc of downward polarized state was approximately 6 times larger than that of the upward one. The real-time interface changes, in relation to the device's non-volatile characteristics, were obtained by simultaneously performing synchrotron x-ray techniques and pulse characterizations upon the devices. This allowed us to separately probe the electronic/chemical states of the GFNO (a p-type semiconductor) and STO (an n-type semiconductor) while varying pulse direction, thus better identifying the causes of observed phenomena.

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Keywords –Perovskite oxide, Pulse voltage