# Facile Liquid-Phase Exfoliated 2D GeP nanosheets for UV-Vis photodetector

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**Table S1.** The light powder density ($P_\lambda$) of the incident light with various irradiation wavelengths. The gradually increased $P_\lambda$ were labelled with **I**, **II**, **III**, **IV**, and **VI** levels, respectively.

| $P_\lambda$ (mW/cm$^2$) | I level | II level | III level | IV level | VI level |
|---|---|---|---|---|---|
| **Simulated light (SL)** | 26.2 | 53.0 | 83.1 | 118 | 122 |
| **350 nm** | 0.61 | 1.52 | 2.52 | 3.26 | 3.41 |
| **365 nm** | 0.76 | 1.66 | 2.55 | 3.57 | 3.69 |
| **380 nm** | 0.32 | 1.02 | 1.91 | 2.68 | 2.77 |
| **400 nm** | 0.64 | 2.04 | 3.57 | 5.22 | 5.35 |
| **475 nm** | 1.91 | 4.33 | 7.01 | 10.1 | 10.6 |
| **550 nm** | 2.04 | 3.95 | 5.98 | 8.28 | 8.40 |
| **650 nm** | 2.04 | 4.08 | 6.02 | 8.54 | 8.92 |

**Table S2.** Typical parameters of 2D GeP nanosheets-based photodetector at 0.6 V applied bias potential and under 0.5 M KOH electrolyte.

| Wavelength (nm) | Light intensity ($P_\lambda$, mW·cm$^{-2}$) | Responsivity ($R_{ph}$, µA·W$^{-1}$) | Detectivity (D*, Jones) | EQE (%) |
|---|---|---|---|---|
| | 26.2 | 12.2 | $1.84 \times 10^5$ | - |
| | 53.0 | 10.0 | $1.51 \times 10^5$ | - |
| SL | 83.1 | 7.7 | $1.16 \times 10^5$ | - |
| | 118 | 6.1 | $9.20 \times 10^4$ | - |
| | 122 | 6.3 | $9.50 \times 10^4$ | - |
| 350 | 0.61 | 82.0 | $7.89 \times 10^{11}$ | 29.1 |
| 365 | 0.76 | 92.1 | $1.00 \times 10^{12}$ | 31.3 |
| 380 | 0.32 | 187.5 | $2.14 \times 10^{12}$ | 61.3 |
| 400 | 0.64 | 93.8 | $1.11 \times 10^{12}$ | 29.2 |
| 475 | 1.91 | 31.4 | $3.68 \times 10^{11}$ | 8.2 |
| 550 | 2.04 | 9.8 | $1.21 \times 10^{11}$ | 2.2 |
| 650 | 2.04 | 8.3 | $1.04 \times 10^{11}$ | 1.6 |

**Table S3.** Comparison of the characteristic parameters of the 2D GeP nanosheets-based photodetector with other reported photodetectors.

| Materials | Device configuration | Measure conditions | Responsivity ($\mu A$ $W^{-1}$) | Detectivity (Jones) | Response time ($\tau_r/\tau_f$) | Ref. |
|---|---|---|---|---|---|---|
| 2D GeP | PEC | 0.5 M KOH, 0.6 V, SL | 9.54 | $1.84 \times 10^5$ | ~ 0.1/1 s | This work |
| 2D GeP | PEC | 0.5 M KOH, 0.6 V, 380 nm | 187.5 | $2.14 \times 10^{12}$ | ~ 0.1/1 s | This work |
| BP | PEC | 0.1 M KOH, 0 V | 1.9−2.2 | - | 0.5/1.1 s | 1 |
| InSe | PEC | 0.2 M KOH, 1 V | 3.3 | - | 5 s | 2 |
| Te | PEC | 0.1 M KOH, 0.6 V | 1.0−1.3 | - | 70 ms | 3 |
| Bi | PEC | 1 M KOH, 0.5 V | 1.8 | - | 2/3 s | 4 |
| BP | Photodiode | FET, Vds = 0.3 V, Vg = 0 V | $4.8 \times 10^3$ | - | 1 ms | 5 |
| GO | Photodiode | FET, Vds = 1 V | $2.36 \times 10^4$ | $3.31 \times 10^7$ | 100/105 ms | 6 |
| GQDs | Photoconductor | 5 V, 254 nm | $2.1 \times 10^3$ | $9.59 \times 10^{11}$ | 64/43 ms | 7 |
| ZnO nanocrystals | Photoconductor | 120 V, 370 nm | $6.1 \times 10^6$ | - | <0.1/1 s | 8 |
| $TiO_2$ | Photoconductor | -5 V | $2.1 \times 10^7$ | $1.71 \times 10^{12}$ | 33.4/ >60 s | 9 |
| $TiO_2$ NTs | Photoconductor | 0.5 V, 312 nm | $1.3 \times 10^7$ | - | 0.5/ 0.7 s | 10 |
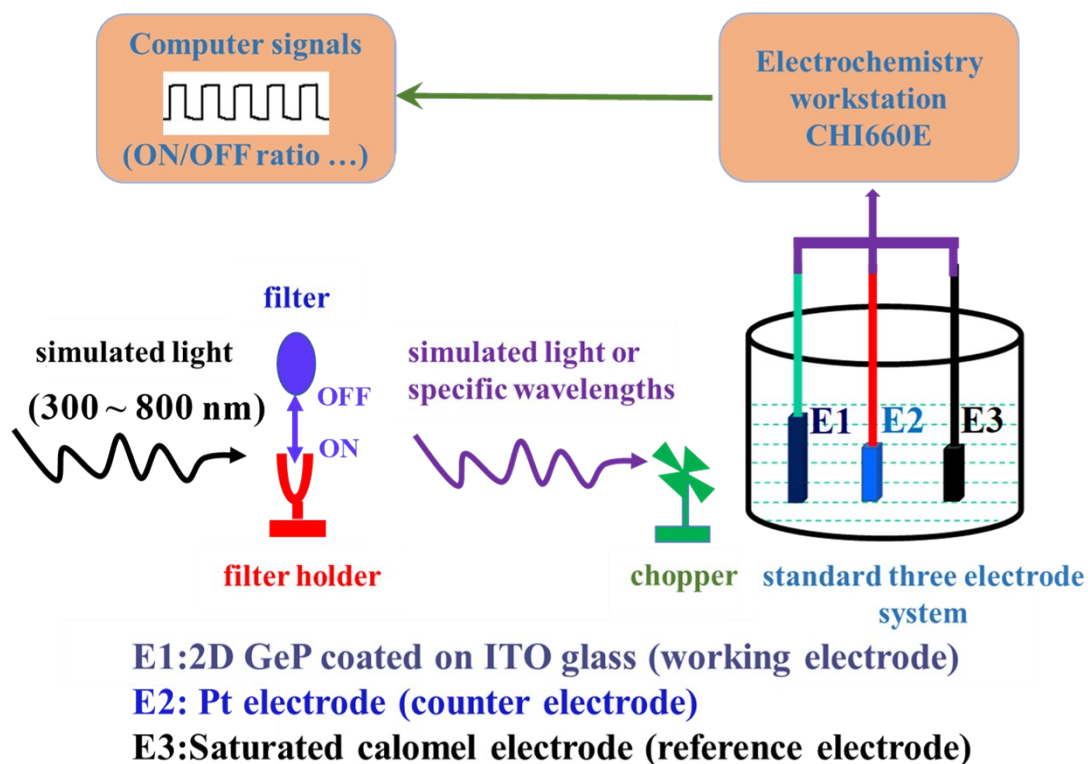
**Scheme S1.** A typical PEC system built for evaluating the photoresponse behavior of the 2D GeP-based photodetectors in different electrolytes.
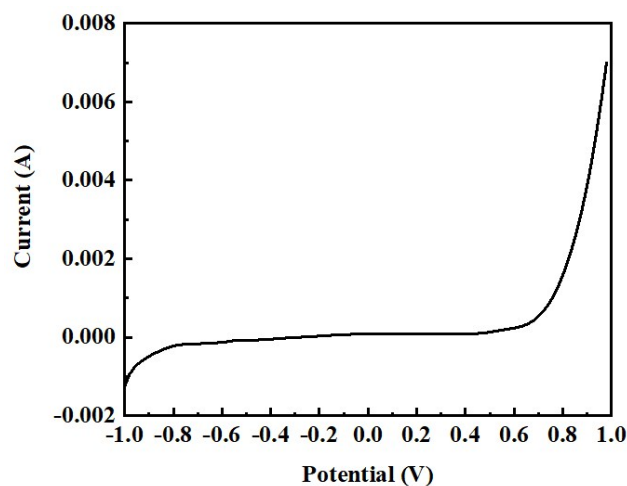


**Figure S1.** Linear sweep voltammetry curves of 2D GeP nanosheets-based photodetectors in 0.5 M KOH.
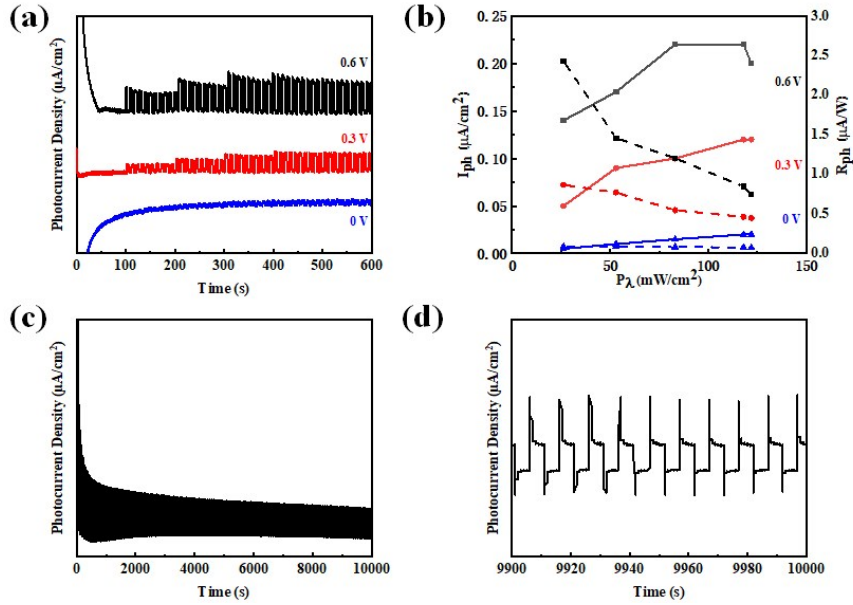
**Figure S2.** Typical photo-response behavior of the 2D GeP nanosheets-based photodetector in 0.5 M KCl under SL and irradiation with various wavelengths. (a) ON/OFF switching behavior triggered by SL with three selected applied potentials 0, 0.3 and 0.6 V; (b) Calculated photocurrent density (solid lines) and responsivity (dash lines) from (a); (c) Stability of photo-response behaviours of 2D GeP nanosheets-based photodetector with 10000 s cycles with 0.5 M KCl and at voltages of 0.6 V; (d) Enlarged last 100 s cycles of (c).
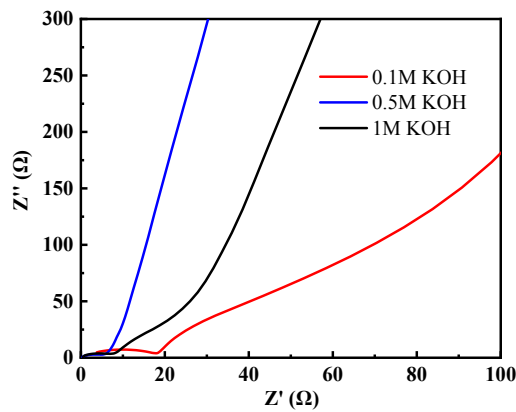


**Figure S3.** The impedance spectroscopic plots of 2D GeP nanosheets in different KOH electrolyte concentrations (0.1 M, 0.5 M, 1 M).
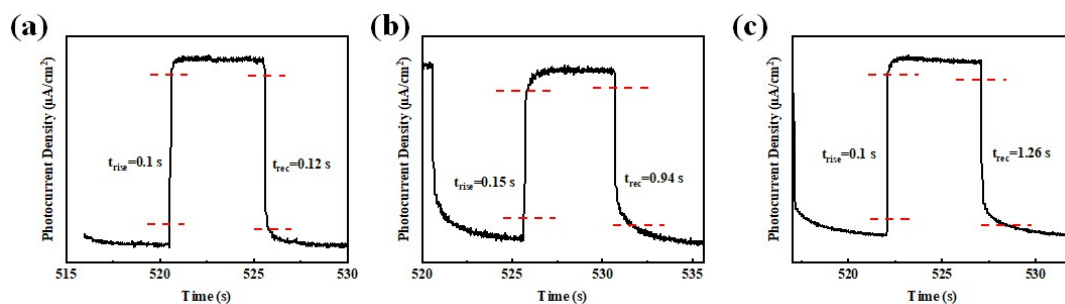
**Figure S4.** The photocurrent density versus time for the response ($t_{res}$) and recovery ($t_{rec}$) times of 2D GeP nanosheets in different KOH electrolyte concentrations (a) 0.1 M, (b) 0.5 M and (c) 1 M.

## Notes and references:

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