Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information

Surface functionalization-induced photoresponse characteristics of monolayer MoS_2 for fast flexible photodetectors

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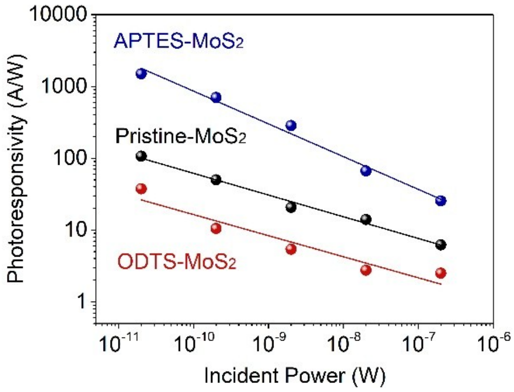

Fig. S1 Photoresponsivity with respect to the incident illumination powers for the pristine, ODTS-, and APTES-MoS_2 devices.

The photoresponsivity $R = I_{ph}/P$ was calculated for the pristine, ODTS-, and APTES-MoS_2 devices, and these values reached maximum values of 1500 A/W and 37.5 A/W at the lowest incident power for the APTES-MoS_2 and ODTS-MoS_2 devices, respectively. Photoresponsivity represents photocurrent generation respective to the incident illumination power. Therefore, the APTES-MoS_2 device with higher photoresponsivity suggests that more excitons were transported through the functionalized channel.

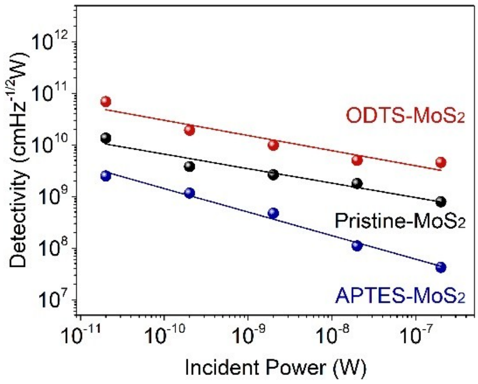

Fig. S2 Detectivity with respect to the incident illumination powers for the pristine, ODTS-, and APTES-MoS_2 devices.

The detectivity D* can be expressed as $D^* = \sqrt{AB}/NEP$, where A is the device area, B is the bandwidth, and NEP is noise-equivalent power which is the minimum detectable power when the signal-to-noise is equal to unity and bandwidth is limited to 1 Hz. The detectivity takes account the noise of a device, device area, and bandwidth. Highest detectivity of 10^{11} cmHz$^{-1/2}$W was measured for the ODTS-MoS_2 device under the lowest illumination intensity, and it can be attributed to the lowering of the dark level by effectively withdrawing electrons from the channel.

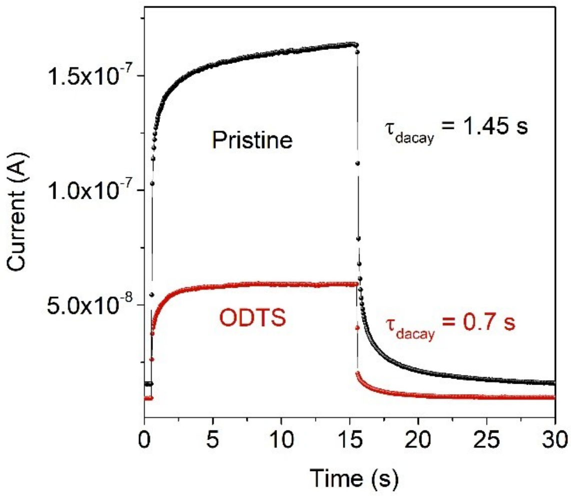

Fig. S3 Time-dependent photocurrent measurement of the flexible MoS_2 photodetector before and after ODTS-functionalization.

Summary of performance of MoS_2 photodetectors							
Materials	Device Type	Operation	Photoresponsivity (A/W)	Detectivity ($cmHz^{-1/2}W$)	Rise Time (s)	Decay Time (s)	Ref
1L-MoS2	Phototransistor	V_{gs} = -70V V_{ds} = 8V	880	-	4	9	Nat. Nanotech. 8, 2013 (Ref 1)
Multilayer MoS2	Phototransistor	V_{gs} = -3V V_{ds} = 1V	0.05-0.12	10^{10}-10^{11}	-	-	Adv. Mater. 24, 2012 (Ref 2)
1L-MoS2	Phototransistor	V_{gs} = +50V V_{ds} = 1V	2200	-	10-100		Adv Mater. 25, 2013 (Ref 3)
1L-MoS2	Phototransistor	V_{gs} = +60V V_{ds} = 1V	415-1750	-	-	-	Nat. Commun. 8, 2017 (Ref 4)
Multilayer MoS2	Photodetector	V_{ds} = 10V	0.057	1.55 x 10^9	-	-	Adv. Mater. 29, 2017 (Ref 5)
1L-MoS2	Photodetector	V_{ds} = 3V	178		>30		Adv. Mater. 29, 2017 (Ref 6)
1L-MoS2	Photodetector	Vds = 0.1-1V	37-1500	10^9-10^{11}	1.6	0.7	This work

Table S1. Summary and comparison of the MoS_2 photodetectors.

Supplementary References

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