Non-Volatile Reconfigurable p–n Junction Utilizing Intercoupled Ferroelectricity in 2D WSe2/a-In2Se3 Asymmetric Heterostructures

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The demand for decreasing dimensions of electronic devices has been growing since the invention of the first computer. The benefits of miniaturization are power consumption/heating reduction, operation speed, cost and portability. Two-dimensional (2D) materials have been drawing utterly strong attention since their discovery in 2004 by Andrey Geim and Konstantin Novolselov. The utilization objective stems from their outstanding properties such as one-atom thickness, electrostatic tunability, impurity-free structures, dangling bonds-free interfaces, ultimately high Young's modulus, immense thermal- and electroconductivity. Room-temperature stable ferroelectricity down to the monolayer thickness makes In2Se3 a perfect candidate for a novel low write-power, non-volatile memory, and cutting-edge electro-optical devices. Moreover, the intercoupling between in-plane (IP) and out-of-plane (OOP) polarization and the optical ferroelectric polarization switching introduces additional leverages for device manipulation.
In the present research, we realized 2D optoelectronic devices based on 2D a-In2Se3 combined with ambipolar WSe2. We demonstrate re-configurable p-n junction operation using electrostatic doping. In addition, we characterize the photoresponse and the photovoltaic effects, showing stable short-circuit current direction switching. Finally, the ferroelectric nature of In2Se3 enables the memorization of multibit electronic states, paving the way toward novel optical in-memory operation.

References

[1] M. Uzhansky, S. Mukherjee, G. Vijayan, E. Koren, Non-Volatile Reconfigurable p–n Junction Utilizing In-Plane Ferroelectricity in 2D WSe2/a-In2Se3 Asymmetric Heterostructures. Adv.Funct.Mater, 2306682. (2023)