Experimental Section

Synthesis of Graphene Oxide

The chemicals were analytical reagent grade and used as received without further purification. Graphene Oxide (GO) was synthesized from natural graphite powder using modified Hummer's method.[1] In brief, 0.5g graphite powder was mixed with 0.74 g of $NaNO_3$ and 34 mL H_2SO_4 (98%), and vigorously stirred in an ice-water bath. Then 5.0 g of $KMnO_4$ was later slowly added, and the temperature was maintained at less than 20°C. This mixture was stirred at 35 °C for 3 h. After that, 250 ml of water and 4 mL of H_2O_2 (30 wt %) were further added slowly. The obtained bright yellow suspension was washed 5 times with HCl and water (1:10 v/v). The solid (GO) was finally dried at 50 °C overnight.

Reduction of Graphene Oxide

In a typical experiment, 50 mg of the as-prepared GO were dispersed into 50 mL of DI water by sonicating for 1h. Then 50 μL of hydrazine monohydrate was added, and the mixture was heated at 95°C for 1h. After centrifugation and washing with water and ethanol several times, the obtained reduced graphene oxide (rGO) was re-dispersed in 50 mL deionized water by sonication for 1h.

Preparation of Polyaniline and Reduced graphene oxide-Polyaniline PET films

The PET film (1cm × 1cm) was cleaned by sonicating in acetone and washed with ethanol and dried at 50 °C. In a typical procedure, aniline was first distilled under vacuum to remove the oxidation impurities. The weight feed ratio of aniline to rGO was varied as 99.9 : 0.1, 99.5 : 0.5, 99.0 : 1.0 and 97.5 : 2.50, and the resulting hybrids were named as PRG0.1, PRG0.5 , PRG1.0 and PRG2.5, respectively. The purified aniline (0.137 mL) and a certain amount of rGO were dissolved in 15 mL of 1 M HCl aqueous solution by sonicating 15min. And the ammonium peroxydisulfate (APS, 0.3423g) in 15 mL of 1 M HCl aqueous solution was poured in the aniline solution with vigorous stirring at ice-water bath. After that, a piece of pretreated PET film was rapidly added and kept for 30 min at ice-water bath. At the end, the green PET film with polymerized PANI was taken out and the resultant precipitates were collected via washed with water and ethanol. The film and the precipitates were dried at 50 °C. For comparison, pure PANI-PET film was prepared in the absence of rGO using a similar procedure.

Characterization

Crystallographic information for the samples was collected using powder X-ray diffraction (XRD, Rigaku D/MAX-2500 diffractometer, copper Kα radiation with λ= 0.154 nm). A scanning rate of $10^\circ\ \mathrm{min}^{-1}$ was applied to record the patterns in the range 10-50° (2θ). The product morphology was examined by field emission scanning electron microscopy (FESEM, Zeiss Supra 55, on 20.0 kV). Room-temperature Raman spectra were obtained using an RM 2000 microscopic confocal Raman spectrometer with 532 nm laser excitation. X-ray photoelectron spectroscopy (XPS) spectra were recorded on an X-ray photoelectron spectrometer (VG ESCALAB-MK) with aluminum Kα radiation.

Sensor fabrication and response measurement

The film of PANI-PET or PET film of hybrid was welded on a special pedestal with six poles by silver paint. The sensing properties to NH_3 were measured at room temperature using a JF02E sensor test system with an 18 L chamber and one fan (Guiyang Jinfeng Technology Co., Kunming, China). The Film was placed in the chamber, calculated amount of ammonia hydroxide was rapidly dropped onto a hot plate in the chamber to generate 10, 20, 40, 80 and 100 ppm $NH_{3,}$ after that, the film was exposed to air to measure their change of resistance in gas and air, respectively. The response of NH_3 is defined as the ratio of $R_{gas}/R_{air,}$ where the R_{air} is the resistance of the film in air and the R_{gas} is the resistance of the film in testing gases. The selectivity of film was also measured by the same method except dropped methylbenzene, methanol, formaldehyde, acetone and ethanol, respectively. The response time and recovery time were defined as the time to reach 90% of the final signal.[2]

Supporting Figures

Table 1 Gas-sensing properties to NH_3 in the present work and other composites reported in the literature.

Materials	Concentration (ppm)	Operating temperature	Response/recovery times (s/s)	sensor response	Reference
Graphene/PANI	100	RT	50/23	11.33	[3]
PANI/TiO_2	117	RT	18/58	5.55	[4]
Core-shell PANI	1	RT	150/300	0.11	[5]
Processable PANI	100	RT	120/300	2.3	[6]
CeO_2-PANI	50	RT	57.6/--	6.5	[7]
rGO-PANI	100	RT	20/27	344.2	This work

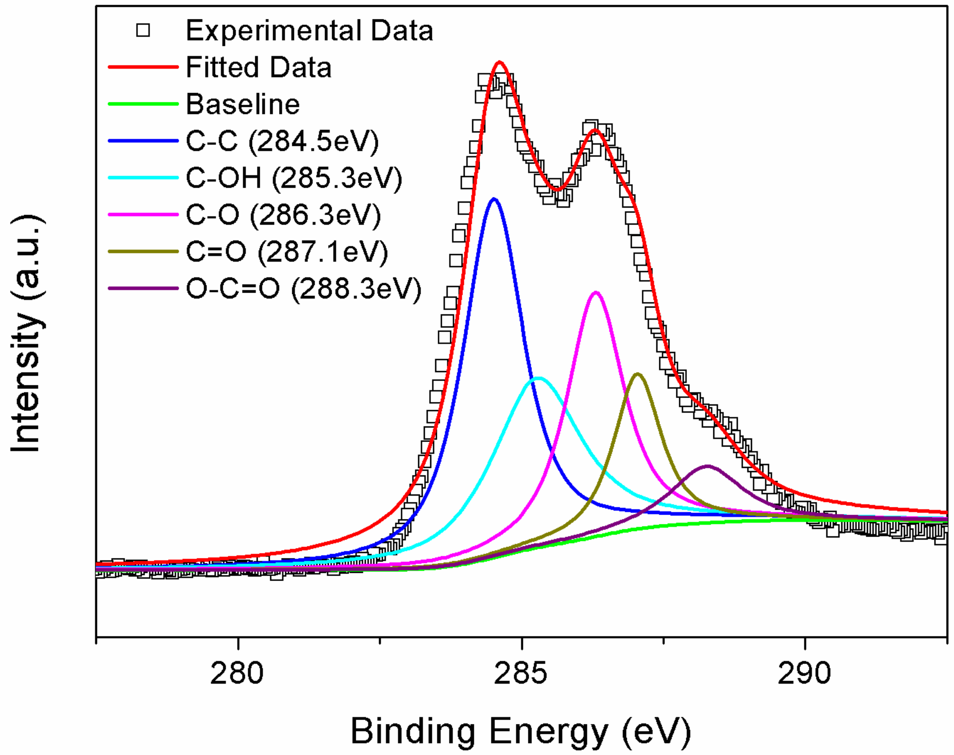

Fig.S1 XPS spectra of the C1s region of GO.

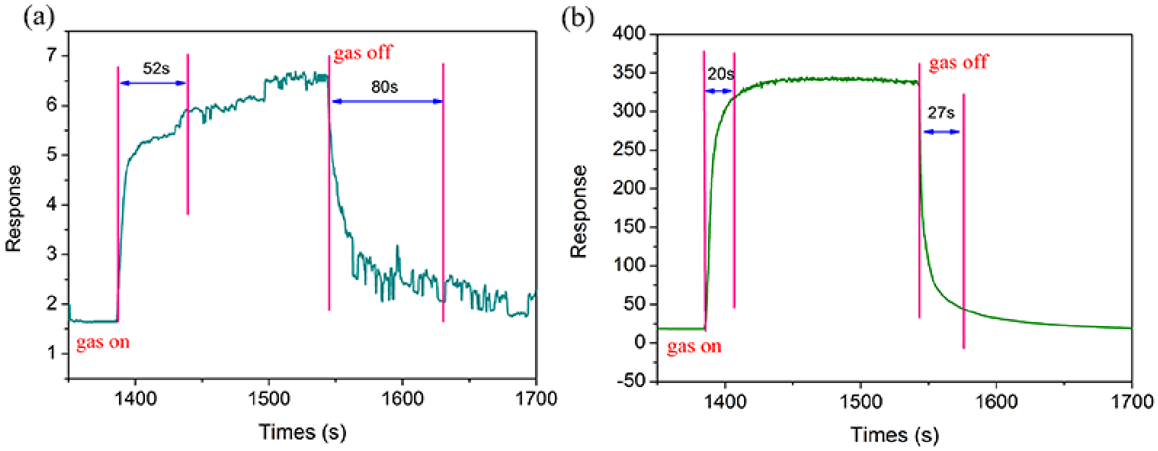

Fig. S2 Response time and recovery time of (a) PANI and (b) PRG1.0 to 100 ppm NH_3.

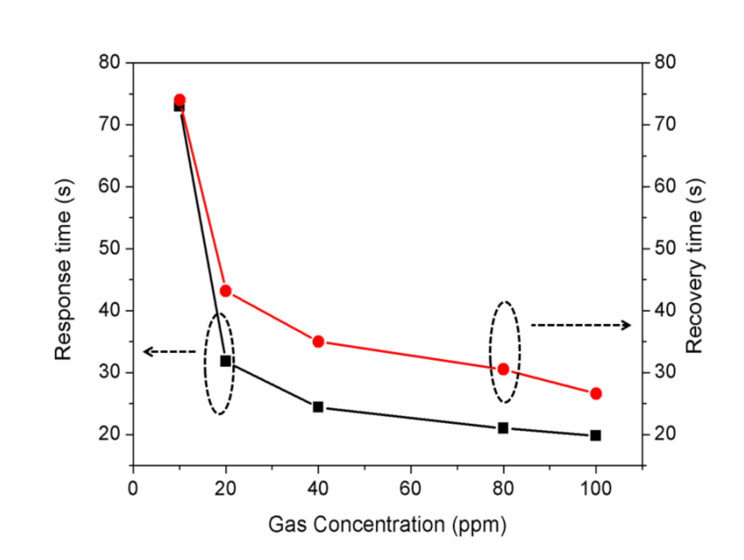

Fig. S3 Response time and recovery time of PRG1.0 to 10–100 ppm NH_3.

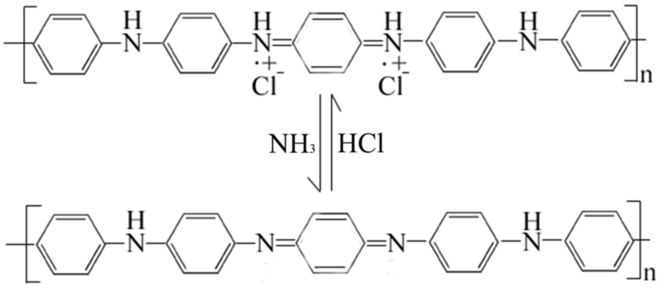

Fig. S4 Schematic diagram of sensing mechanism for PANI to NH_3 gas

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