Electronic Supplementary Information

An Electrical Solid State Sulphur dioxide Vapour Sensor based on Polyvinyl alcohol Formaldehyde Composite

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1. Synthesis of PVFCNPs, PVFCNTs, PVFTH and PVFCY

50 g of PVA was dissolved in deionized water by vigorous stirring with a magnetic stirrer at 95 °C until completely dissolved. It was then followed by addition of formaldehyde (10 ml) and PEG-100 (1.5 g) into the hot PVA solution with vigorous stirring. 30 mg/ml solution of CNTs was added to the froth followed by addition of 15 ml conc. H₂SO₄ at room temperature. The raw material was oven dried for 5 h. The unreacted materials was removed by washing 5 times with deionized water. The sample so obtained was finally dried for 1 h at 60 °C.

Similarly, PVFCNTs was prepared by adding an aqueous solution 0.02 g of CNTs. PVFCY and PVFTH were also prepared by slight modification with the addition of 0.1g aqueous solution of cytochrome c and 1 ml thiophene respectively.

2. Thermogravimetric analysis (TGA)

TGA of the synthesized composite materials-PVF, PVFCNTs, PVFCNPs, PVFTH, PVFCY and PVFCOU are carried out. The thermograms suggest that the materials are considerably stable and their complete degradation take place at 600 °C.
Fig. S1 TGA of the synthesized materials-PVF, PVFCNTs, PVFCNPs, PVFTH, PVFCY and PVFCOU.

3. EDAX analysis of PVFTH/PVFTHSO\(_2\) and PVFCOU/PVFCOUSO\(_2\)

EDAX analysis of PVFTH and PVFCOU are carried out and the EDAX profiles are given below in Fig. S2. It is found that S content of SO\(_2\) impregnated PVFTH increases from 4.28 % (PVFTH) to 10.06% (PVFTHSO\(_2\)) whereas from 0% (PVFCOU) to 4.29% (PVFCOUSO\(_2\)).

Fig. S2 EDAX profiles of (A) PVFTH and PVFTHSO\(_2\); and (B) PVFCOU and PVFCOUSO\(_2\)
4. FT-IR analysis of PVFCNTsSO₂, PVFCNPsSO₂ and PVFCYSO₂

The FT-IR analysis of PVFCNPs, PVFCNTs and PVFCOU were carried out before and after SO₂ sensing and the plot is depicted below in Fig. S3.

![FT-IR spectra](image)

**Fig. S3** FT-IR spectra of (A) PVFCNPs and PVFCNPsSO₂; (B) PVFCNTs and PVFCNTsSO₂; and (C) PVFCOU and PVFCOUSO₂

5. Repetability and reproducibility studies

Sensing studies are carried out for a consecutive three cycles and it is observed that our sensor exhibit good repeatability and reproducibility (Fig. S4). This study indicates that our sensor can be reusable for upto three times.

![Repeatability and reproducibility curves](image)

**Fig. S4** Repeatability and reproducibility curves for SO₂ sensing by PVFCOU for a consecutive three cycles