

Supporting Information:

Fully printed high performance humidity sensors based on two-dimensional materials

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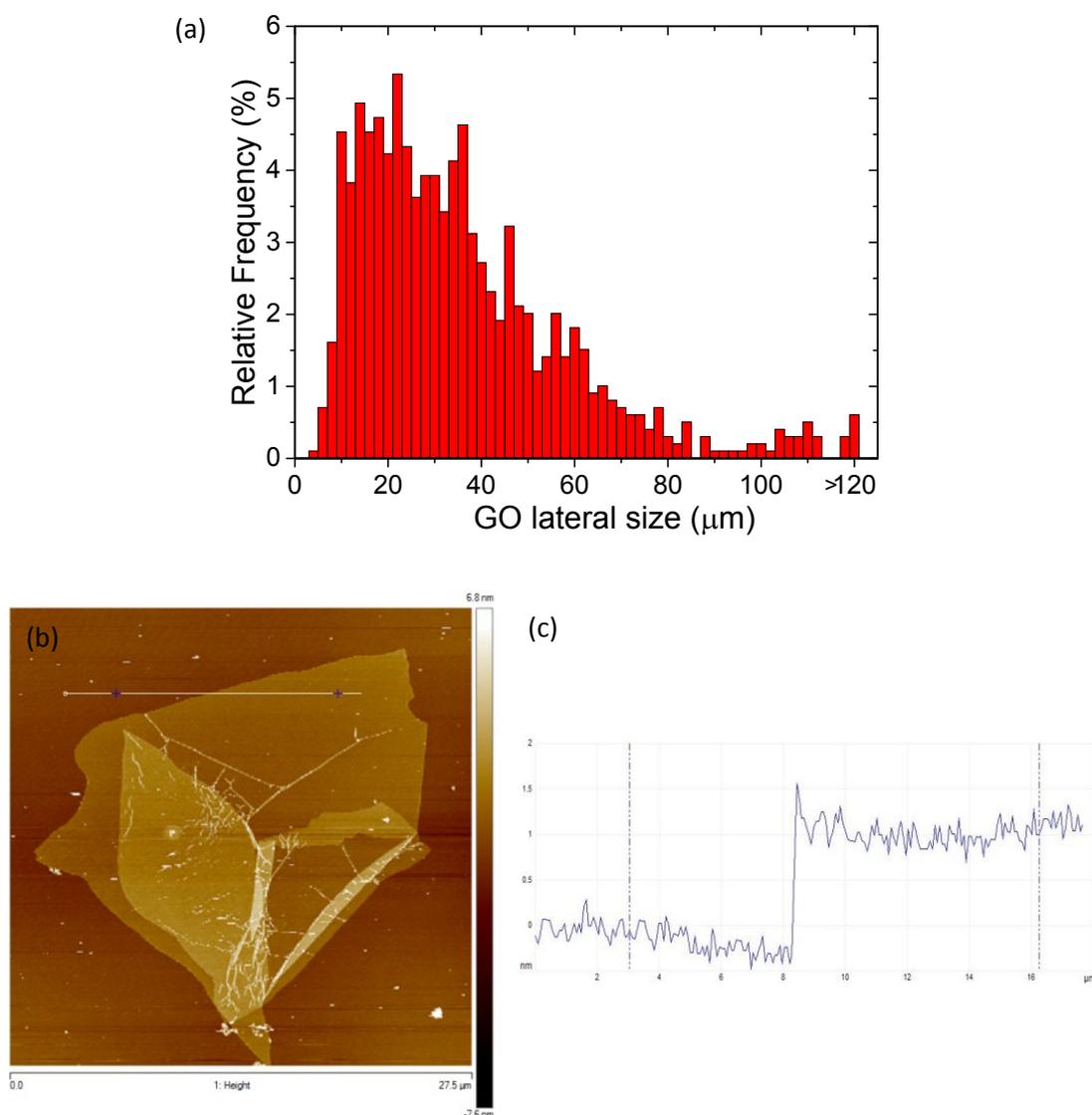


Fig S1. (a) Size distributions of GO sheets for more than 400 flakes. (b) The AFM image of a typical GO flake with lateral size around 25 μm and (c) the height morphology shows the thickness is around 1 nm.

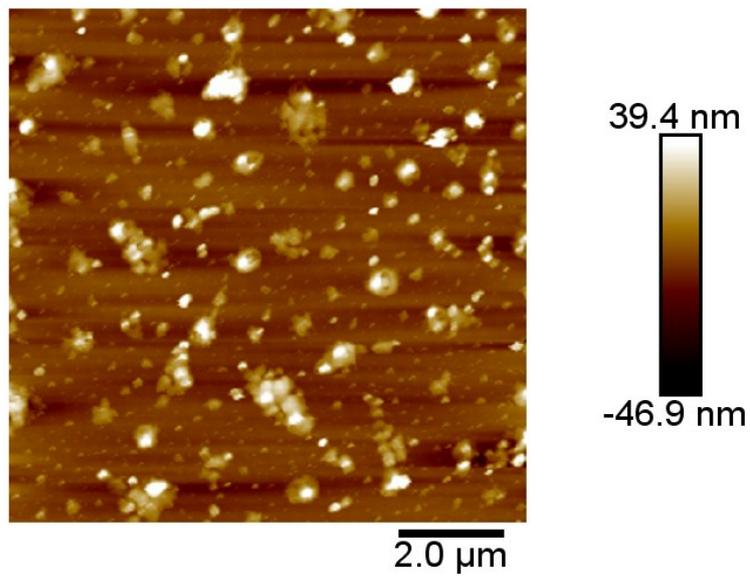


Fig S2. AFM image of few-layer BP flakes coated on Si/SiO₂ substrate. AFM data shows mean height = 8.3 nm, up to maximum of 113.8 nm. The average flake length is 129.3 nm from a minimum of 44.07 nm to maximum of 1132.4 nm (N=576).

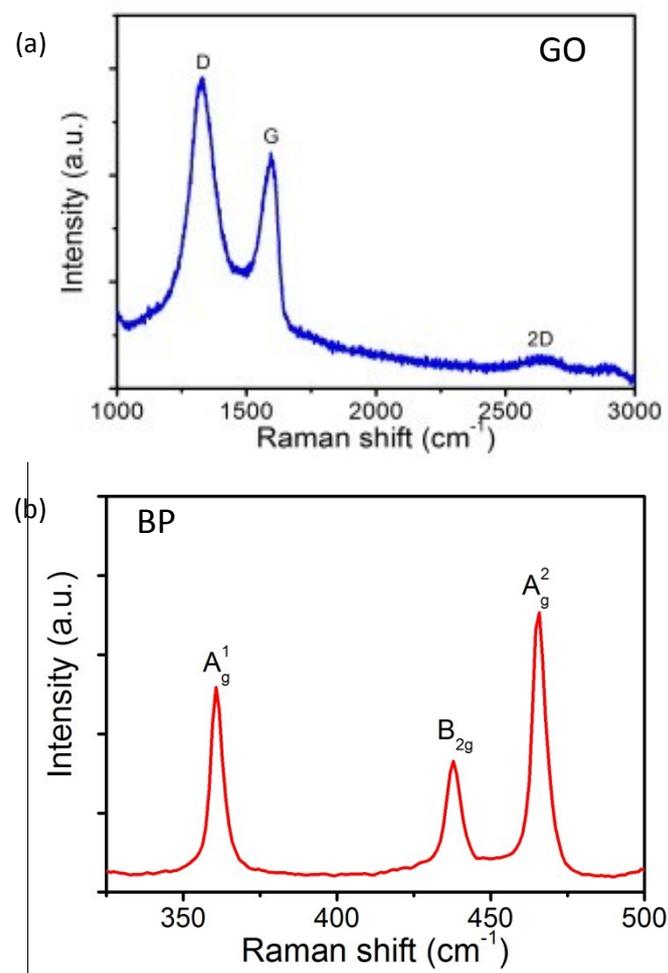


Fig S3. The Raman spectrum of (a) GO and (b) BP nanoflakes on Si/SiO₂ substrates.

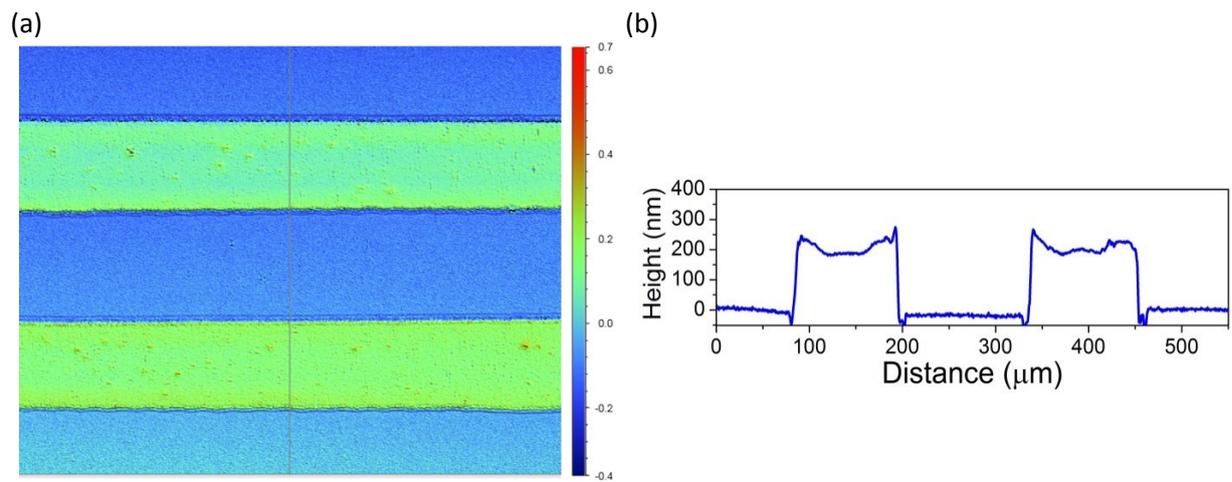


Fig S4. Surface profiler (a) and the corresponding thickness profile (b) of printed silver electrodes on glass substrate.

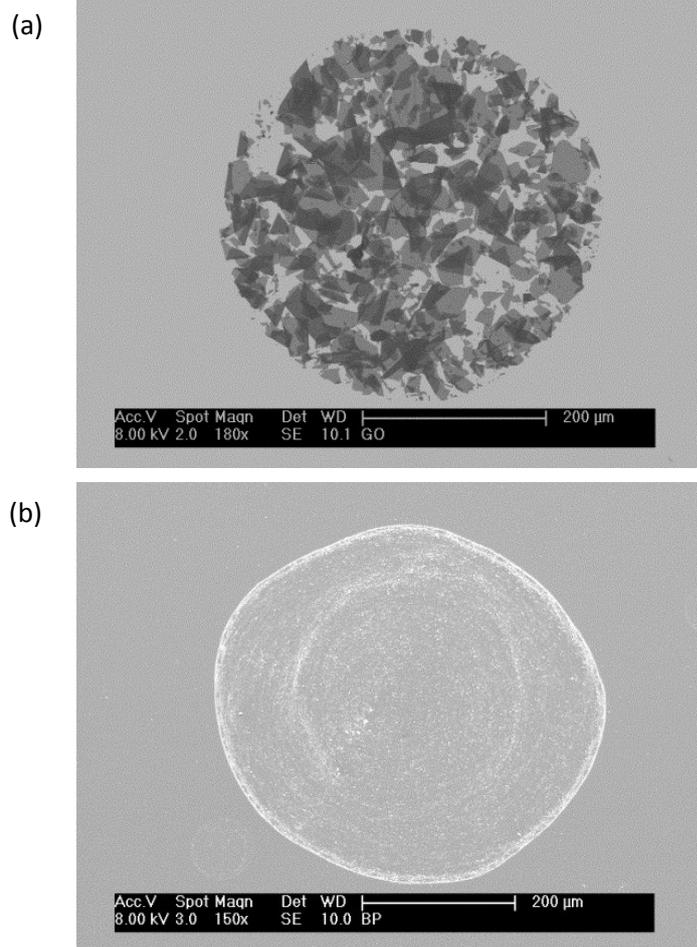


Fig S5. SEM images of a printed GO droplet (a) and BP droplet (b).

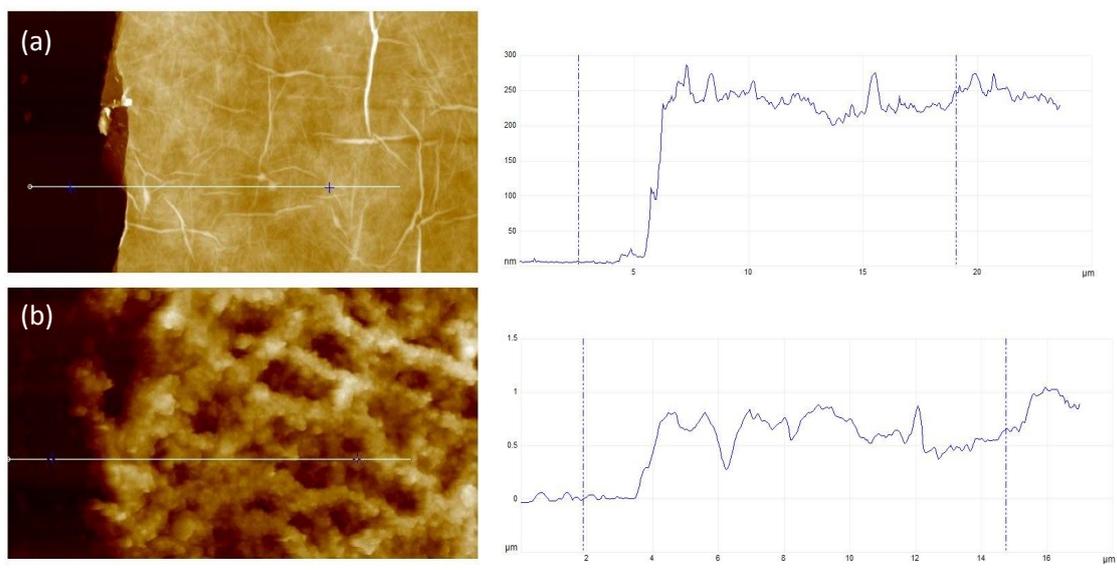


Fig S6. AFM images of printed (a) GO film and (b) BP film.

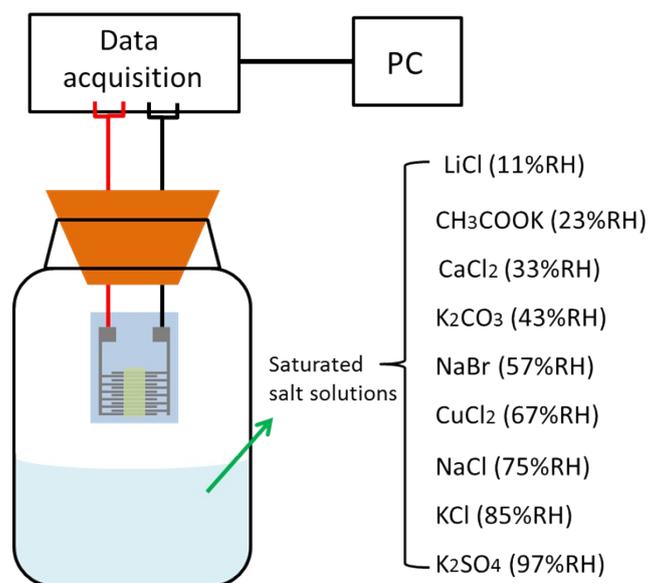


Fig. S7 Diagram of the experimental setup used to measure the humidity sensor properties. The humidity sensor properties were tested in a sealed glass bottle held at a constant temperature of 20 °C. Various relative humidity RH levels were obtained by using the range of saturated salt solutions indicated.

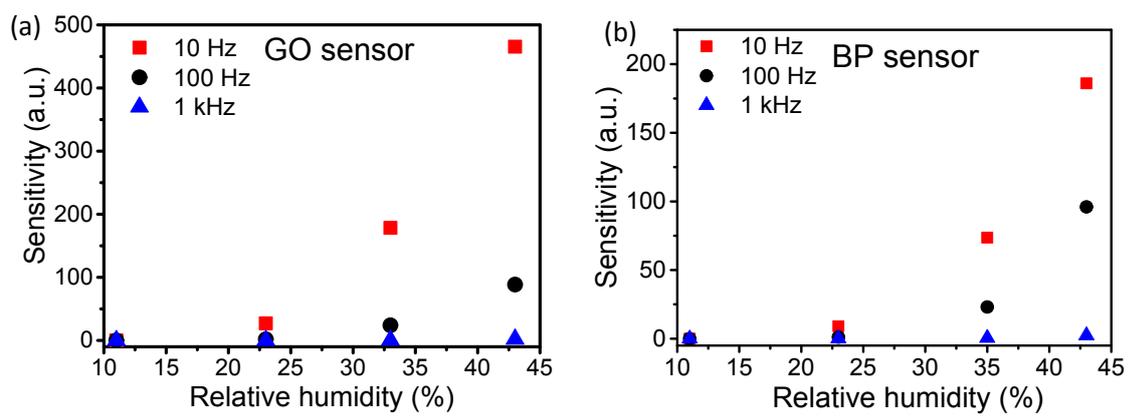


Fig. S8 The sensitivity of GO (a) and BP (b) sensors in low RH (11% to 43%) at 10 Hz, 100 Hz, and 1 kHz.

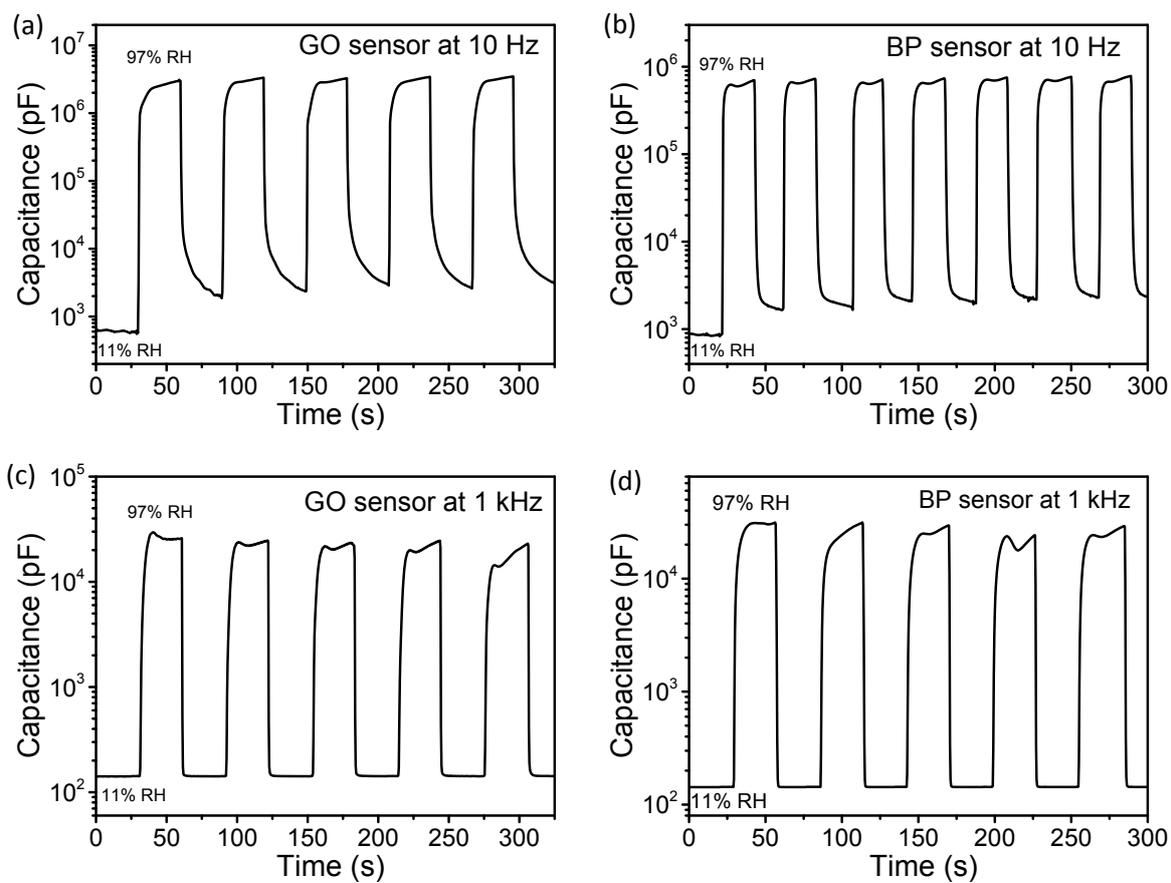


Fig. S9 Time-resolved response behaviour of the GO (a, c) and BP (b, d) sensors under different humidity levels between 11% RH and 97% RH at 10 Hz and 1 kHz.

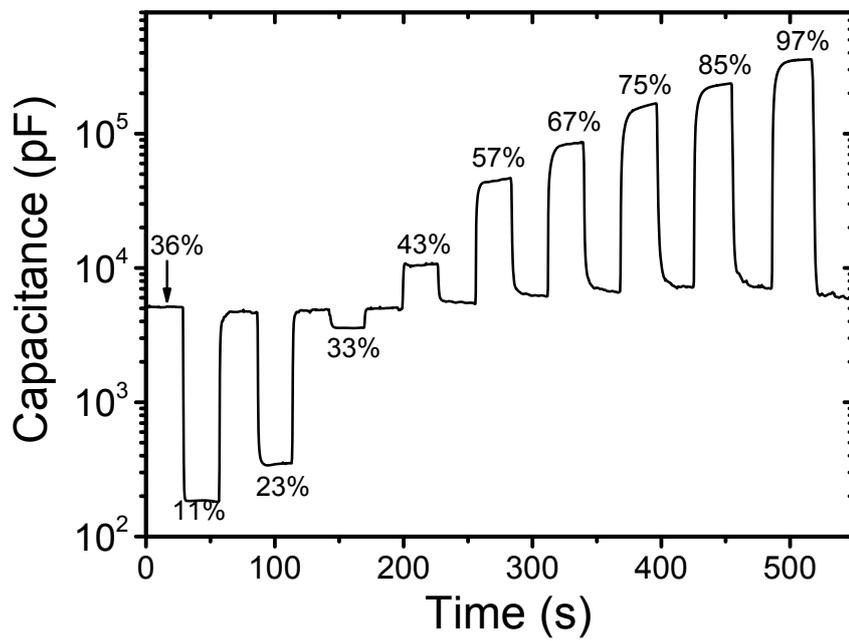


Fig. S10 Time-resolved response behaviour of the BP sensor transferred from room humidity (36% RH) to different humidity levels (11% RH - 97% RH). The measurements were conducted at 100 Hz and with bias voltage of 0.5 V.

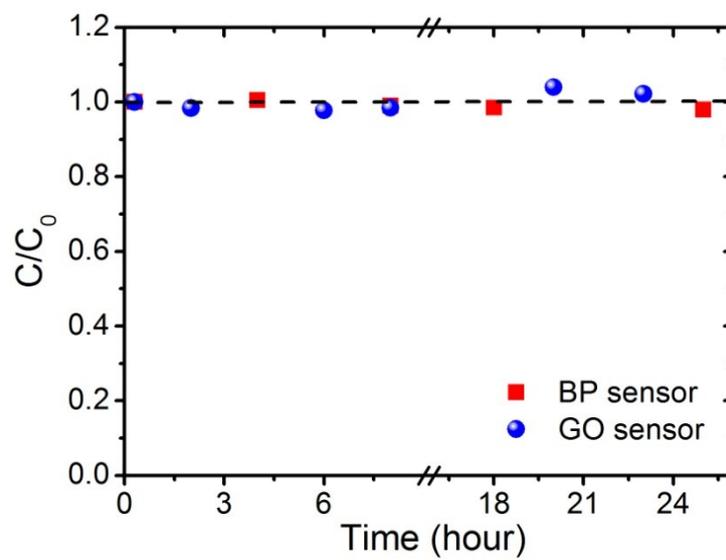


Fig. S11 The relative capacitance of the GO and BP sensor under the fixed humidity condition (11% RH) for about 24 hours.

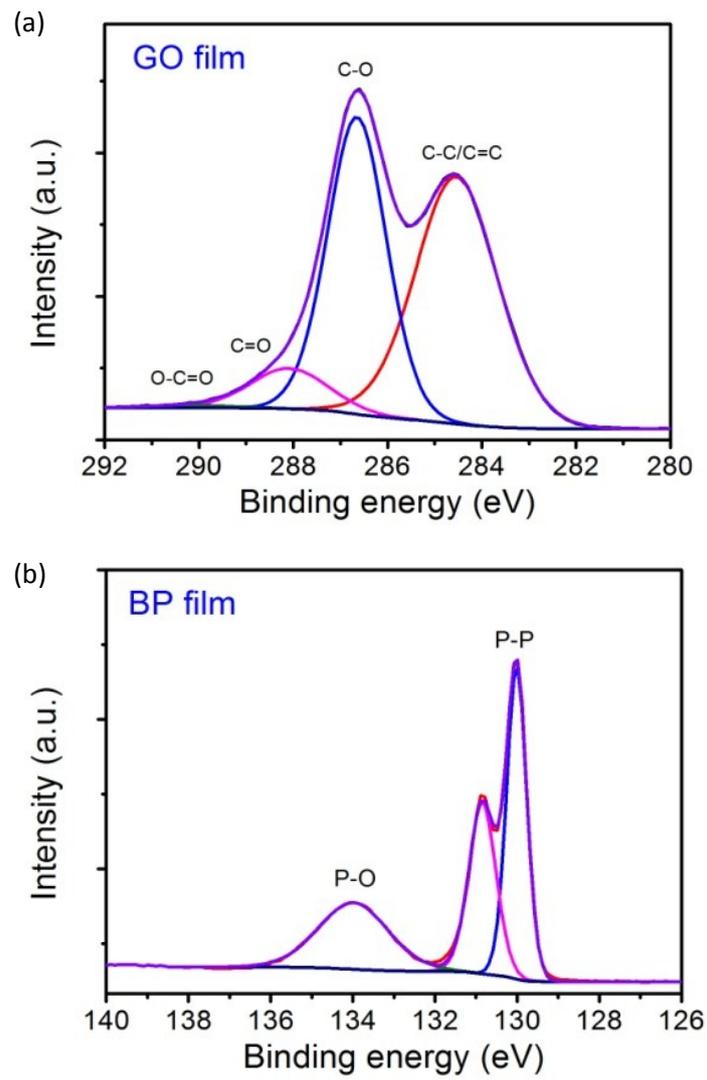


Fig. S12 (a) XPS C1s spectra of the GO film and (b) XPS P2p spectrum of the BP film.

Table S1. Values of R_{ct} , n_1 , and n_2 used in the equivalent circuit obtained over the range of humidity levels by analysing impedance spectra.

		Relative humidity (%)								
		11	23	33	43	57	67	75	85	97
GO sensor	R_{ct} (Ω)	2.05×10^8	2.40×10^7	5.88×10^6	2.59×10^6	1.05×10^6	1.81×10^5	7.56×10^4	4.93×10^4	1.54×10^4
	n_1	0.982	0.979	0.974	0.971	0.990	0.990	0.997	1	1
	n_2	–	–	–	–	0.061	0.088	0.096	0.132	0.223
BP sensor	R_{ct} (Ω)	1.30×10^8	3.07×10^7	6.07×10^6	2.46×10^6	5.22×10^5	3.29×10^5	1.72×10^5	1.04×10^5	6.27×10^4
	n_1	0.984	0.982	0.980	0.977	0.989	0.990	0.991	0.996	1
	n_2	–	–	–	–	0.150	0.225	0.255	0.267	0.283