Supporting Information for

High Responsivity in MoS_2 Phototransistors Based on Charge Trapping HfO_2 Dielectrics

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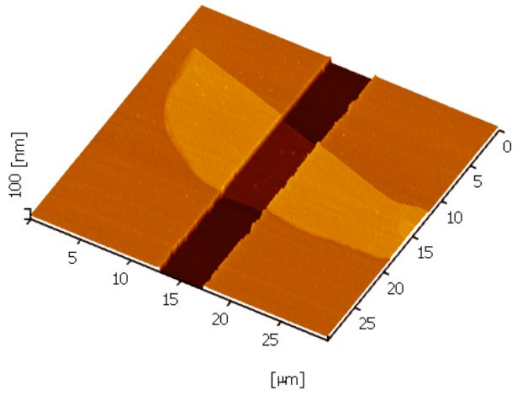
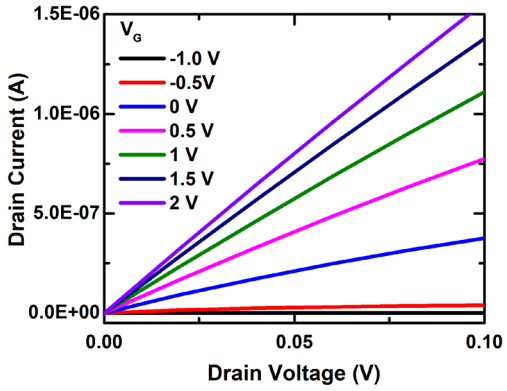
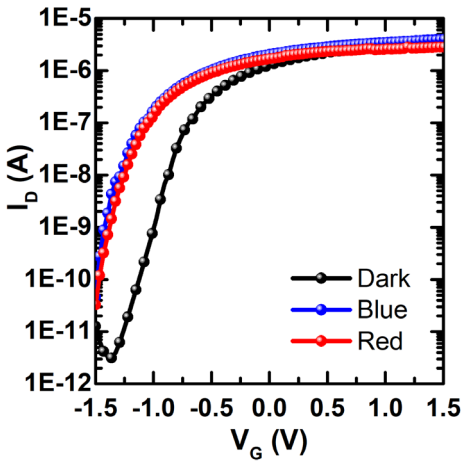


Supplementary Figure 1. AFM Surface Topography of MoS_2 channel region.

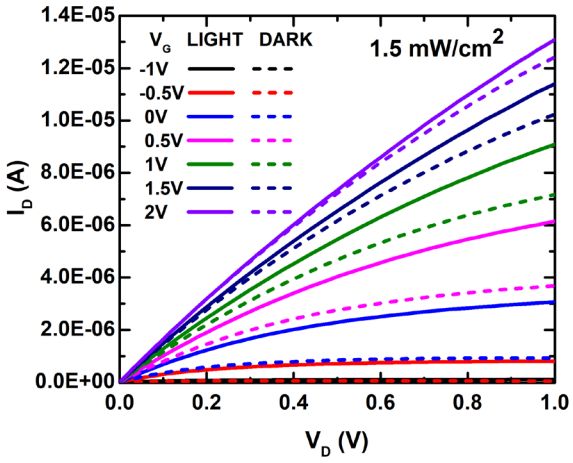


Supplementary Figure 2. Close-up of I_D-V_D for HfO_2 device at low drain voltages where the linear curves indicate the presence of ohmic-type contacts.

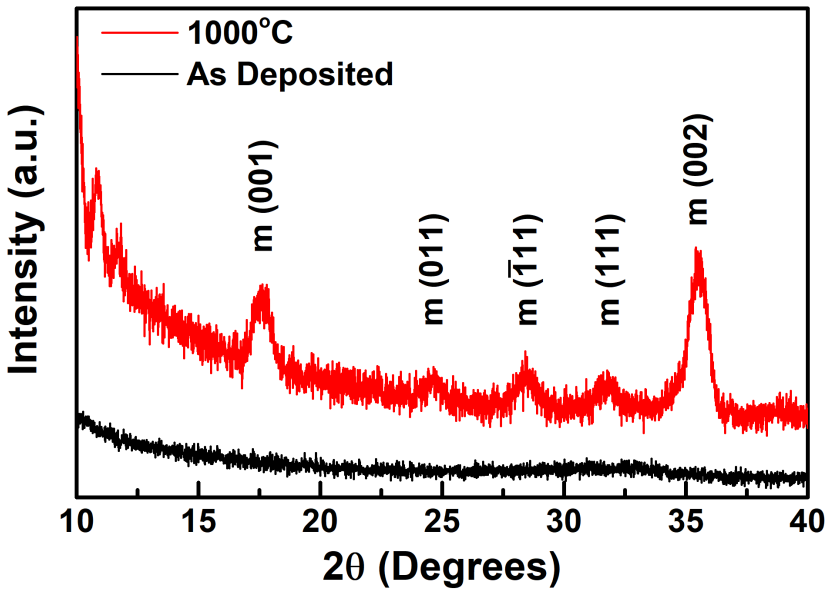


Supplementary Figure 3. A comparison of blue and red illumination with the HfO_2

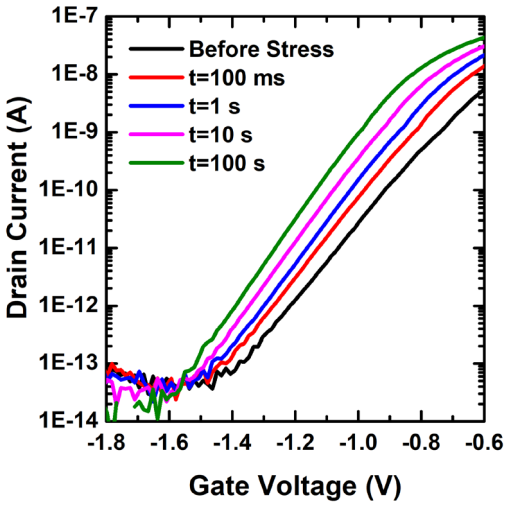
device. Photogating behavior is observed under visible light wavelengths.



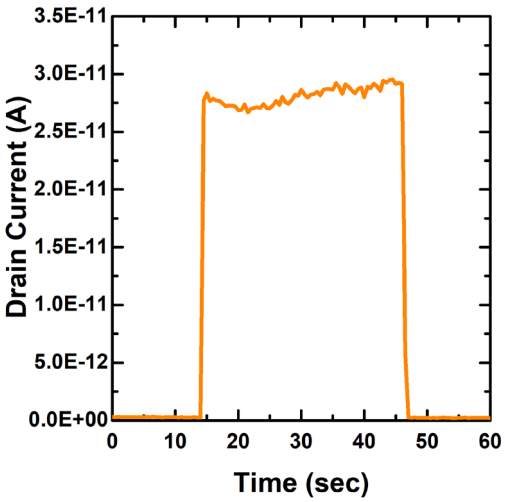
Supplementary Figure 4. Output characteristics of the HfO_2 device under constant illumination with blue light and no illumination.



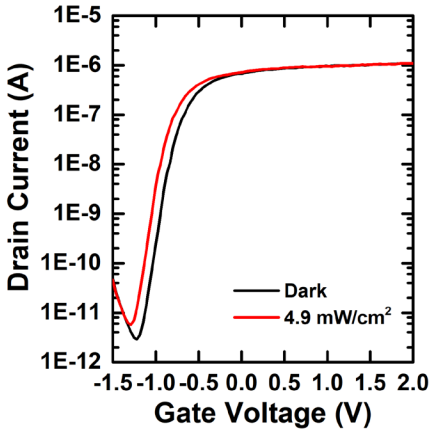
Supplementary Figure 5. XRD of HfO_2 film with no anneal (black) and with rapid thermal annealing (RTA) at 1000 °C for 1 minute (red). The 1000 °C annealed HfO_2 film shows some monoclinic phases.



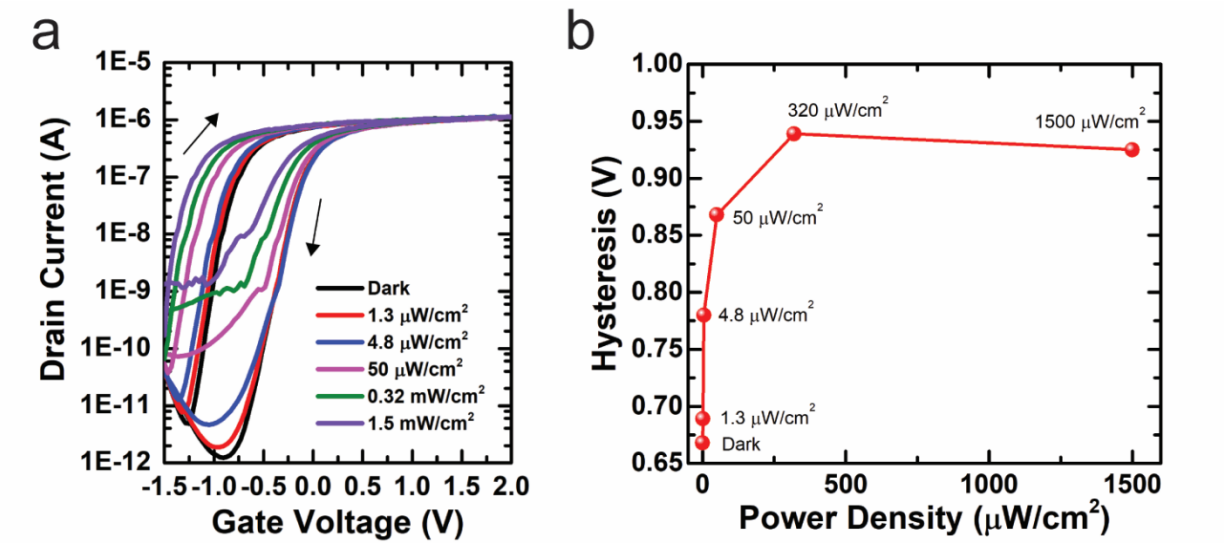
Supplementary Figure 6. Stress and sense I_D-V_G measurement of SiO_2 phototransistor (dark condition) under V_G = -2 V stress bias for various stress times.



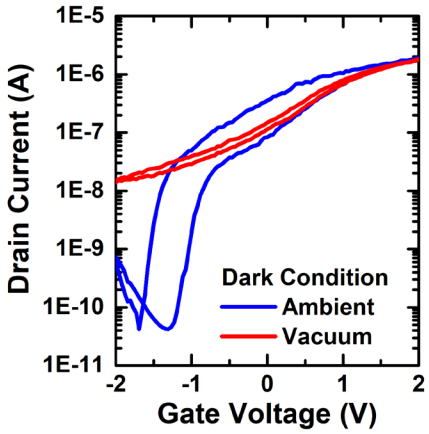
Supplementary Figure 7. Time response of SiO_2 phototransistor with V_{DS} at 150 mV, V_G at -1.5 V, and optical power density at 1.5 mW cm^{-2}.



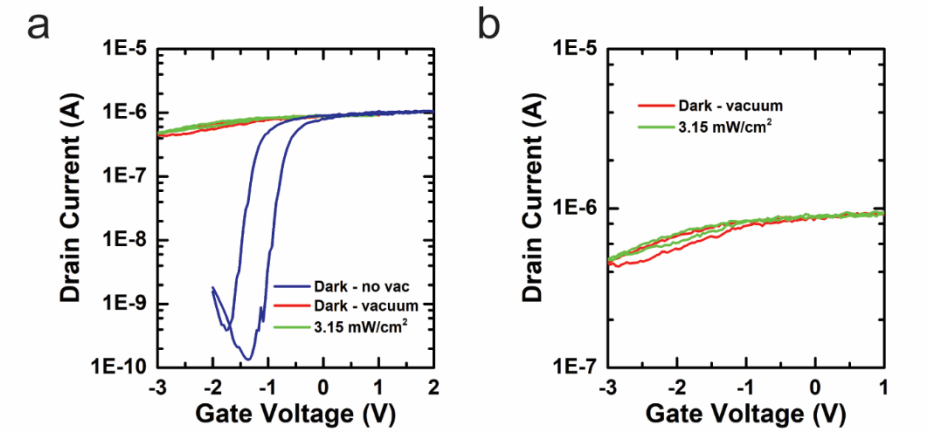
Supplementary Figure 8. HfO_2 device NIR photodetection at 850 nm wavelength with V_{DS} at 150 mV and optical power density at 4.9 mW cm^{-2}.



Supplementary Figure 9. (a) Hysteresis loop under illumination for MoS_2/HfO_2 device. (b) Hysteresis vs. optical power density.



Supplementary Figure 10. Ambient and vacuum measurement of the dark condition for MoS_2/HfO_2 device.



Supplementary Figure 11. Vacuum measurement of MoS_2/HfO_2 device with V_{DS} = 500 mV and vacuum pressure at ~$2x10^{-3}$ Pa. (a) Comparison of dark condition under ambient conditions, dark condition under vacuum, and illumination of blue light with optical power density at 3.15 mW cm^{-2} under vacuum. (b) Close-up of dark and illumination curves under vacuum.

Flake	Length (µm)	Width (µm)	Thickness (nm)	Responsivity (A W^{-1}) at 460 nm
1 (main paper)	5.0	5.05	10.0	$1.1x10^6$
2	4.22	2.97	3.7	$4.83x10^4$
3	4.36	10.6	6.9	$1.08x10^5$
4	4.28	6.70	4.5	$1.17x10^5$
5	4.60	3.09	6.3	$3.57x10^4$

Supplementary Table 1. Table of reproducibility of HfO_2 devices.