

Supplementary Information

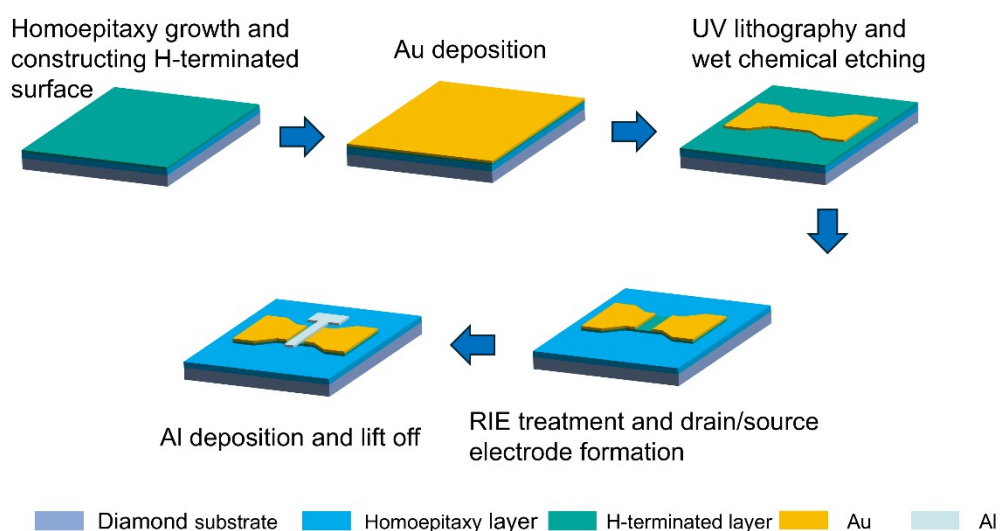


Fig. S1: Schematic diagram of the H-terminated diamond phototransistor fabrication.

Table S1: Homoepitaxy growth parameters of diamond

Input power	H ₂ gas flow	CH ₄ gas flow	Pressure	Temperature	Duration
3.8 kW	400 sccm	12 sccm	13 kPa	950 °C	2 h

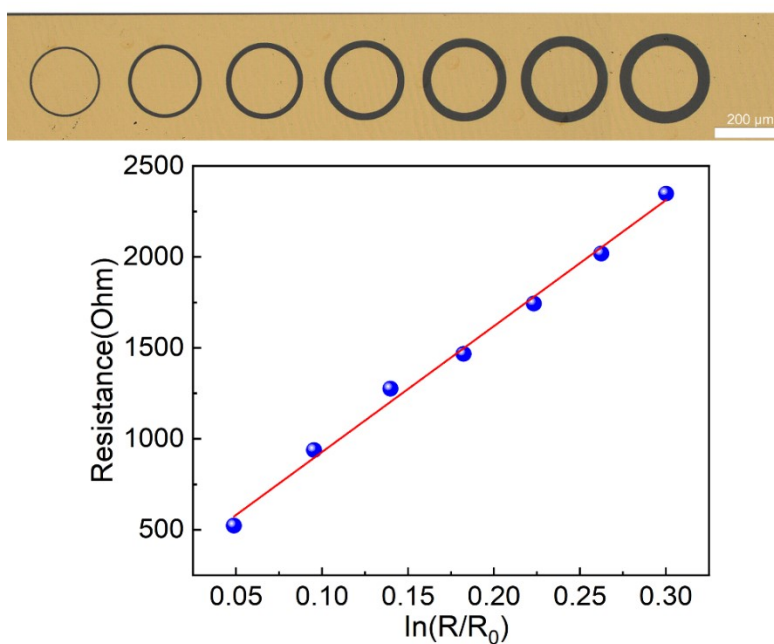


Fig. S2: Optical image of circular-type TLM pattern and the results of the linear fitting resistance.

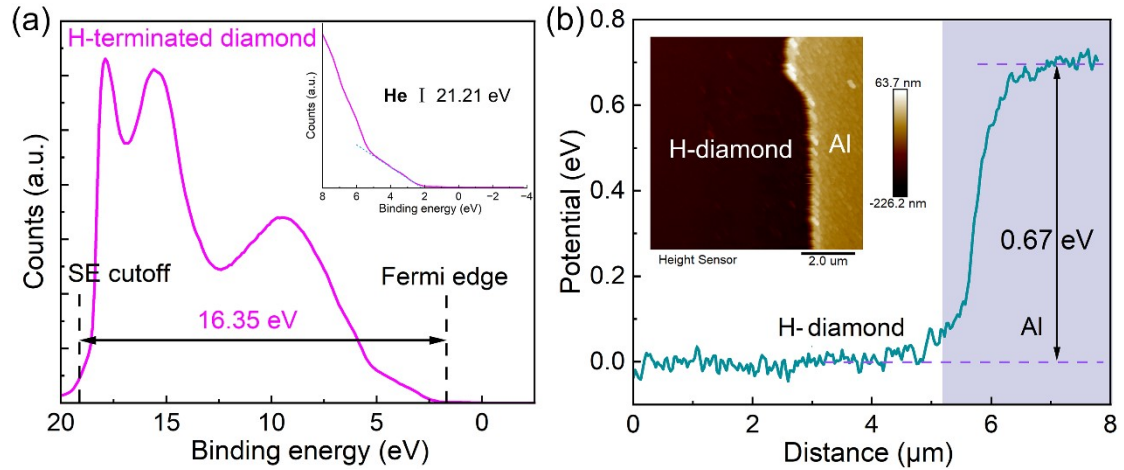


Fig. S3: (a) UPS spectra of the H-Diamond excited by He I photons ($h\nu = 21.2$ eV), the affinity energy (χ) of H-diamond is calculated to be -0.38 eV.¹ (b) Potential distribution of Al on h-diamond surface, the Schottky barrier between Al and H-diamond is 0.67 eV.²

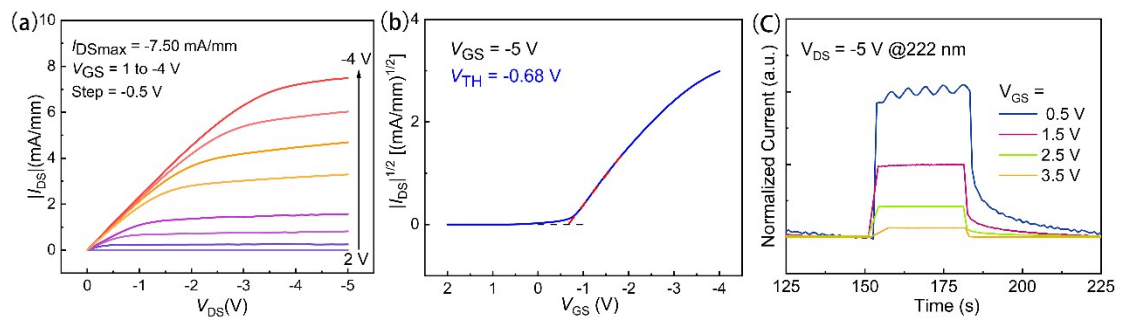


Fig. S4: (a) Output characteristics of the 15-minute treated H-diamond phototransistor under various V_{GS} ranging from 2 to -4 V. (b) The evolutions of $|I_{DS}|^{1/2}$ depending on V_{GS} under a constant V_{DS} of -5 V. (c) Comparison of rise and decay times at various V_{GS} and a constant V_{DS} of -5 V.

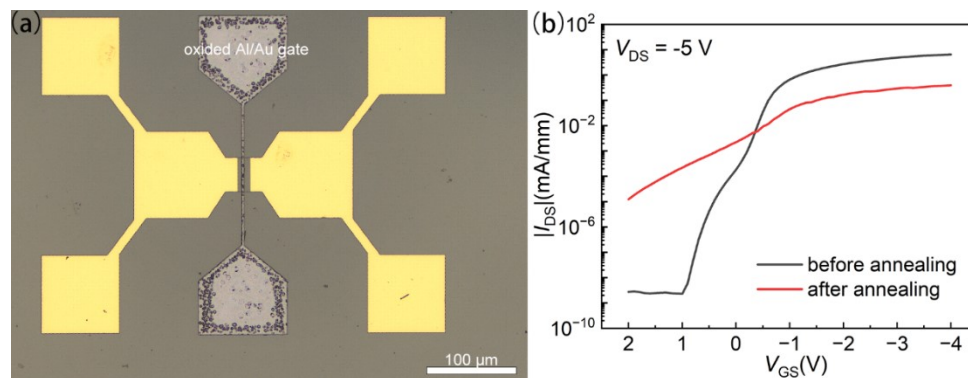


Fig. S5: (a) Optical image of the annealed H-diamond phototransistor. (b) Transfer characteristics curves of the H-diamond phototransistor before and after annealing.

Table S2: Comparison of the Performance of Single-crystal Diamond-Based Photodetectors

Structure of the device	Light/dark current ratio	Responsivity ($A W^{-1}$)	Detectivity (Jones)	Rise/decay time	Ref.
MSM	160	84.3	$< 10^{12}$	$< 240ms$	3
MSM	10^5 - 10^6	22.6	4.2×10^{14}	13 ns/303.8 μs	4
MSM	-	0.015	-	-/0.086 ms	5
MSM	1.4×10^4	56.3	1.26×10^{13}	1.03 ns/1.05 ns	6
Homojunction	-	0.0035	1.13×10^{12}	0.016 s/2.2 s	7
MSM	2.4×10^8	0.083	-	-	8
MSM photodiode	-	524.9	3.42×10^{15}	$< 16 \mu s/120 \mu s$	9
phototransistor	2.11×10^6	2.48×10^4	5.08×10^9	88 ms/36 ms	10
phototransistor	2.2×10^7	2.16×10^4	9.36×10^{11}	25.5 ms	11
phototransistor	8.68×10^6	1.42×10^7	2.79×10^{13}	2.04 s/5.49 s	This work

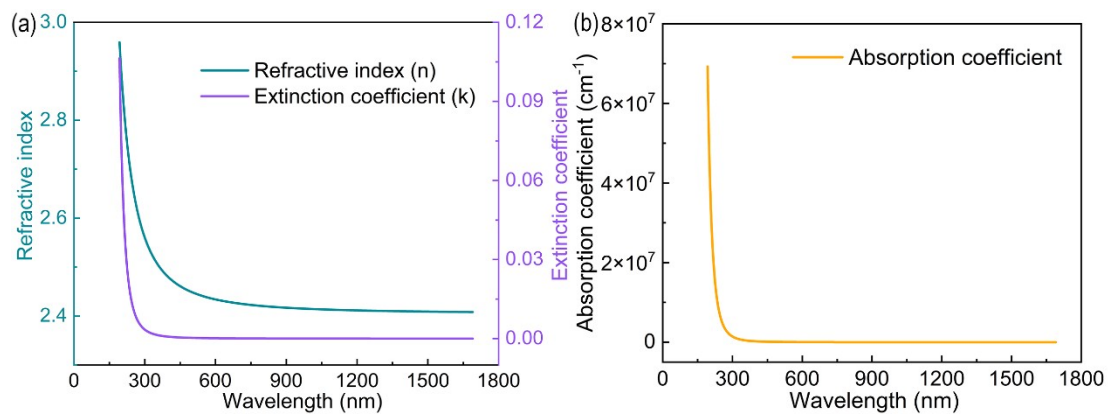


Fig. S6. (a) Refractive index (n) and extinction coefficient (k) of H-diamond as a function of wavelength. (b) Absorption coefficient (α) of H-diamond derived from the extinction coefficient (k) using the equation $\alpha = 4\pi k/\lambda^{12}$.

References

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