Supporting Information

Two-dimensional $NiPS_3$ for flexible humidity sensors with high selectivity

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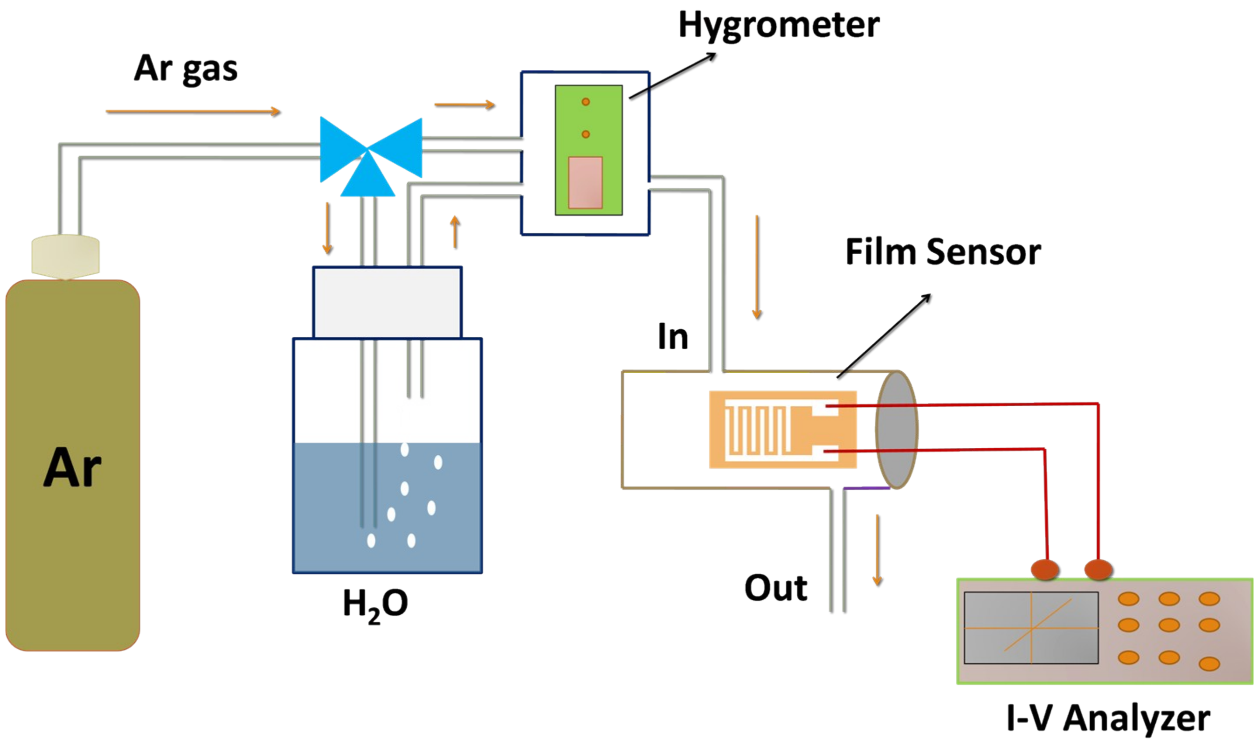

Figure S1. Schematic diagram of humidity sensor setup.

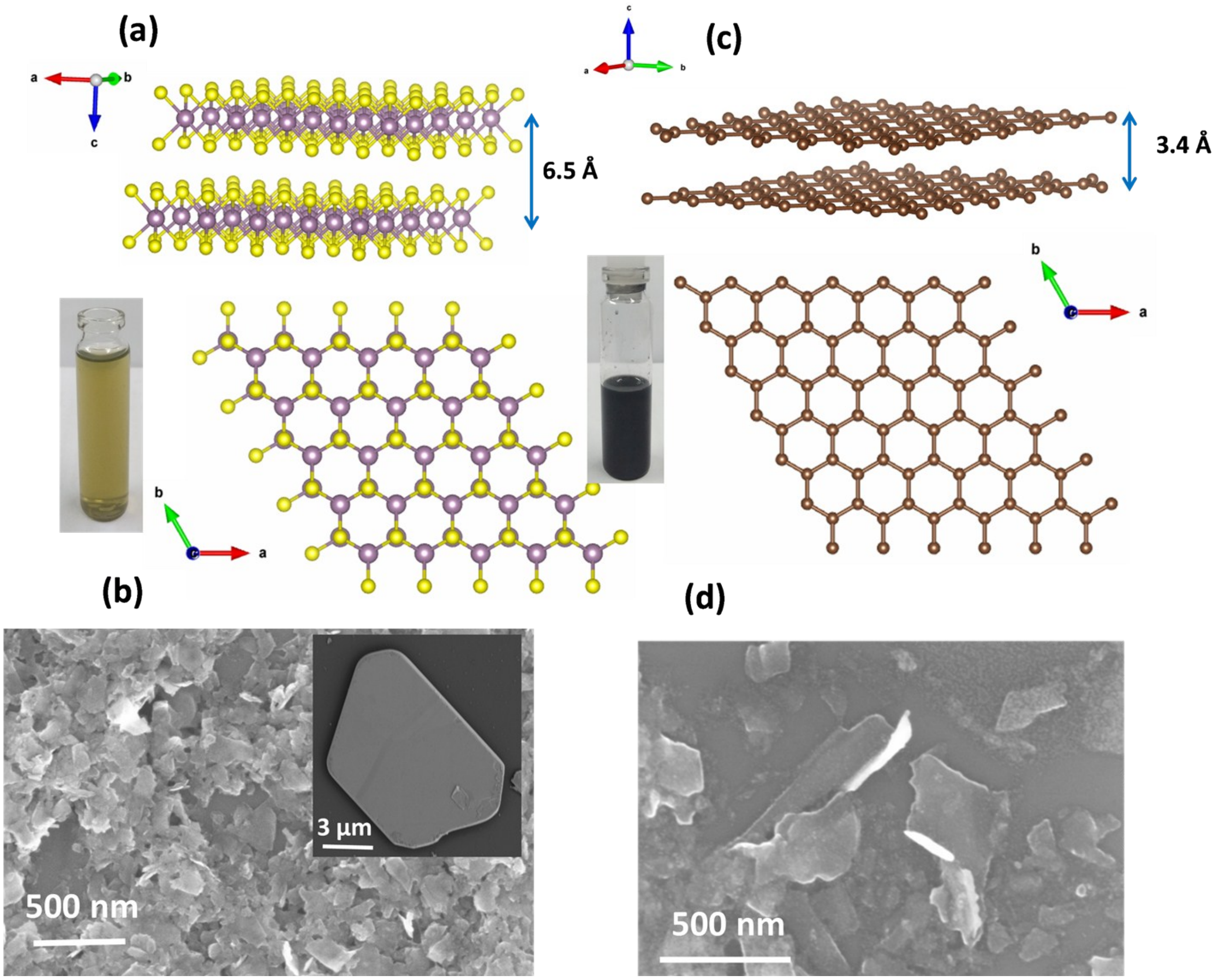

Figure S2. Structural representation of (a) MoS_2 along with the (b) scanning electron microscopic (SEM) images of bulk and few-laye MoS_2 and (c) graphene along with the (d) SEM image.

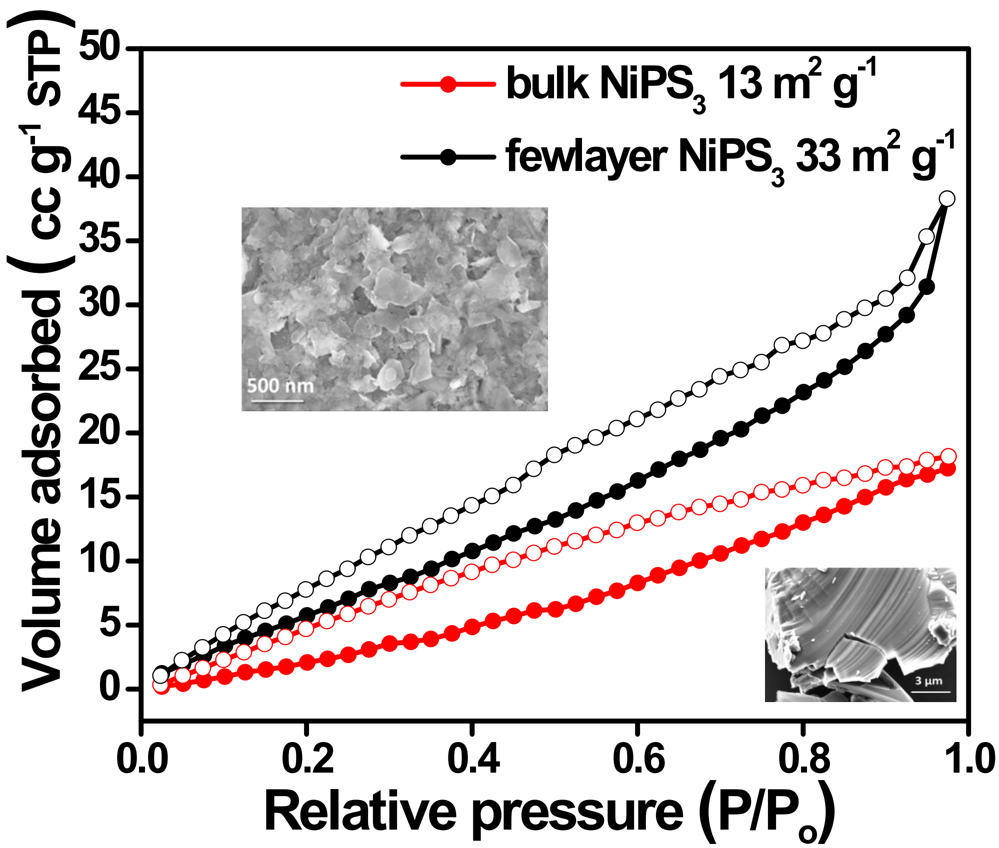

Figure S3. BET adsorption – desorption isotherms of bulk and few-layer $NiPS_3$. BET measurements are carried out in N_2 atmosphere and at 77K temperature.

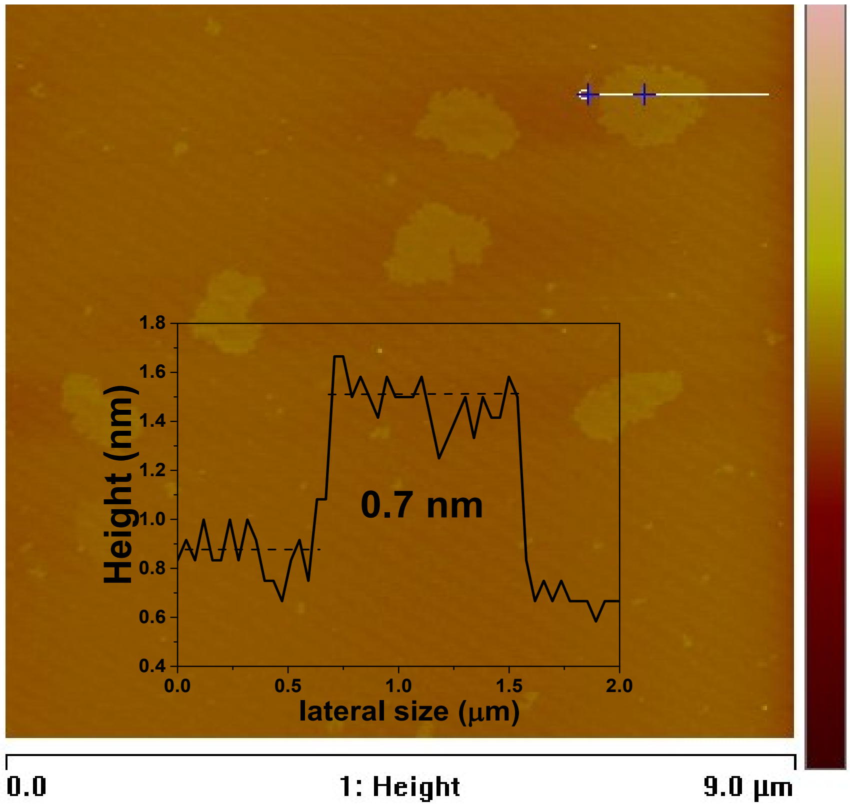

Figure S4. Atomic force microscopic (AFM) image of single layer $NiPS_3$ and corresponding height profile (inset).

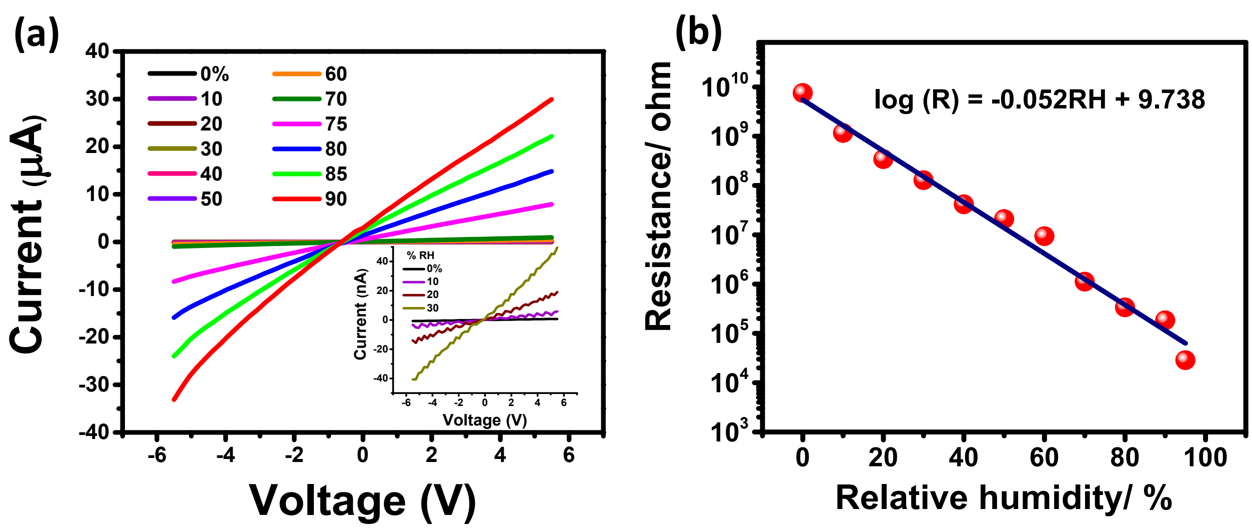

Figure S5. (a) I-V profiles of $NiPS_3$ obtained at different relative humidity (RH) values. (b) log(R) vs RH.

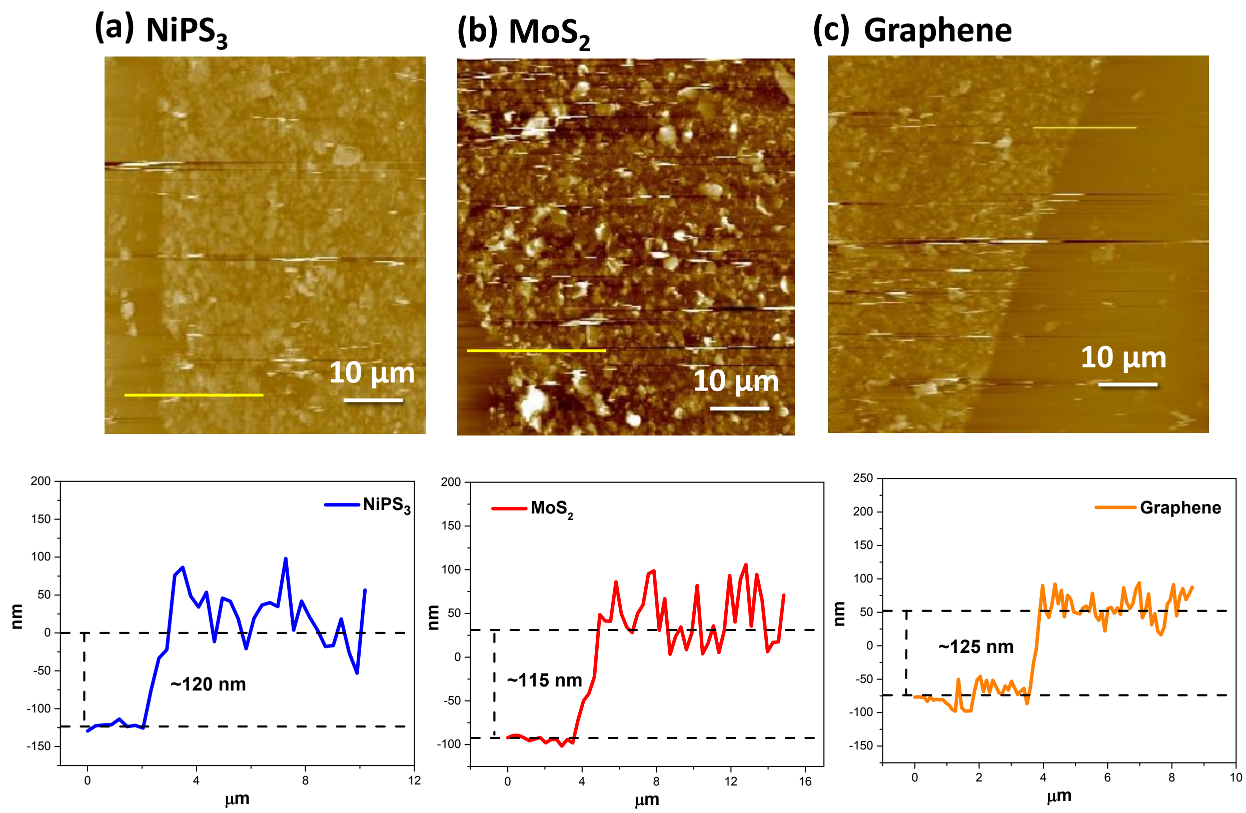

Figure S6. Atomic force microscopic images of thin films a) $NiPS_3$, b) MoS_2 and c) Graphene along with corresponding height profiles.

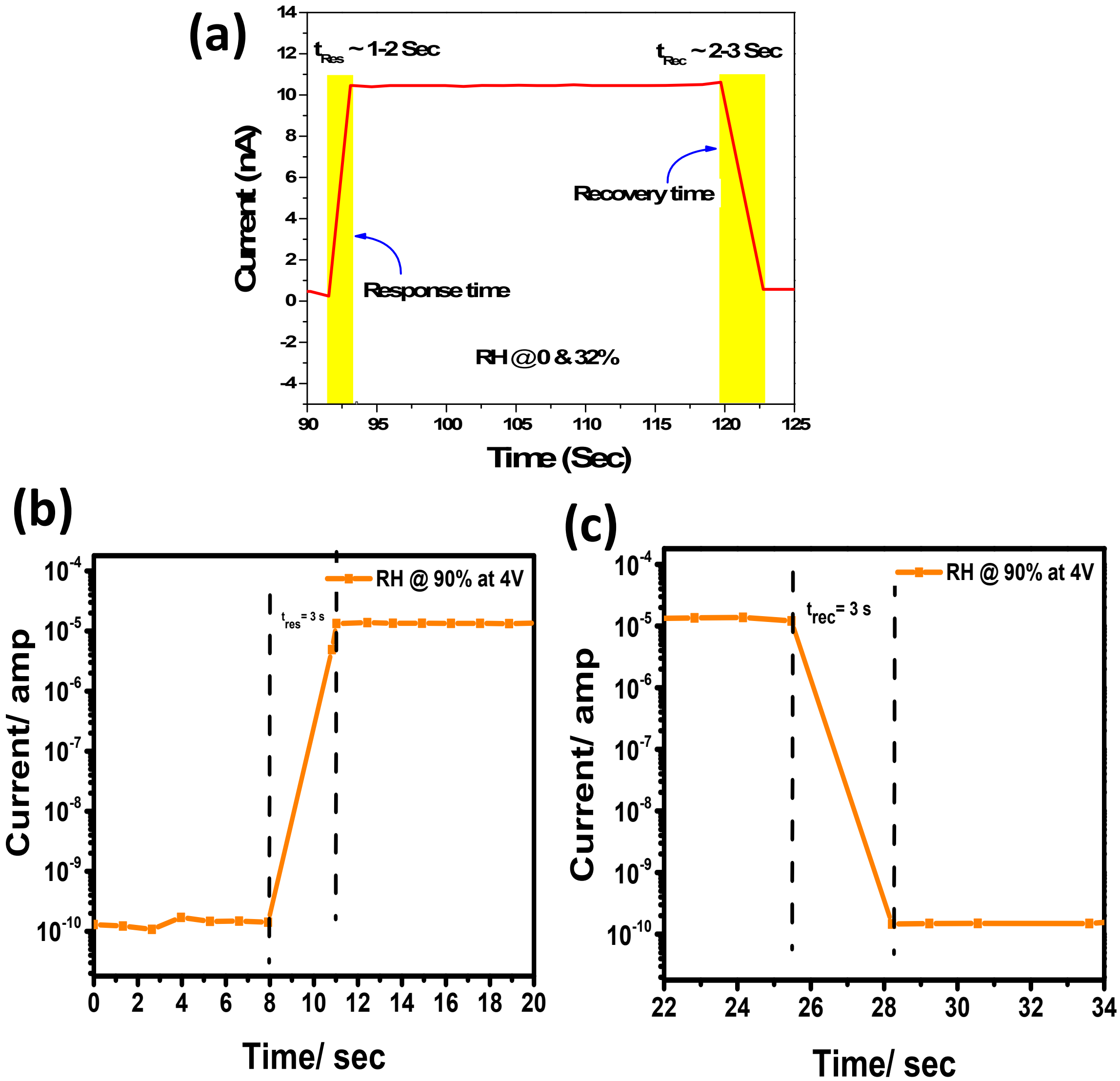

Figure S7. (a) Response vs recovery time at low humidity (RH of 0% to 32%); (b, c) denote high humidity response and recovery between RH of 0% to 90%.

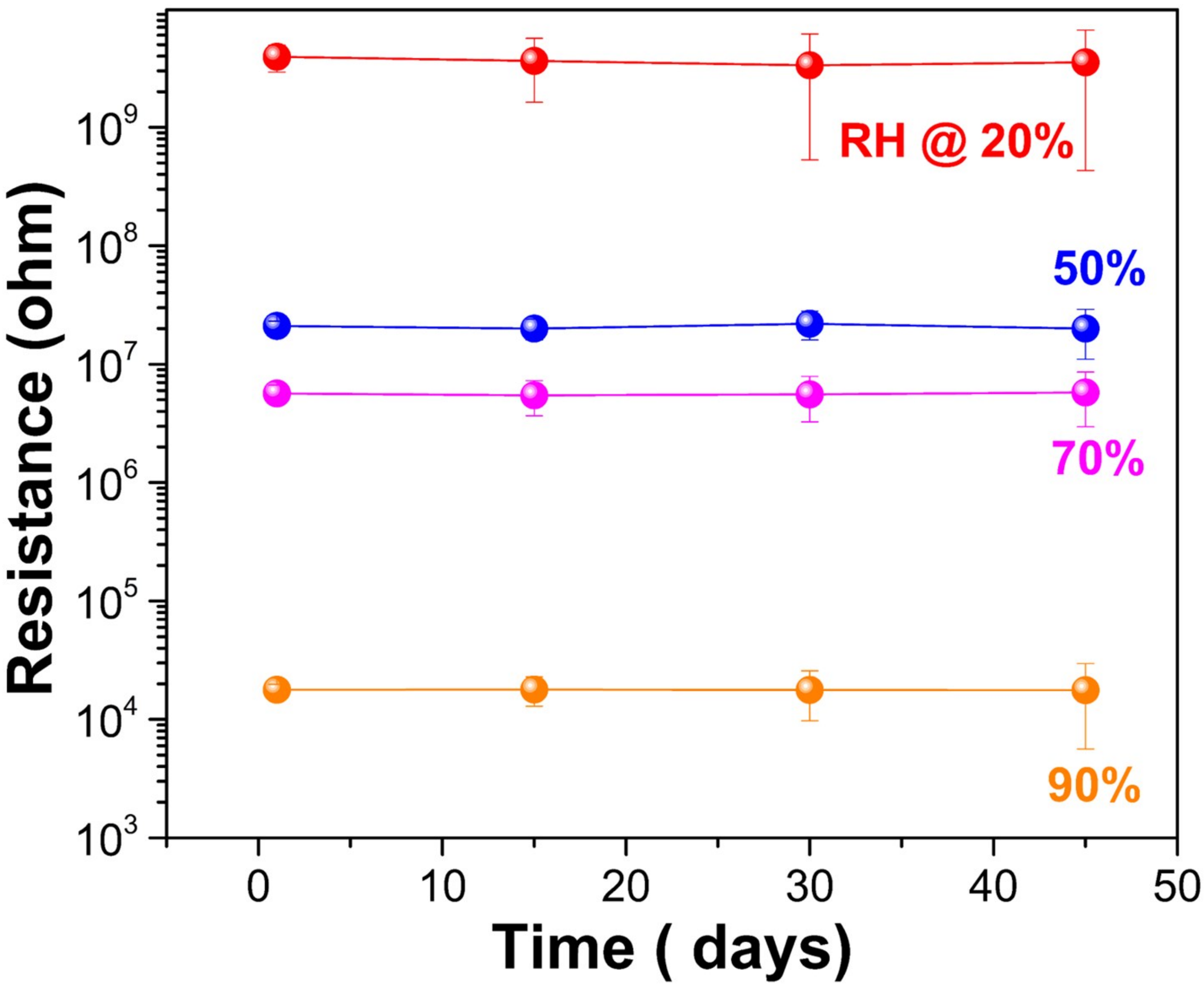

Figure S8. Stability of few-layer $NiPS_3$ humidity sensor over storage time for various humidity levels.

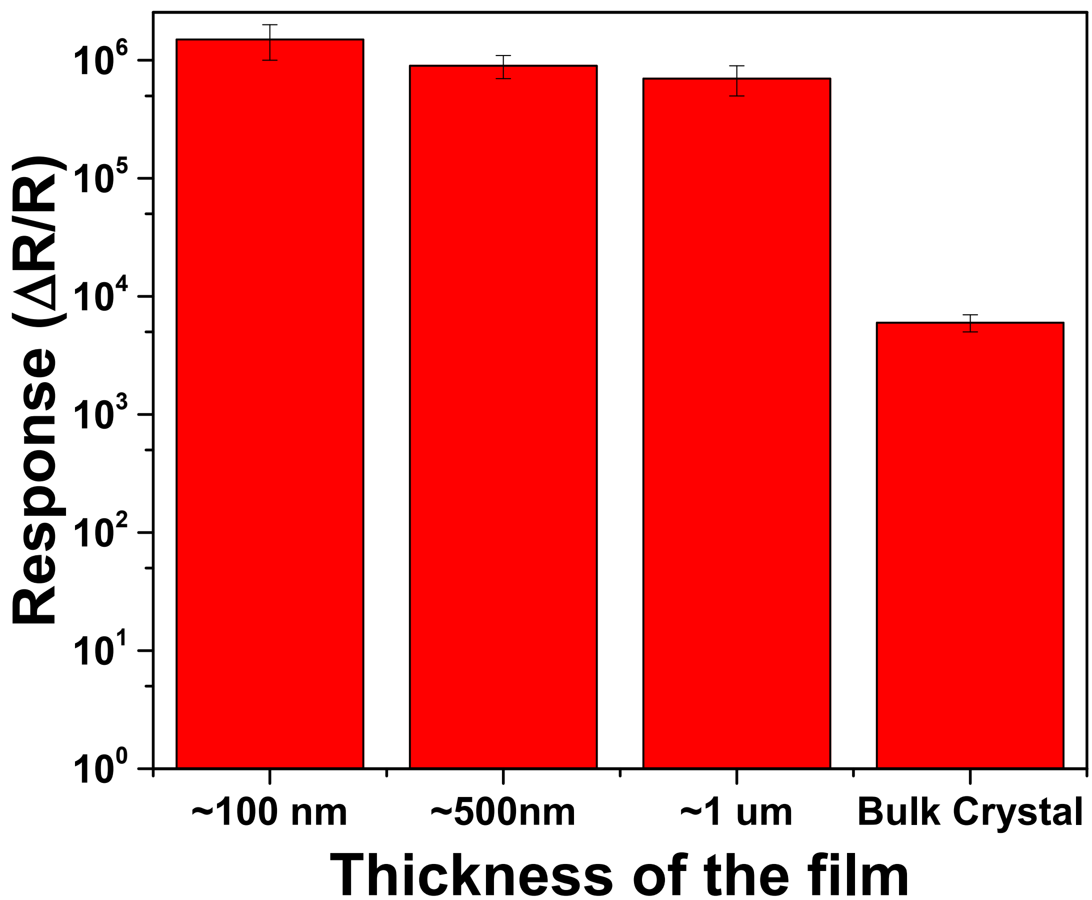

Figure S9. Thickness dependent humidity sensing performance of restacked few-layer $NiPS_3$ films of various thicknesses (~100nm, ~500nm and ~1000nm) and bulk crystal.

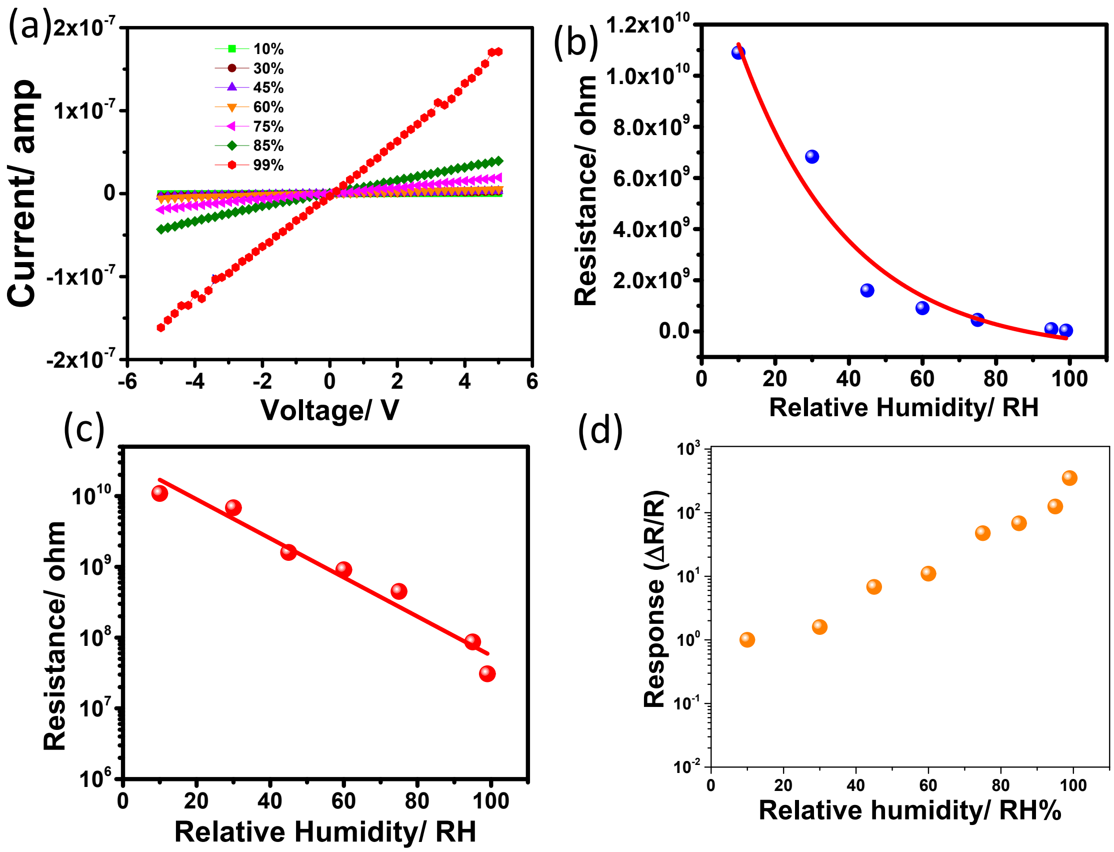

Figure S10. (a) I-V profiles obtained for the device based on bulk $NiPS_3$ at different relative humidity (RH) values (b) Resistance (R) vs RH at different ranges of humidity; (c) Log(R) vs RH, (d) Responsivity (ΔR/R) vs. RH of bulk $NiPS_3$.

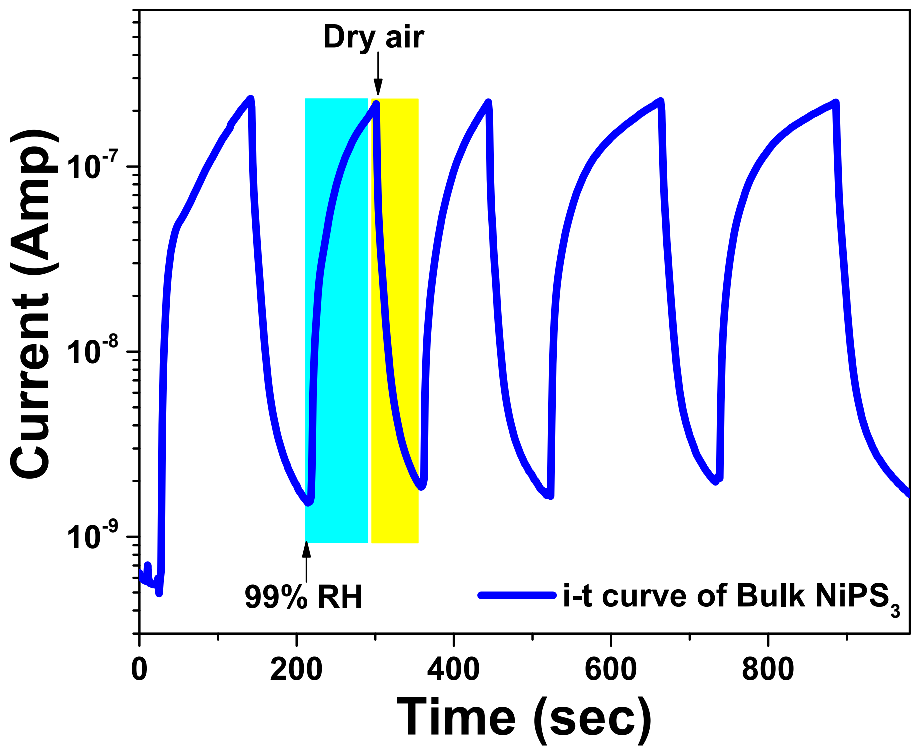

Figure S11. Response of bulk $NiPS_3$ based sensor between dry air and 99% RH.

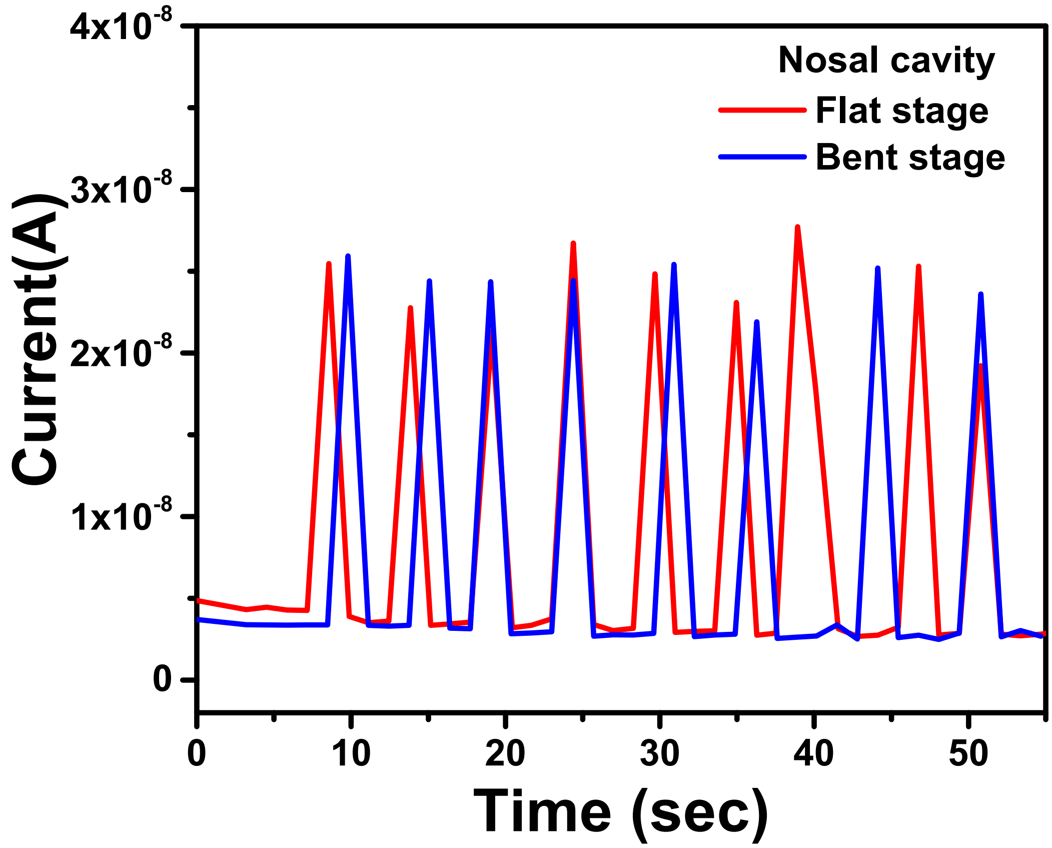

Figure S12. Current response to RH of the breath exhaled from the nasal cavity in both flat and bent configurations.

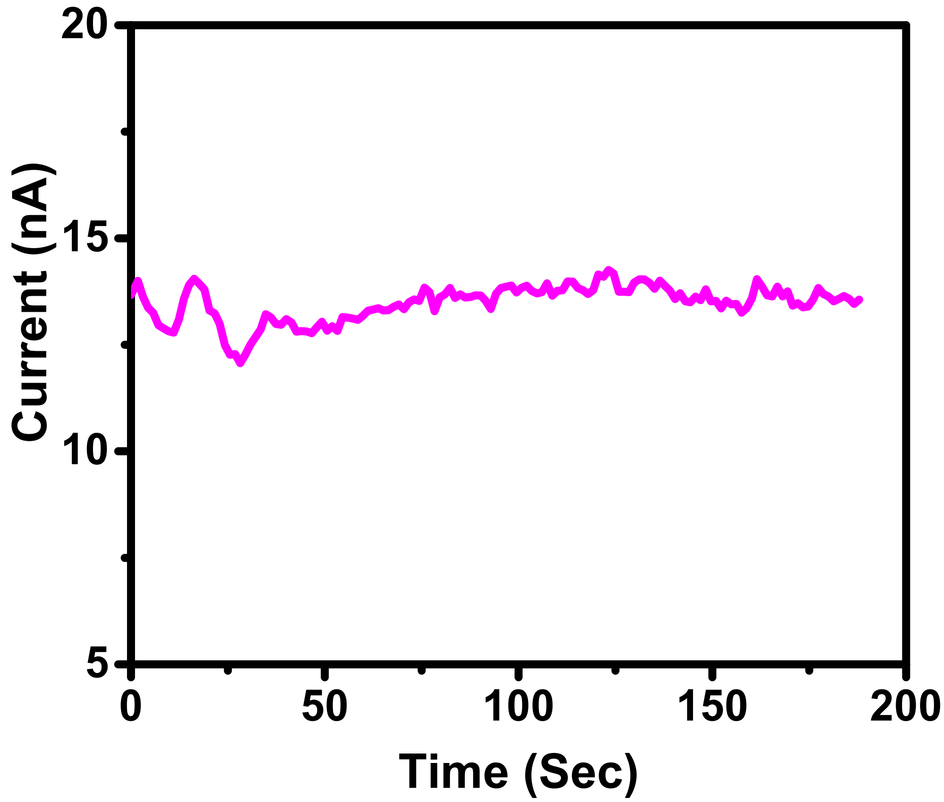

Figure S13. Response of the sensor for glove wearing hand. The base current is due the ambient humidity in the laboratory.

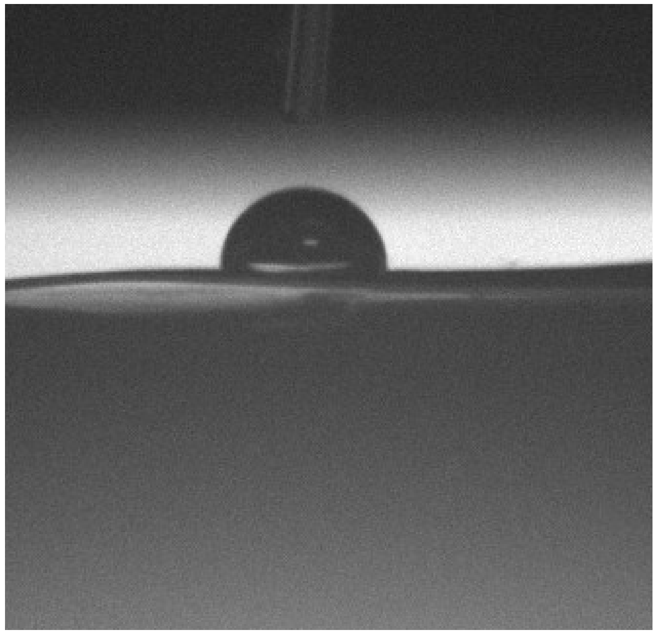

Figure S14. Water contact angle data on $NiPS_3$ film (80°).

Table S1. Comparison of humidity sensing performance obtained using $NiPS_3$ with other reported 2D materials.

Material	Sensing technique	Response time (s)	Recovery time (s)	Response	Reference
VS_2	Resistive	30-40	12-50	30 ($\Delta R/R$)	*Adv. Mater.* **2012**, **24**, 1969.
MoS_2	Resistive	9	17	150 ($\Delta R/R$)	*Nanotech.* **2014**, *14*, 8518.
MoS_2	FET	10	60	-	*Adv. Mater.*, **2017**, *1702076*.
MoS_2/GO	Resistive	43	37	~900 ($\Delta R/R$)	*RSC Adv.* **2016**, *6*, 57424.
MoS_2/SnO_2	Capacitive	5	13	3285000% ($\Delta C/C$)	*ACS Appl. Mater. Inter.* **2016**, *8*, 14142.
WS_2	Resistive	13	17	3750 ($\Delta R/R$)	*Nanotech.* **2016**, *27*, 475503.
WS_2	Resistive	5	6	2357 ($R_{20\%}/R_{90\%}$)	*Nanoscale* **2017**, *9*, 6246.
WS_2 nanoparticle	Resistive	12	13	~ 475 ($\Delta R/R$)	*ACS Appl. Mater. Inter.* **2016**, *8*, 3359
SnS_2	Resistive	67	5	-	*RSC Adv.* **2016**, *6*, 105421.
$SnSe_2$	Resistive	74	30	-	*Chem. Select* **2016**, *1*, 5380.
GO	Impedance	0.03	0.03	-	*ACS Nano* **2013**, *7*, 11166-11173.
GO	Resistive	~5	~6	120000 ($\Delta l/l$)	*IEEE Trans. on Nanotech.* **2015**, *14*, 931.
GO	Capacitive	10.5	41	37757 ($\Delta C/C$)	*Sci. Rep.* **2013**, *3*, 2714.
GO	Piezoelectric	19	10	79.3(ΔV/RH%)	*Sens. Act.,B* **2012**, *161*, 1053.

GO	Capacitive	2.7	4.6	4450544 (ΔC/C)	*Nanoscale* **2018**, *10*, 5599.
GO/polyelectrolyte	Capacitive	-	-	265640 (ΔC/C)	*Sens. Act., B* **2014**, *203*, 263.
Graphene	Resistive	0.6	0.4	0.31(ΔR/R% ΔRH)	*Nanoscale,* **2015**, *7,* 19099–19109.
rGO	Resistive	28	48	0.043 (logZ/RH%)	*Sens. Act., B* **2014**, **200**, 9.
BP	Resistive	255	10	99.17 (ΔR/R)	*Micropor. Mesopor. Mat.,* **2016**, *225*, 494.
BP	Capacitive	4.7	3.0	507825 (ΔC/C)	*Nanoscale* **2018**, *10*, 5599.
$NiPS_3$	**Resistive**	**~1-2**	**~2-3**	**1.5×10^6 (ΔR/R)**	**Present study**