# Supporting Information

## Interface-Engineered CVD Graphene/$WS_2$ Heterostructures for Transforming Transient Photodetection into Optoelectronic Synaptic Plasticity

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## 1. The calculation formulas of the photoresponsivity (*R*), external quantum efficiency (*EQE*), and specific detectivity (*D**)

$$R = \frac{I_{ph}}{PA} \tag{1}$$

$$EQE = \frac{Rhc}{e\lambda} \tag{2}$$

$$D^* = \frac{EQE \cdot \lambda e}{hc}\left(\frac{4kT}{R_0 A} + 2e^2 \cdot EQE \cdot \Phi_b\right)^{-1/2} \tag{3}$$

Where $I_{ph}$ is the photocurrent, $P$ is the incident light power density, $A$ is the active area upon illumination, $h$ is the Planck constant, $c$ is the speed of light in vacuum, $e$ is the elementary charge, $\lambda$ is the wavelength of the incident light, $k$ is the Boltzmann constant, $T$ is the photodetector temperature, $R_0$ is the resistance at zero bias, and $\Phi_b$ is the background flux density.

## 2. The UV−vis absorption spectrum of $WS_2$

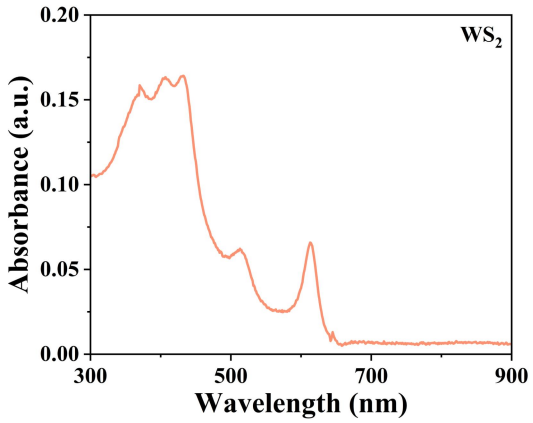



**Figure S1.** The UV−vis absorption spectrum of $WS_2$.

## 3. The photoresponse of pure graphene

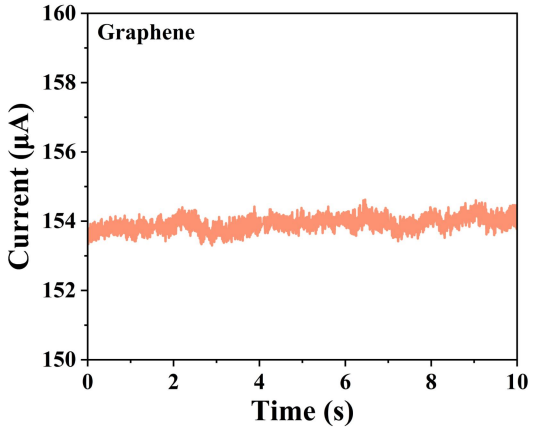



**Figure S2.** The photoresponse of pure graphene.

## 4. The electric properties of the graphene/$WS_2$ heterojunction FETs

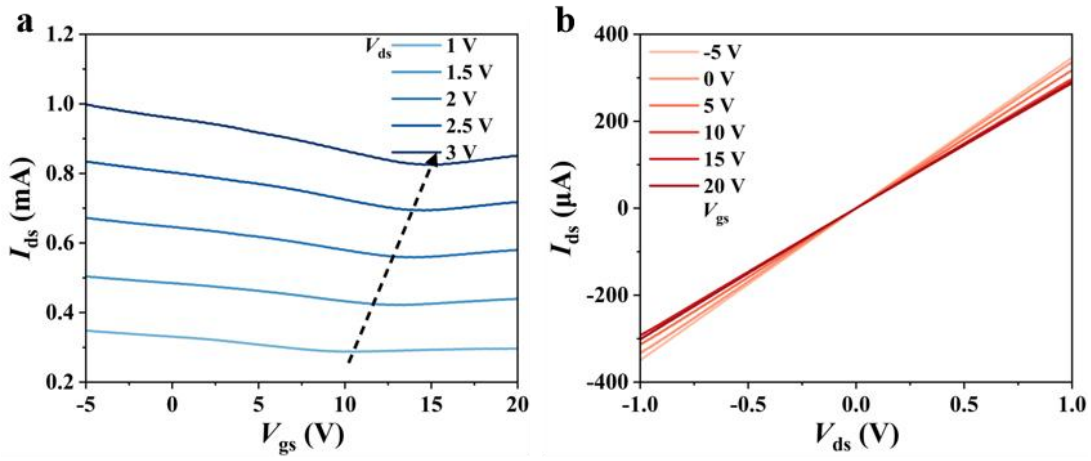



**Figure S3.** The electric properties of the graphene/$WS_2$ heterojunction FETs.

## 5. The energy band diagrams of the graphene/$WS_2$ heterojunction FETs

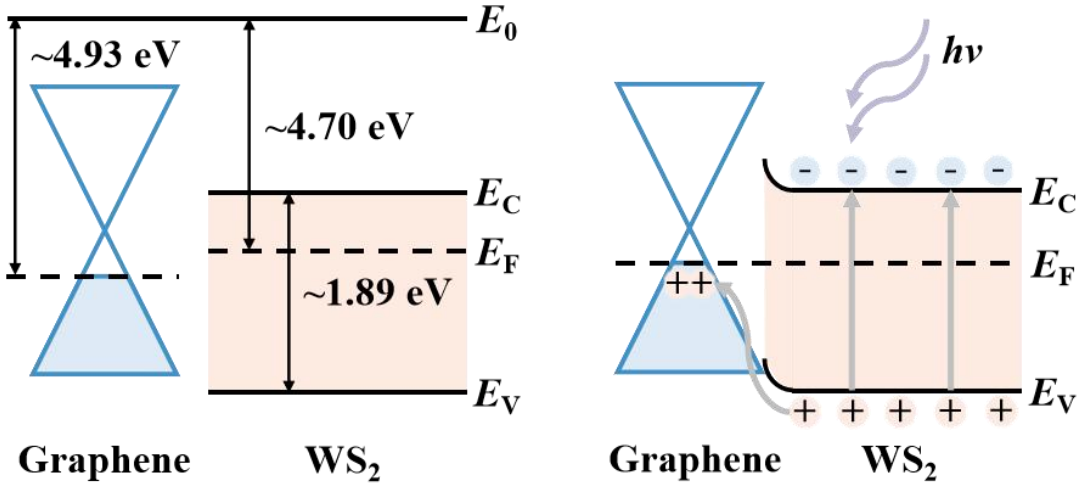



**Figure S4.** The energy band diagrams of the graphene/$WS_2$ heterojunction FETs.