Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

Enhanced Ammonia Sensing with Reduced Graphene Oxide–Tin Oxide Hybrid Film at Room Temperature

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The scanning electron microscope (SEM) images of the 10: 4, 10: 5 and 1: 1 (RGO: SnO_2) samples are shown in Fig. S1.

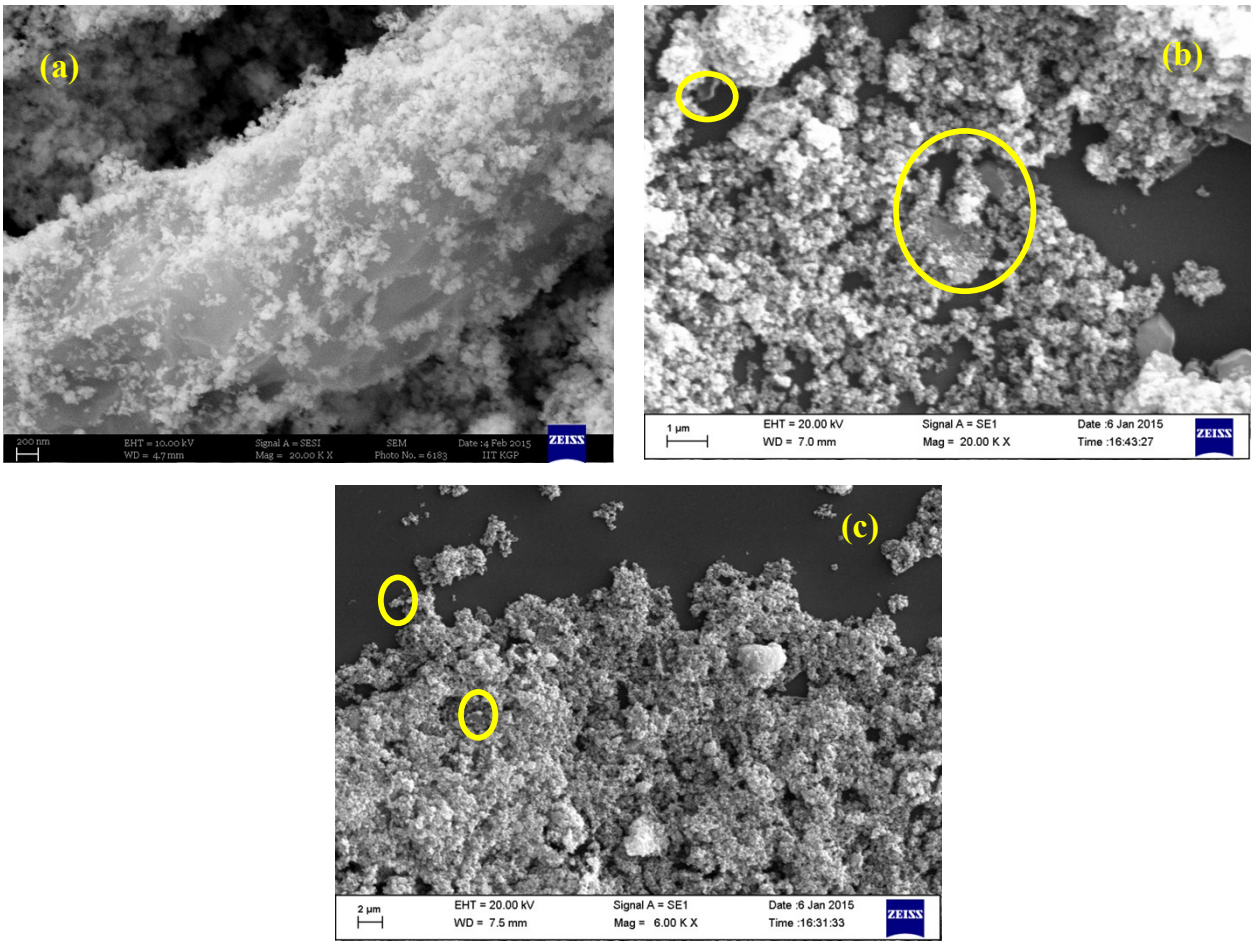

Fig. S1 SEM images of (a) 10: 4 (RGO: SnO_2) (b) 10: 5 (RGO: SnO_2) and (c) 1: 1 (RGO: SnO_2) samples

The SnO_2 nanoparticles attached RGO flake is shown in Fig. S1. The RGO flakes in the hybrid samples are marked in the respective images. As it was difficult to differentiate between the samples with different SnO_2 wt % through SEM images, energy dispersive X-ray spectroscopy (EDAX) was carried out to ensure the ratio of GO to SnO_2 in the hybrid samples.

The conductivity of 30 minutes thermally reduced GO was measured to be 7.726 S/m at room temperature. No measurable conductivity of SnO_2 nanoparticles was observed at room

temperature. The conductivity of SnO_2 nanoparticles at 200 ºC was found to be 8.09×10^{-2} S/m and that of RGO−SnO_2 hybrid sample was found to be 2.55×10^{-3} S/m at room temperature.

The response times of the hybrid samples were found to be faster than that of RGO and were comparable to that of SnO_2 nanoparticles as can be seen in Fig. S2.

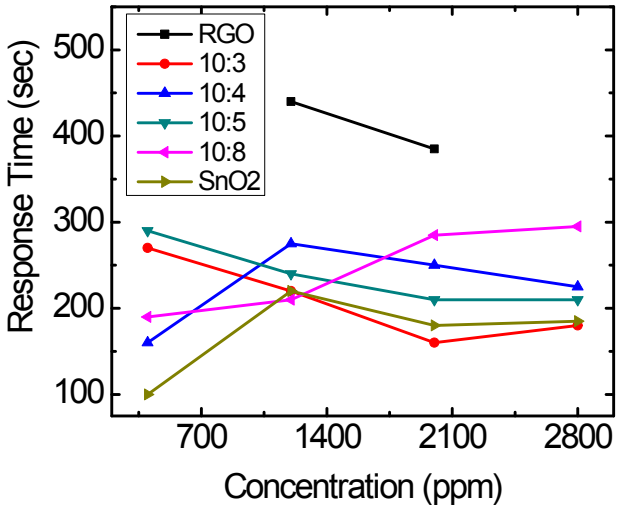

Fig. S2 Comparative plot of response times of RGO, RGO−SnO_2 hybrid samples and SnO_2 nanoparticles for different concentrations of ammonia

The 10: 5 (GO: SnO_2) sample was drop casted on IDE and reduced for 30 minutes at 160 º C. The hence prepared sample was exposed to four different concentrations of ammonia as is shown in Fig. S3 (a)

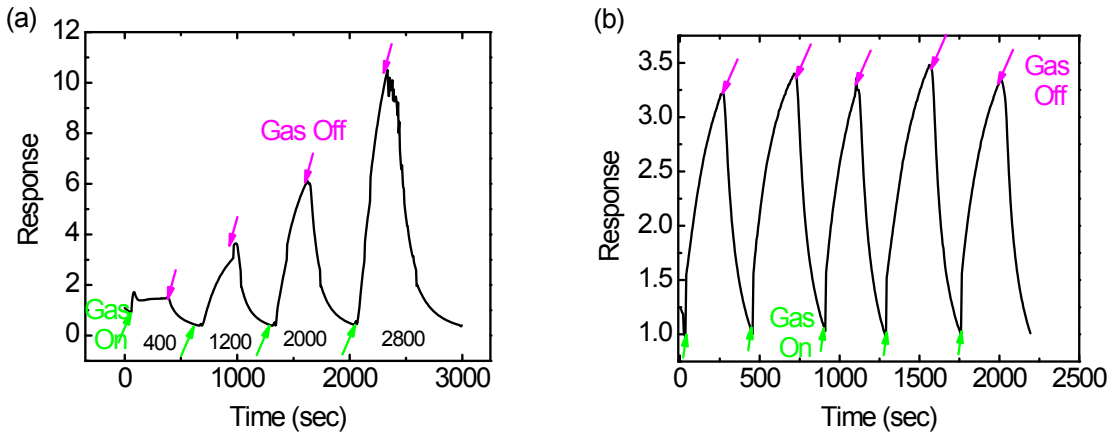

Fig. S3 (a) Response of 10: 5 (RGO: SnO_2) hybrid sample towards ammonia (400– 2800 ppm) (b) repeatable response of the 10: 5 (RGO: SnO_2) sensor towards 1200 ppm of ammonia.

The wt% of SnO_2 was increased to 1: 1 (RGO: SnO_2) and its performance against ammonia was observed. It was observed that the resistance of the 1: 1 (RGO: SnO_2) sample increased to a not measurable value when purged with dry air at room temperature. So, the temperature was increased and the resistance of the 1: 1 (RGO: SnO_2) samples decreased to a measurable value at around 290 ºC. So, the ammonia test was carried out at 300 ºC. The response of the 1: 1 (RGO: SnO_2) towards four different concentrations of ammonia at 300 ºC is shown in Fig. S4.

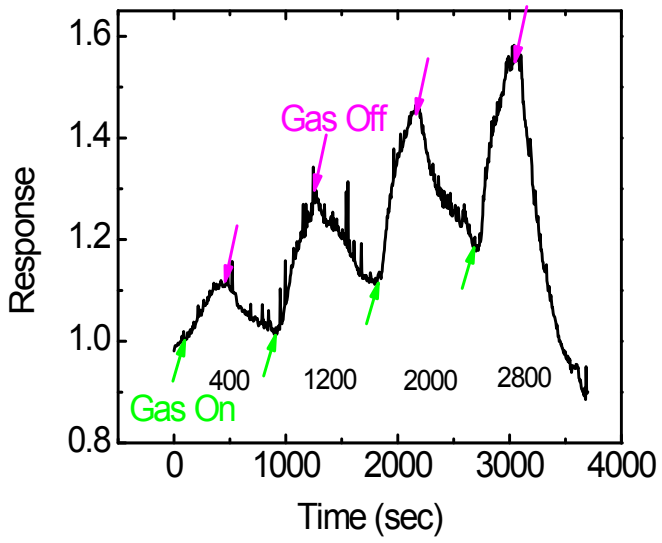

Fig. S4 Response of 1: 1 (RGO: SnO_2) hybrid towards ammonia (400– 2800 ppm) at 300 ºC

The hydrothermally synthesized RGO–SnO_2 samples didn't show any resistance at room temperature. So, the gas test was carried out at 120 ºC because the sample showed measurable resistance at around 117 ºC.

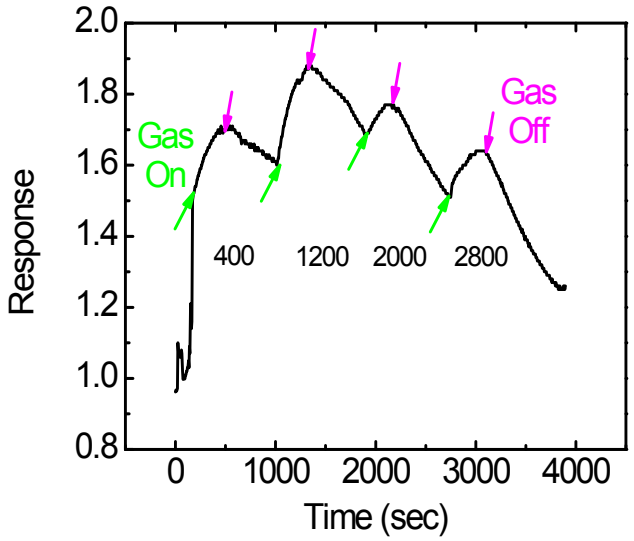

Fig. S5 Response of hydrothermally synthesized RGO– SnO_2 hybrid sample towards ammonia (400– 2800 ppm) at 120 ºC

The response of the hydrothermally synthesized sample is shown in Fig. S5. The response of the sample saturated after 1200 ppm as is evident from Fig. S5. The sample showed a response of 1.9 times against 1200 ppm ammonia but it gradually decreased from 1.75 times (against 2000 ppm ammonia) to 1.6 times (against 2800 ppm ammonia). The probable reason for such behavior is deficiency of enough active sites for ammonia to get attached.