

## CORRECTION

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[View Journal](#) | [View Issue](#)Cite this: *J. Mater. Chem. A*, 2019, 7, 1357**Correction: Graphene materials as a superior platform for advanced sensing strategies against gaseous ammonia**Kumar Vikrant,<sup>a</sup> Vanish Kumar<sup>b</sup> and Ki-Hyun Kim<sup>\*a</sup>

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[www.rsc.org/MaterialsA](http://www.rsc.org/MaterialsA)Correction for 'Graphene materials as a superior platform for advanced sensing strategies against gaseous ammonia' by Kumar Vikrant *et al.*, *J. Mater. Chem. A*, 2018, 6, 22391–22410.

The authors regret the following errors in the original manuscript.

(1) Table 1 and the related discussion contains some errors in the values presented. The corrected version of Table 1 and the corrected sentences are shown here.

Page 7 (left column): These graphene sheets were further transferred onto a silica insulator to showcase a good NH<sub>3</sub> sensing capability (detection limit (DL) of 250 ppm with 500 s response time)<sup>66</sup> (Table 1).

Page 7 (left column): In a similar approach, controlled CVD-grown graphene sheets showcased a DL of 0.5 ppm for gaseous NH<sub>3</sub> under ambient conditions with good reversibility by desorbing the adsorbed species at 200 °C under vacuum *via* a hot plate (Fig. 4).<sup>39</sup>

Page 7 (left column): Interestingly, NSM graphene showcased better sensitivity and performance (DL of 1 ppm with 300 s response time) compared to double layer graphene and more stacked, few-layer types of graphene sensors (Table 1) (Fig. 5).

Page 8 (left column): Ti/Gr showcased good performance (DL of 18 ppm with 150 s response time) ascribed to the catalytic synergistic effect between graphene and naturally produced TiO<sub>x</sub>.<sup>72</sup> (Table 1).

Page 8 (right column): In a similar approach, a mica-supported graphene-based detector was observed to perform well (DL of 20 ppm with 60 s response time) for gaseous NH<sub>3</sub> sensing with an enhanced sensitivity, which can be attributed to the higher p-doping induced in the graphene framework by mica (Table 1).<sup>72,76</sup>

Page 8 (right column): The P-GNS-400 displayed good performance (DL of 1 ppm with 134 s response time) toward NH<sub>3</sub> sensing, which may be attributed to the presence of electron rich phosphorus species (Table 1).<sup>78</sup>

Page 8 (right column): The GMHW showcased excellent performance (a DL of 0.3 ppm with a 0.4 s response time) to support the great potential of such a sensing method (Table 1).<sup>81</sup>

Page 9 (right column): A graphene/PANI nanocomposite was synthesized for effective sensing of gaseous NH<sub>3</sub> (DL of 1 ppm with 50 s response time) (Table 1).<sup>28</sup>

Page 9 (right column): In light of these factors, GO, ZnO, and PANI were synergistically combined to obtain hybrid layer-by-layer films (PANI/GO/PANI/ZnO LbL) for effective sensing of gaseous NH<sub>3</sub> (DL of 23 ppm with 30 s response time) (Table 1).<sup>22</sup>

Page 10 (left column): An inexpensive and highly flexible polymer polyethylene terephthalate (PET) was used as a substrate to synthesize an rGO-PANI loaded hybrid gaseous NH<sub>3</sub> sensor (a DL of 100 ppm with a 20 s response time) (Table 1).<sup>95</sup>

Page 10 (left column): The developed system demonstrated a fairly average performance compared to other sensors (a DL of 50 ppm with a 1080 s response time) (Table 1).

Page 10 (left column): For sensing applications, PET was used as a substrate to fabricate graphene quantum dots (tied edge graphene sheets with a lateral size ≤100 nm) doped with N and S (S,N-GQD/PANI; a DL of 0.5 ppm with a 115 s response time).

Page 10 (right column): Cobalt (Co(II) ion) bearing tetra-baminephthalocyanine, coupled covalently with GO, was applied for sensing gaseous NH<sub>3</sub> with a DL of 0.8 ppm (Table 1) (Fig. 10).<sup>102</sup>

Page 10 (right column): The fluorination method was utilized to insert fluorine atoms onto the GO surface to form f-GO sensors for gaseous NH<sub>3</sub> (DL of 100 ppm) (Table 1).<sup>45</sup>

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Table 1 Application of graphene-based sensors for gaseous NH<sub>3</sub>

Order	Graphene-based material	Detection limit		Response time (s)	Reference
		Raw information	In ppm		
1	CVD synthesized graphene	250 ppm	250	500	66
2	CVD synthesized graphene	500 ppb	0.5	—	39
3	NSM graphene	1 ppm	1	300	25
4	Ti/Gr	18 ppm	18	150	9
5	TiO <sub>2</sub> /PPy-GN	1 ppm	1	36	41
6	Graphene/mica	20 ppm	20	60	76
7	NO <sub>2</sub> -doped graphene	1 400 ppb	1.4	—	44
8	Graphene/Au NP	6 ppm	6	—	40
9	GMHW	0.3 ppm	0.3	0.4	81
10	P-GNS-400	1 ppm	1	134	78
11	PANI/GO/PANI/ZnO LbL film	23 ppm	23	30	22
12	rGO-PANI hybrid loaded PET film	100 ppm	100	20	95
13	S,N-GQD/PANI	500 ppb	0.5	115	43
14	rGO-PANI	50 ppm	50	1080	96
15	Graphene/PANI	1 ppm	1	50	28
16	aPcM-GO	800 ppb	0.8	—	102
17	f-GO	100 ppm	100	—	45
18	PEDOT-PSS/GO	1 ppm	1	95	107
19	rGO	430 ppb	0.43	—	151
20	rGO	1 ppm	1	1.4	111
21	rGO/Ag	—	—	10	113
22	NiPc/rGO	800 ppb	0.8	200	116
23	ZnO-rGO	500 ppb	0.5	50	117
24	PPy/rGO	1 ppm	1	—	23
25	rGO/AgNW	15 ppm	15	60	114
26	rGO/P3HT	10 ppm	10	141	123
27	ZnO/rGO	10 ppm	10	78	133
28	PMMA/rGO	10 ppm	10	60	26
29	Pd/SnO <sub>2</sub> /rGO	5 ppm	5	420	125
30	Pd NP/TiO <sub>2</sub> MR/RGO film	2.4 ppm	2.4	184	57
31	ZnO NW-RGO	1 ppm	1	50	25
32	rGO/TBPOMPC	0.3 ppm	0.3	—	37
33	RGO/3-CuPc	400 ppb	0.4	—	42
34	Cu <sub>2</sub> O nanorod/rGO	100 ppm	100	28	119
35	rGo/SnO <sub>2</sub> -nanorod	200 ppm	200	8	121

Page 10 (right column): The PEDOT-PSS GO sensors displayed relatively enhanced sensitivity but with a rather slow response (a DL of 1 ppm with a 95 s response time) in the presence of common volatile gaseous pollutants such as ethanol, methanol, propanol, acetone, and chlorobenzene<sup>107</sup> (Table 1).

Page 11 (left column): GO can be reduced chemically *via* a pyrrole to make rGO-based sensors with good performance and selectivity toward gaseous NH<sub>3</sub> (a DL of 1 ppm with a 1.4 s response time) (Table 1).<sup>111</sup>

Page 11 (right column): In a similar approach, rGO nanosheets were coated onto Ag nanowires (rGO/AgNWs) to fabricate sensors for effective detection of gaseous NH<sub>3</sub> with good stability and recovery (a DL of 15 ppm with a 60 s response time) (Table 1).<sup>114</sup>

Page 11 (right column): Tetra- $\alpha$ -iso-pentyloxypthalocyanine nickel (NiPc) was synergistically combined with rGO to fabricate sensors for gaseous NH<sub>3</sub> detection with a DL of 0.8 ppm (a response time of 200 s) (Table 1).<sup>116</sup>

Page 12 (left column): ZnO nanowires were also combined with rGO for detection of gaseous NH<sub>3</sub> (a DL of 0.5 ppm with a 50 s response time) (Table 1).<sup>117</sup>

Page 12 (left column): Likewise, Cu<sub>2</sub>O nanorods were synergistically combined with rGO to effectively detect gaseous NH<sub>3</sub> with good sensitivity at room temperature (a DL of 100 ppm with a 28 s response time)<sup>119</sup> (Table 1).

Page 12 (left column): Similarly, SnO<sub>2</sub> nanorods were synergistically combined with rGO to effectively detect gaseous NH<sub>3</sub> (a DL of 200 ppm with an 8 s response time) at room temperature with good sensitivity<sup>121</sup> (Table 1).

Page 12 (right column): Polypyrrole (PPy) was anchored on the surface of rGO nanosheets to fabricate a PPy/rGO hybrid composite sensor for gaseous NH<sub>3</sub> detection (a DL of 1 ppm) (Table 1).<sup>23</sup>

Page 12 (right column): Poly (3-hexylthiophene) was coupled with rGO to form nanocomposite (rGO/P3HT) sensors for gaseous NH<sub>3</sub> detection (a DL of 10 ppm with a 141 s response time) with appreciable selectivity in the presence of interfering substances like CO<sub>2</sub>, CO, SO<sub>2</sub>, and NO<sub>2</sub> (ref. 123) (Table 1).



Page 12 (right column): A ternary nanocomposite film sensor, synergistically combining Pd, SnO<sub>2</sub>, and rGO (Pd/SnO<sub>2</sub>/rGO), was developed for effective detection of gaseous NH<sub>3</sub> (a DL of 5 ppm with a 420 s response time) (Table 1).<sup>125</sup>

Page 13 (right column): This ternary sensor showed sensing performance for gaseous NH<sub>3</sub> (a DL of 2.4 ppm with a 184 s response time) at room temperature with great stability, sensitivity, and selectivity (Table 1).<sup>57</sup>

Page 13 (right column): This nanocomposite sensor displayed good performance for NH<sub>3</sub> sensing (a DL of 0.05 ppm with a 50 s response time) at room temperature with good recovery (Table 1).<sup>37</sup>

Page 13 (right column): This sensor showed average detection capability for gaseous NH<sub>3</sub> (a DL of 0.4 ppm) with good reversibility and selectivity in the presence of H<sub>2</sub>, CH<sub>4</sub>, CO, and CO<sub>2</sub> (Fig. 14(b)) (Table 1).<sup>42</sup>

Page 14 (left column): In this regard, poly(methyl methacrylate) was coupled with rGO to form nanocomposites (PMMA/rGO) for effective detection of gaseous NH<sub>3</sub> based on SPR technology (a DL of 10 ppm with a 60 s response time)<sup>26</sup> (Table 1).

Page 14 (right column): The lowest detection limit of 0.3 ppm was reported amongst the graphene-based systems using the GMHW and rGO/TBPOMPC<sup>37,81</sup> (Table 1).

(2) Table 2 and the related discussion contains some errors in the values presented. The corrected version of Table 2 and the corrected sentences are shown here.

Page 14 (right column): For other advanced nanostructures, the lowest reported DL was 0.5 ppm for a single wall carbon nanotube-pyrene (SWCNT-pyrene) composite and silica doped CeO<sub>2</sub> (ref. 131 and 132) (Table 2).

Page 15 (left column): In this regard, PANI nanofibers were synergistically combined with WS<sub>2</sub> nanosheets to maximize the sensitivity toward gaseous NH<sub>3</sub> (DL of 50 ppm with 260 s response time)<sup>54</sup> (Table 2).

Page 15 (left column): However, PANI-nanofiber/WS<sub>2</sub> nanosheets displayed poor performance under similar conditions compared to graphene/PANI composites (a DL of 1 ppm with a 50 s response time) (Tables 1 and 2).

Page 15 (left column): On a similar note, cheap and biocompatible ZnO nanospheres with favorable electrical properties were doped with Mn (to increase the amount of surface defects) for effective sensing of gaseous NH<sub>3</sub> (a DL of 20 ppm with a 4 s response time).<sup>134</sup>

Table 2 Application of nanomaterials for gaseous NH<sub>3</sub> sensing

Order	Nanomaterial	Detection limit			Reference
		Raw information	In ppm	Response time (s)	
1	ZnO-PANI	10 ppm	10	21	152
2	PANI-CNT	4 ppm	4	18	153
3	Pd-PANI	10 ppm	10	100	154
4	SWCNT-pyrene	0.5 ppm	0.5	5	131
5	Mn-doped ZnO nanosphere	20 ppm	20	4	134
6	Al-ZnO/CuO	100 ppm	100	14	155
7	Ag/ZnO	10 ppm	10	—	156
8	HCl doped-PANI-nanofiber/WS <sub>2</sub> nanosheet	50 ppm	50	260	54
9	PQT-12/CdSe QD	20 ppm	20	50	157
10	InHCF-NP	3 ppm	3	360	158
11	WS <sub>2</sub> /TiO <sub>2</sub> QD	0.8 ppm	0.8	—	159
12	Silica modified-CeO <sub>2</sub>	0.5 ppm	0.5	760	132
13	ZnFe <sub>2</sub> O <sub>4</sub>	100 ppm	100	95	160
14	Pt/NiO thin film	10 ppm	10	15	106

The Royal Society of Chemistry apologises for these errors and any consequent inconvenience to authors and readers.

