

Gate Tunable and Multi-Functional Black Phosphorous and p-InGaAs Hetero-Structure Device

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Recently, the study about hetero-structure devices consisting of various semiconductor materials from two-dimensional (2D) to bulk semiconductor materials has been attracted great attentions due to their unique functionalities over tradition semiconductor devices. Especially, the remarkable characteristics of 2D materials such as sharp interface, flexibility and anisotropic property accelerated researches about hetero-structure of 2D and 2D or other semiconductor materials. In this report, we demonstrate gate tunable hetero-structure device made of Black phosphorus and p-InGaAs. The forward current of device is vigorously controlled by gate voltage. As a result, the device shows both switching and rectifying behaviors which are carried out by tradition diode and transistor, respectively. Moreover, we demonstrate generation of electrical signal by two factors, electrical gate voltage and optical laser source using photoresponse and gate tunable properties of device. This work presents further understanding of 2D/compound semiconductor hetero-structure device and technological platform for multi-functional device and advanced logic circuit.