Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Photoelectrical properties of Graphene/ doped GeSn vertical heterostructures

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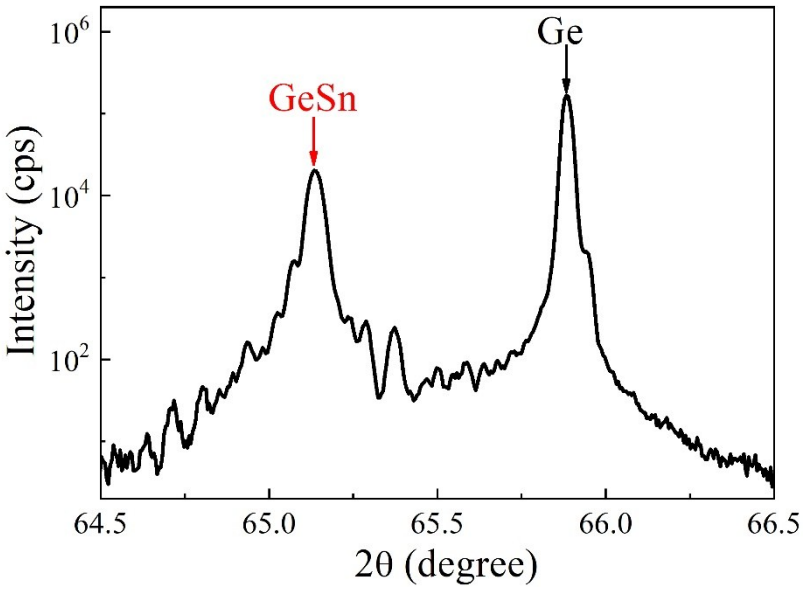

Figure S1. ω-2θ scan of a 160 nm GeSn film grown on Ge substrate with (004) orientation.

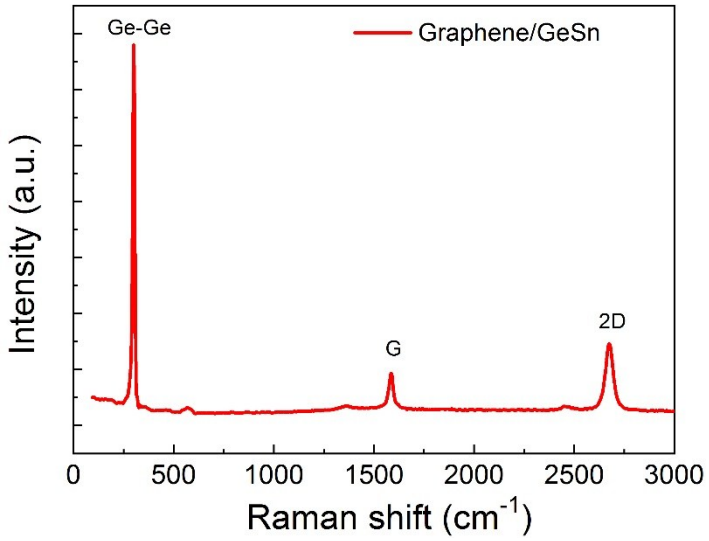

Figure S2. Typical Raman spectra of graphene transferred onto GeSn.

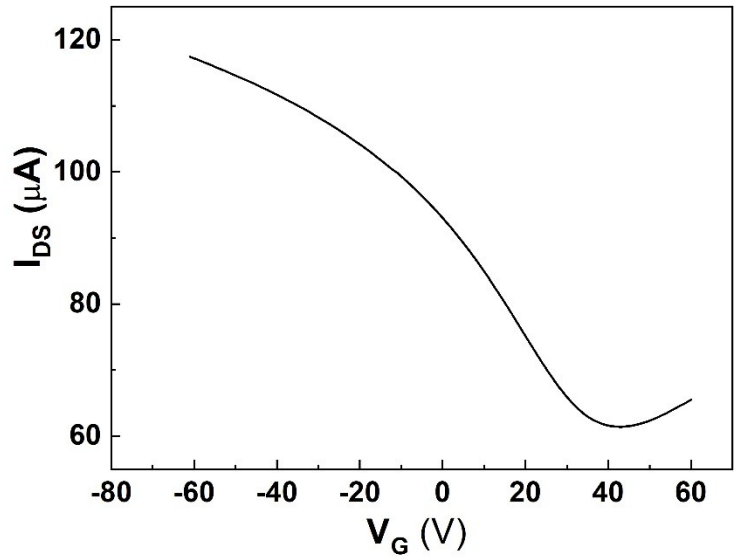

Figure S3. Transfer characteristic curve of graphene transferred onto Si substrate with 300 nm thick SiO_2, indicating that as grown graphene after transfer is in p-type. The bias voltage is 25 mV.

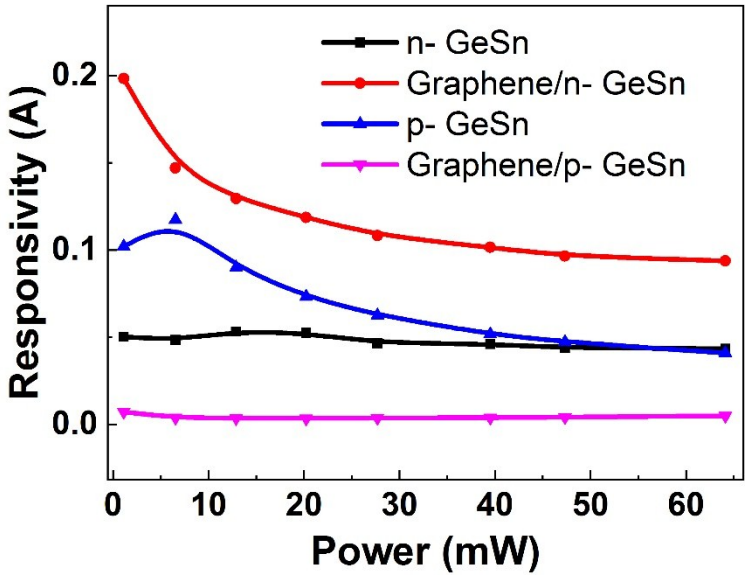

Figure S4. Responsivity as a function of incident power.

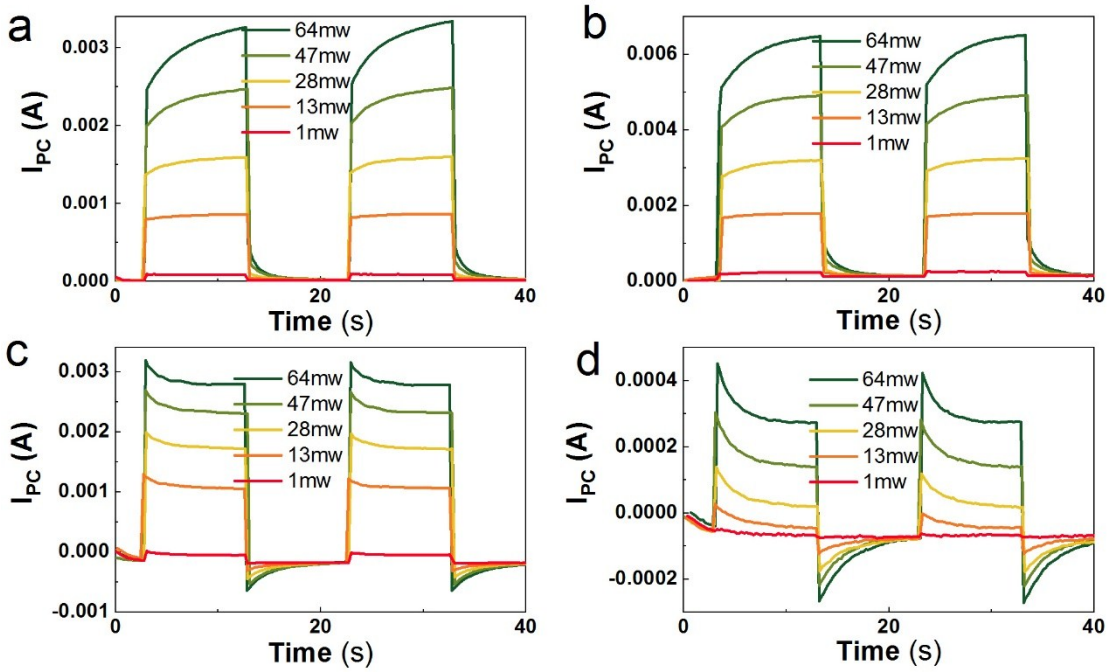

Figure S5. Time response of (a) n-type GeSn, (b) graphene/ n-type GeSn heterostructure, (c) p-type GeSn, and (d) graphene/ p-type GeSn heterostructure under different power density for the 1064 nm laser.

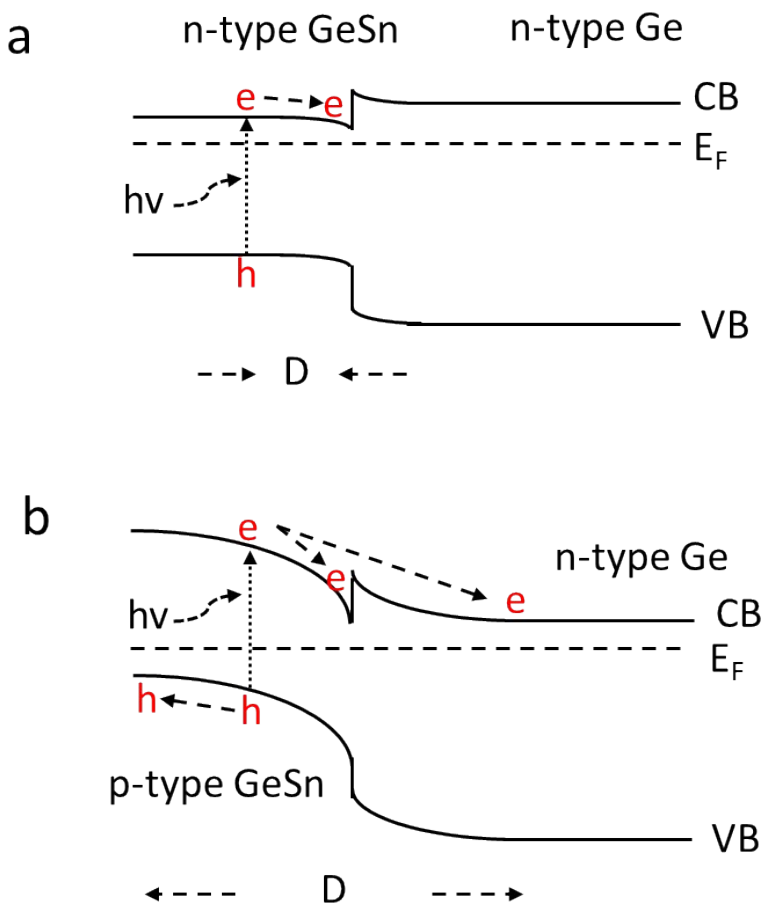

Figure S6. Schematic band profiles for (a) n-type GeSn/n-type Ge heterostructures and (b) p-type GeSn/n- type Ge heterostructures.

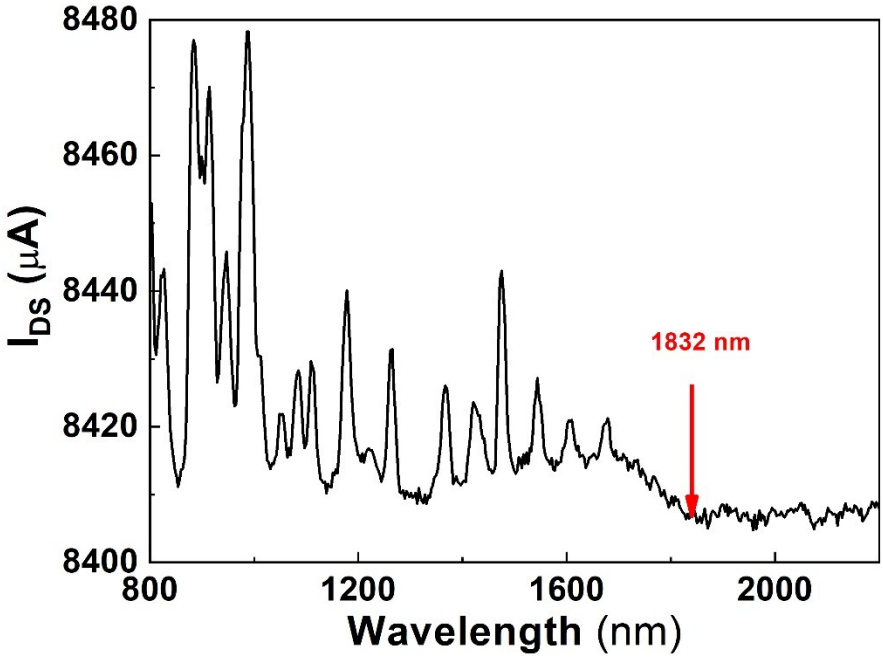

Figure S7. I_{DS} of graphene/n-type GeSn heterostructures measured using Omni-λ300i monochromator with a Zolix 150 W Xenon light source.

Graphene/n-type GeSn for 785 nm laser.

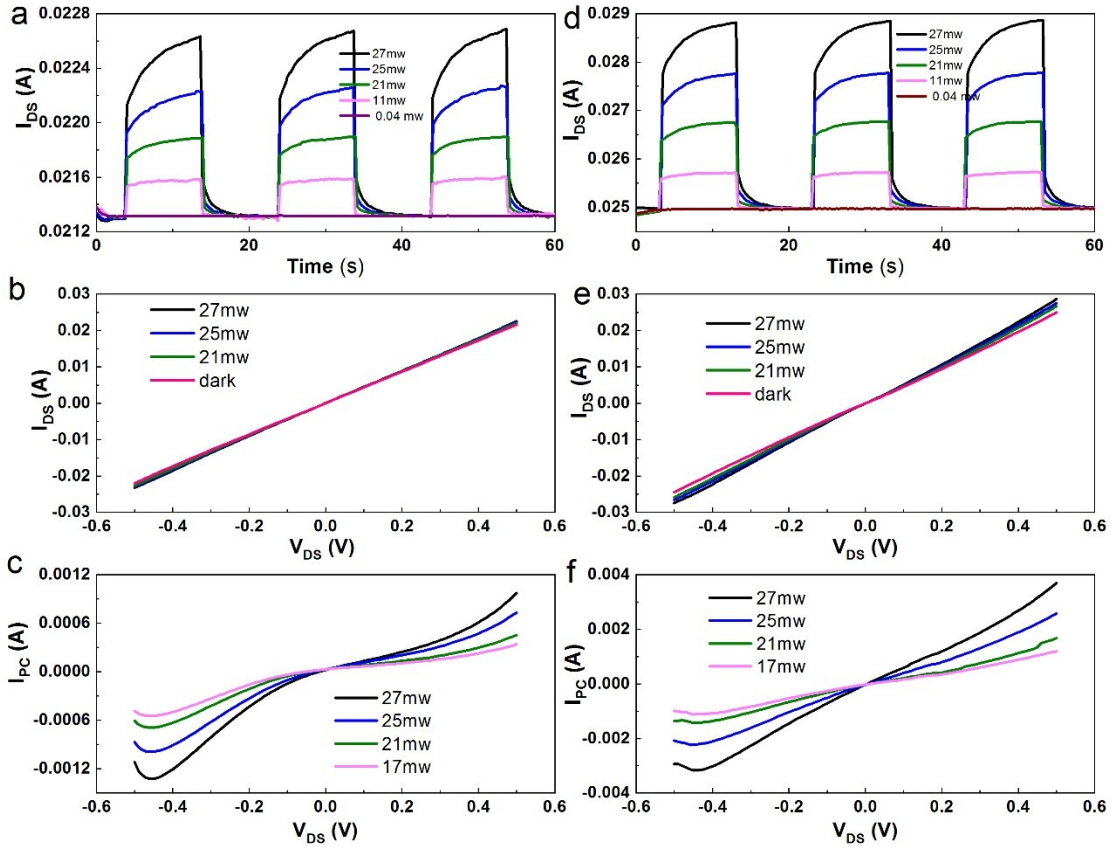

Figure S8. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of n-type GeSn under different power densities for 785 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/n-type GeSn under different power densities for the 785 nm laser.

Graphene/p-type GeSn for 785 nm laser.

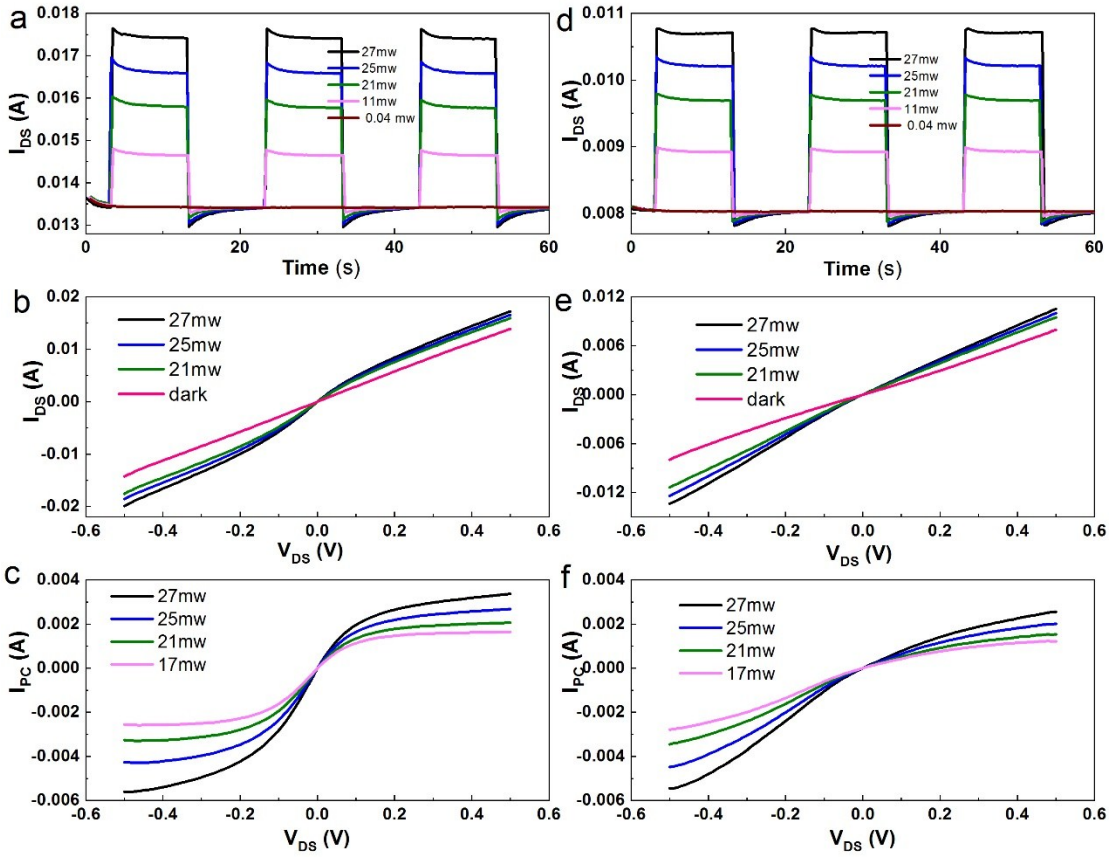

Figure S9. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of p-type GeSn under different power densities for 785 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/p-type GeSn under different power densities for the 785 nm laser.

Graphene/n-type GeSn for 635 nm laser.

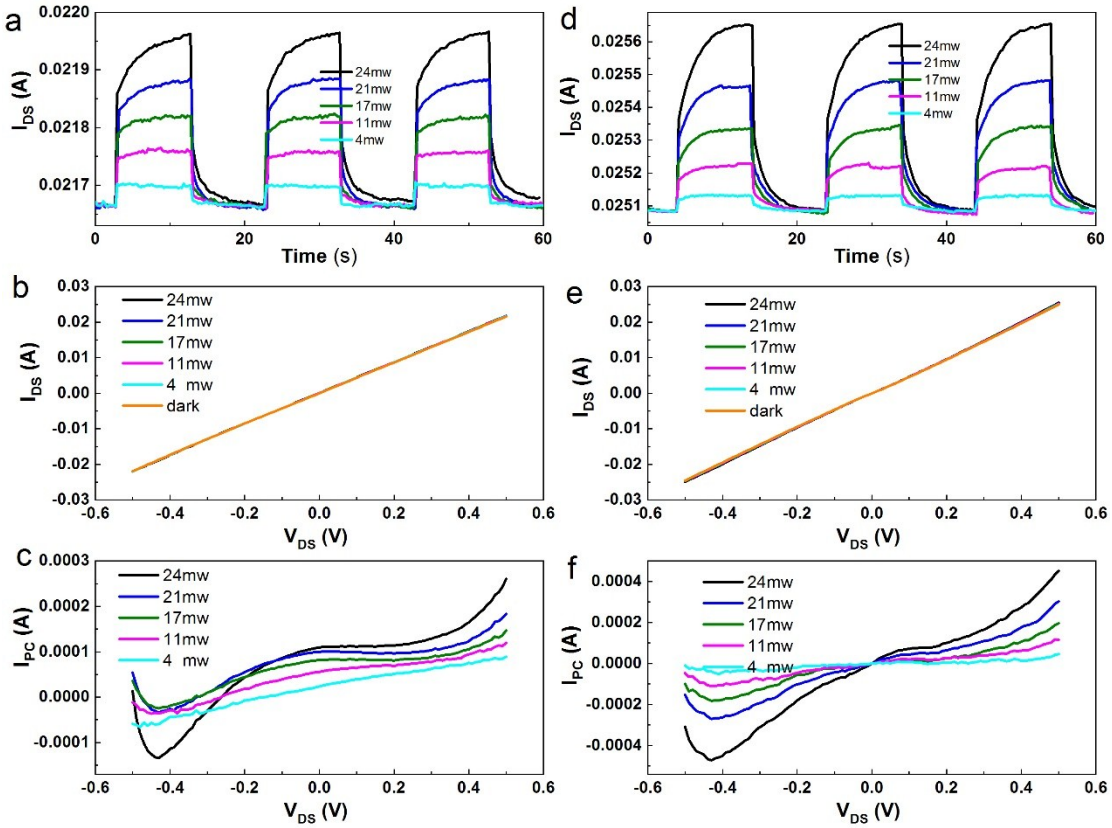

Figure S10. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of n-type GeSn under different power densities for 635 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/n-type GeSn under different power densities for the 635 nm laser.

Graphene/p-type GeSn for 635 nm laser.

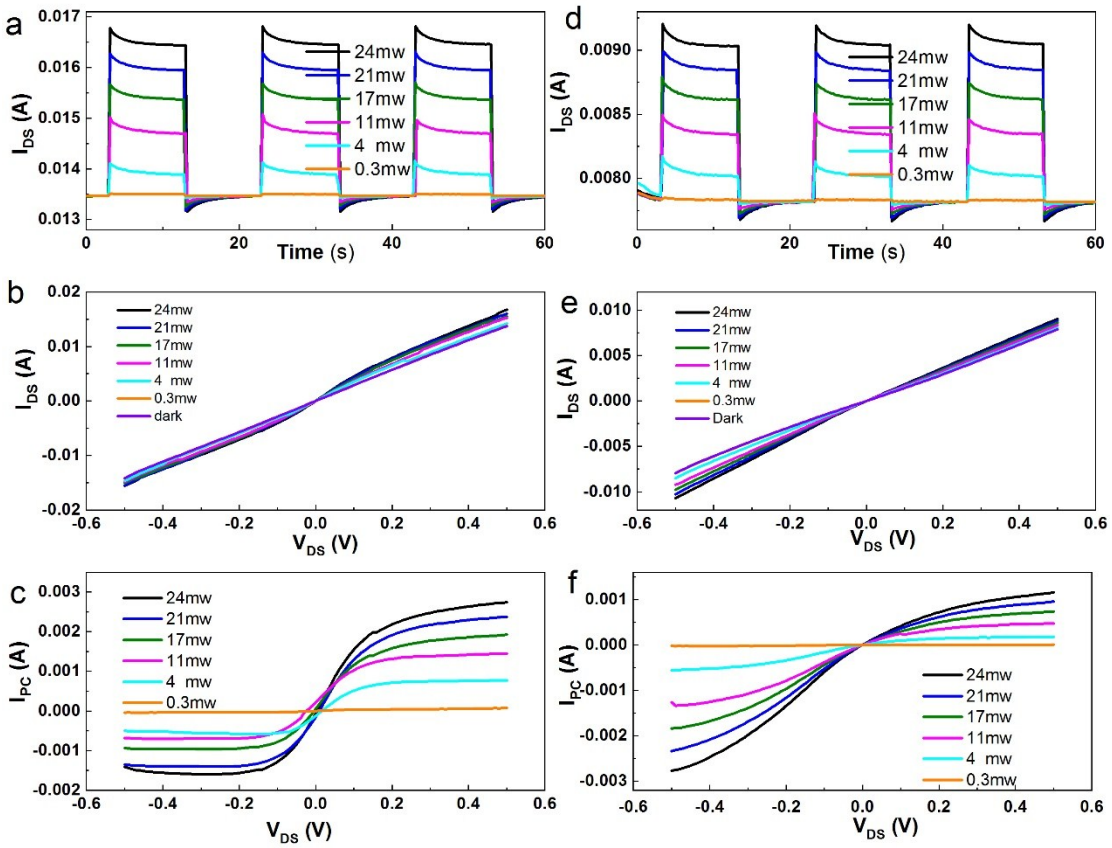

Figure S11. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of p-type GeSn under different power densities for 635 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/p-type GeSn under different power densities for the 635 nm laser.

Graphene/n-type GeSn for 532 nm laser.

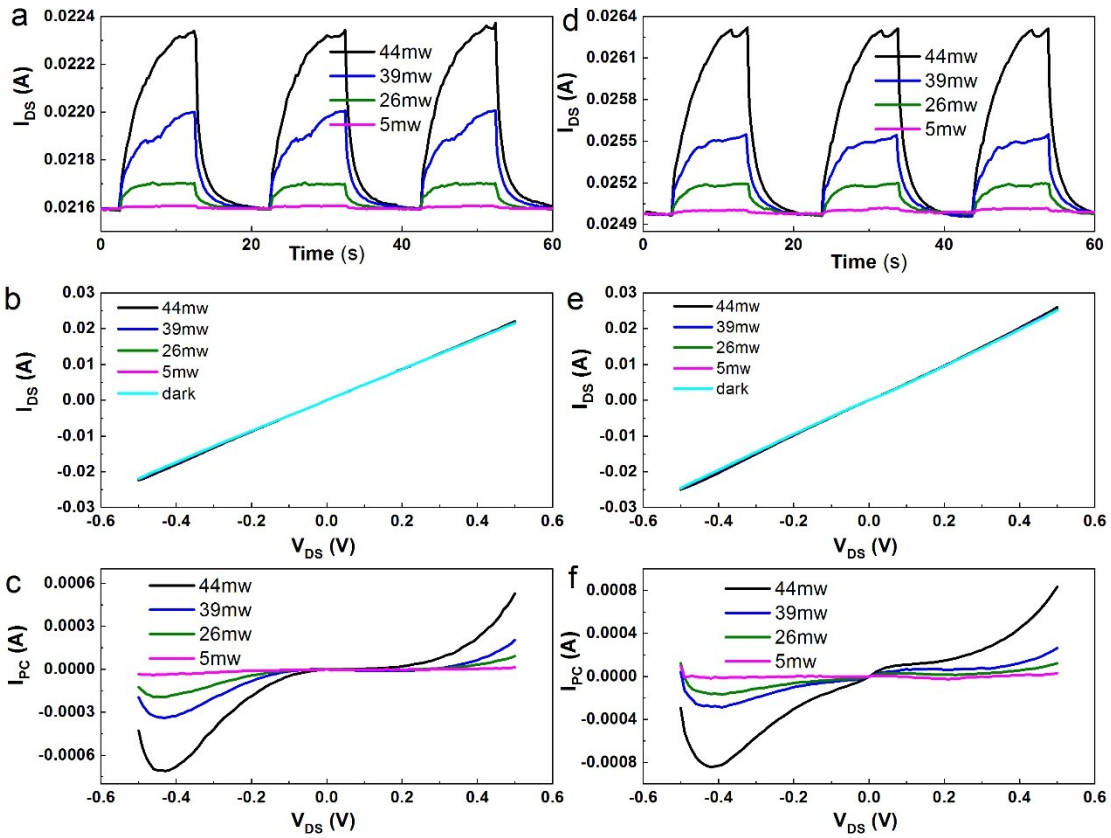

Figure S12. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of n-type GeSn under different power densities for 532 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/n-type GeSn under different power densities for the 532 nm laser.

Graphene/p-type GeSn for 532 nm laser.

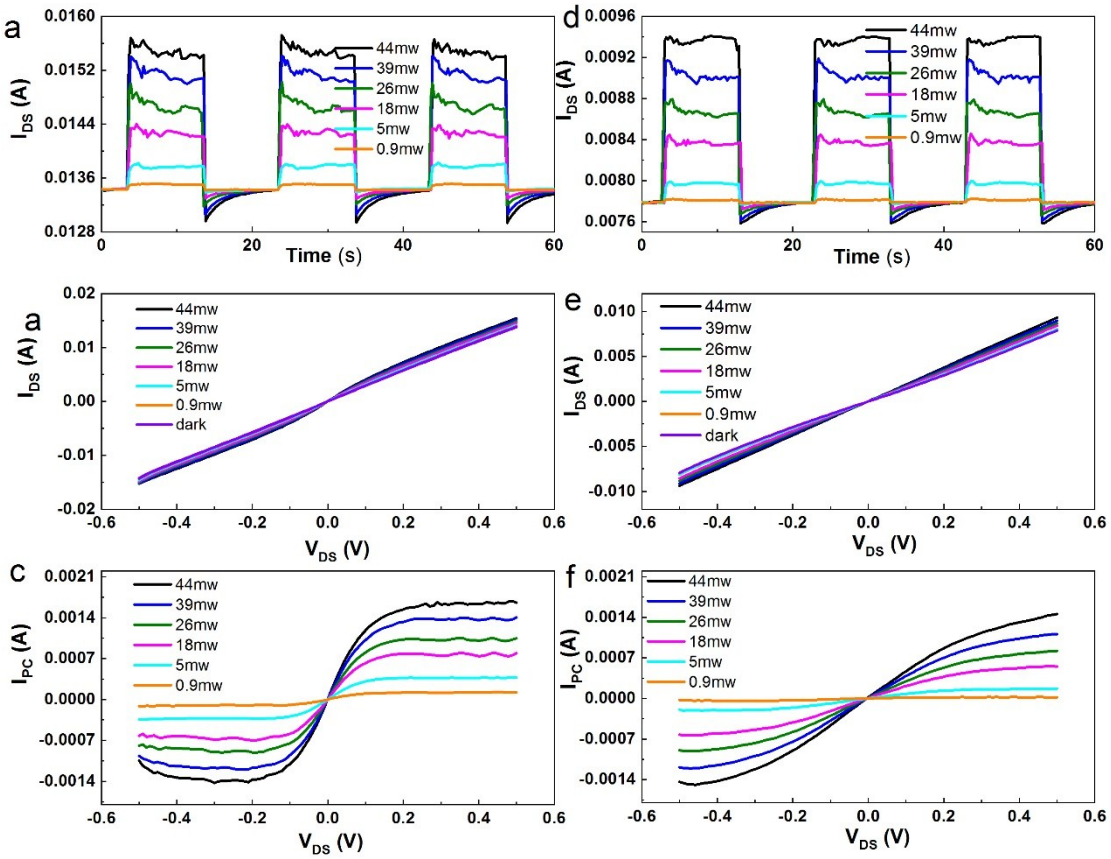

Figure S13. (a-c) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of p-type GeSn under different power densities for 532 nm laser. (d-f) I_{DS}-t characteristics, I_{DS}-V_{DS} characteristics, and I_{PC}-V_{DS} characteristics of Graphene/p-type GeSn under different power densities for the 532 nm laser.