Composites of Fe_2O_3 nanosheets with polyaniline: preparation, gas sensing properties and sensing mechanism

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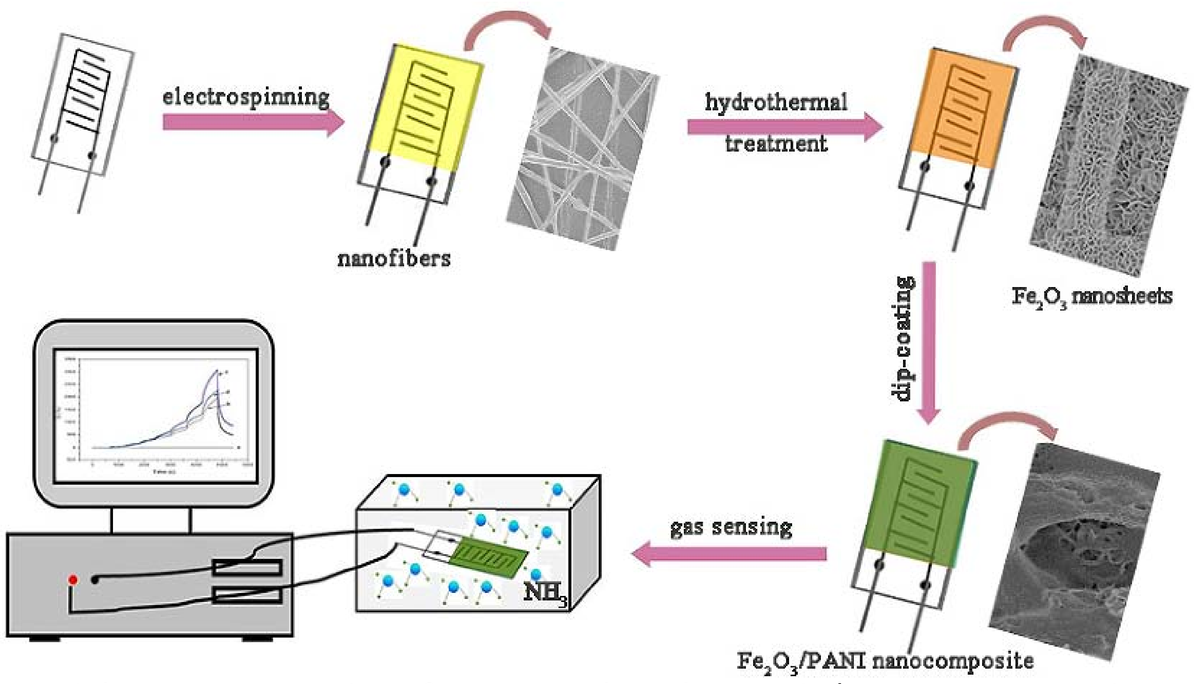
Introduction

➢Gas sensors have played an increasingly important role in various areas. Consequently, there are urgent needs for the development of high performance gas sensitive materials .

➢In this work, we fabricated Fe_2O_3 nanosheets by hydrothermally treating the electrospun nanofibers containing ferric salt precursor. Subsequent coating with water-dispersible PANI obtained Fe_2O_3/PANI nanocomposite.

➢The nanocomposite exhibited much higher response magnitude than either of the constituent, and showed excellent selectivity towards NH_3 at room temperature .



Scheme 1 Preparation of gas sensor based on Fe_2O_3/PANI nanocomposite

Results and discussion

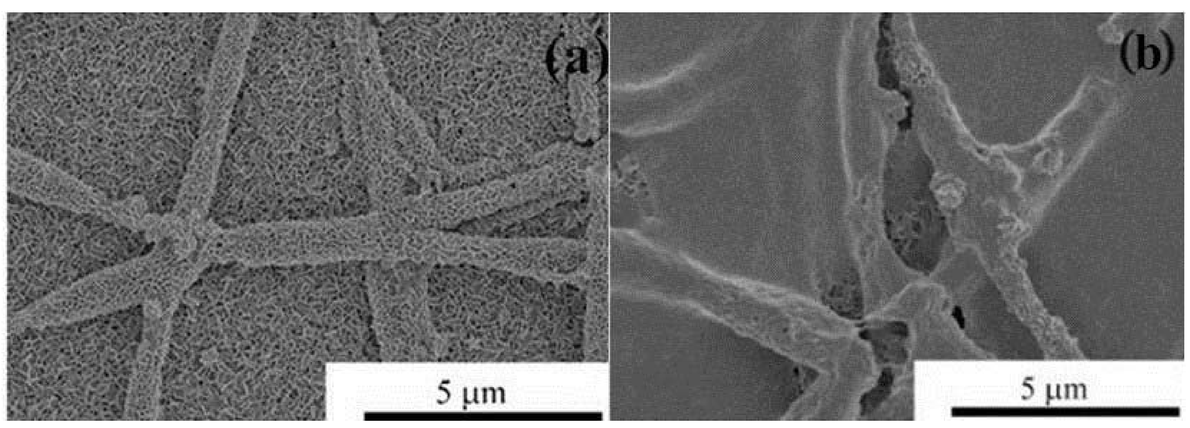


Fig.1 SEM images of (a) Fe_2O_3 nanosheets and (b) Fe_2O_3/PANI nanocomposite

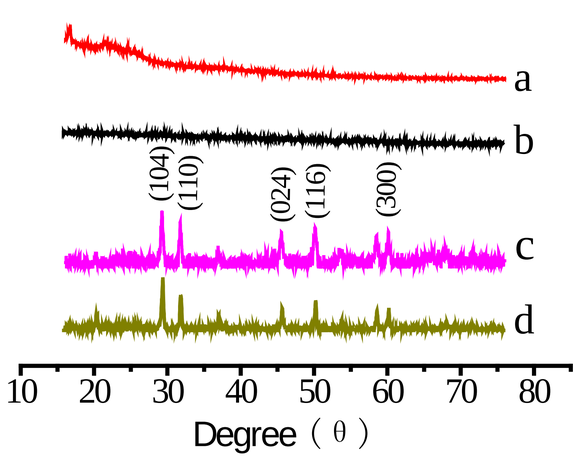


Fig. 2 XRD patterns of (a) PANI, (b) $FeCl_3$ nanofibers, (c) Fe_2O_3 nanosheets and (d) Fe_2O_3/PANI nanocomposite

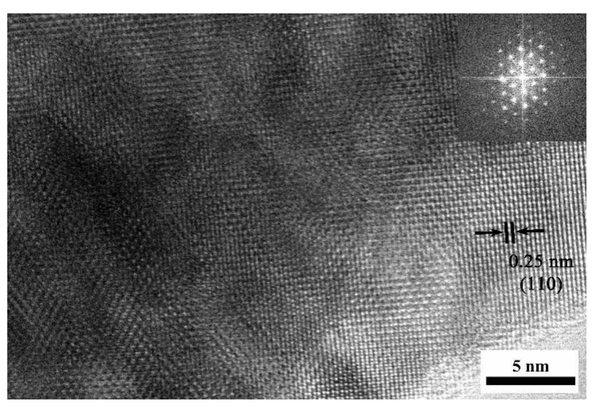


Fig. 3 HRTEM image of Fe_2O_3 nanosheets

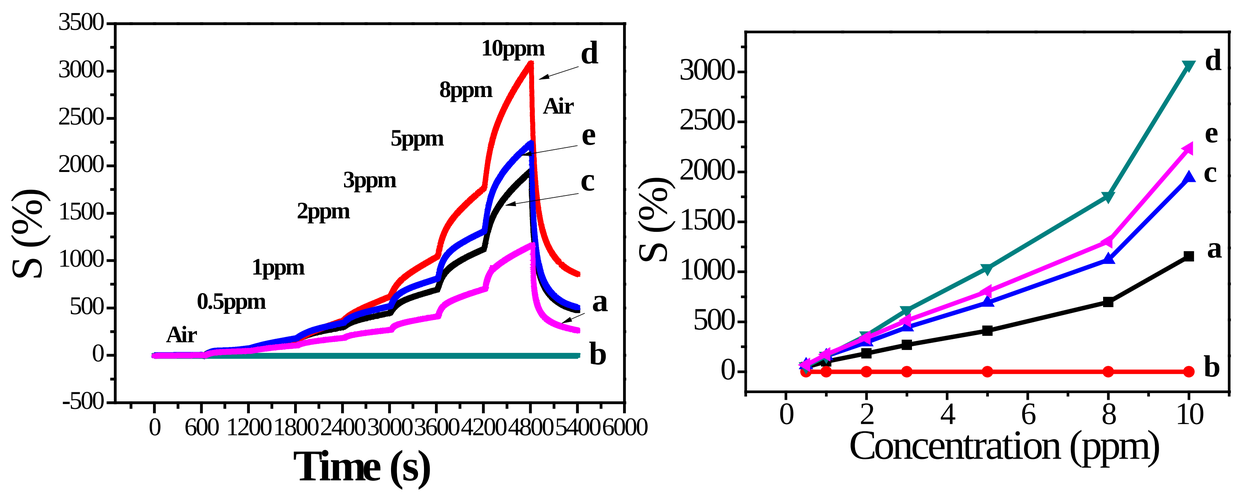


Fig. 4 Dynamic responses to NH_3 of (a) PANI and Fe_2O_3/PANI nanocomposites with various concentrations of PANI solutions (mg/mL): (b) 1 , (c) 5, (d) 10, (e) 15

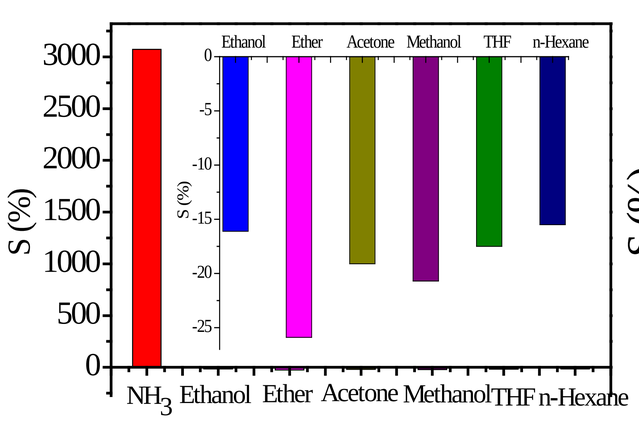


Fig. 5 Response of Fe_2O_3/PANI nanocomposite to different vapors at room temperature

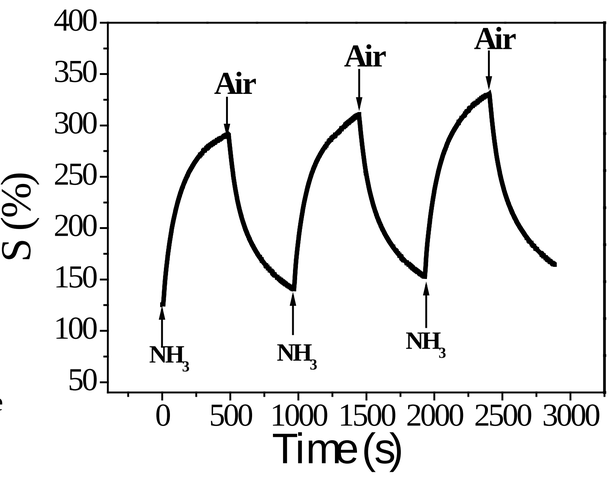
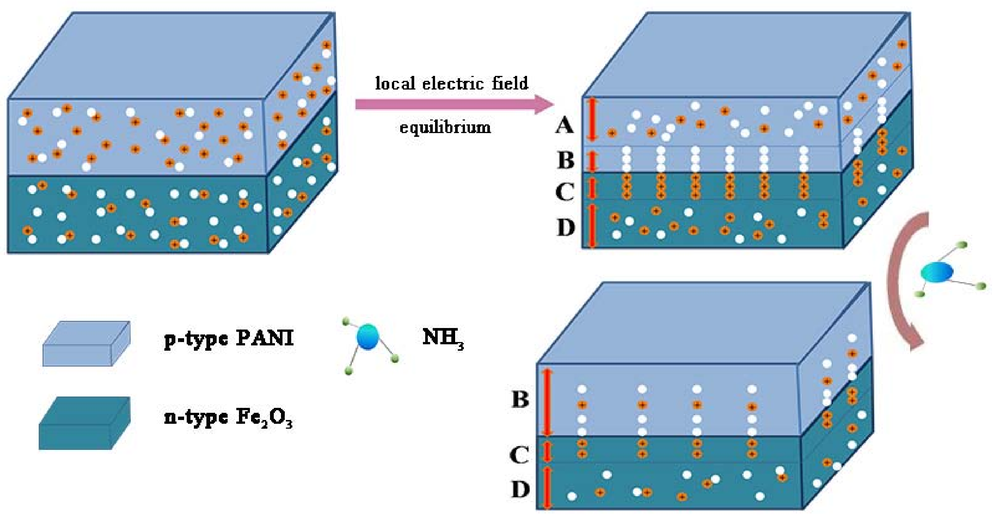


Fig. 6 Dynamic responses of Fe_2O_3/PANI nanocomposite at room temperature during alternate exposure to air and 1 ppm NH_3



Scheme 2 Formation of p-n heterojunction in the nanocomposite and its interactions with NH_3

Conclusion

With a new method combining electrospinning and hydrothermal synthesis, Fe_2O_3 /PANI nanocomposite gas sensor was fabricated. The gas sensor reveals ultrahigh response magnitude towards NH_3 at room temperature (S of 3070% towards 10.7 ppm of NH_3), which is much higher than that of PANI and shows an obvious synergetic effect. Moreover, the sensor is featured with excellent selectivity.

Acknowledgements

This work was financially supported by the National Natural Science Foundation of China (Contract no. 51273174 and 51073134).