Bilayer composite sensor based on polyaniline and polyelectrolyte for sensitive detection of low humidity

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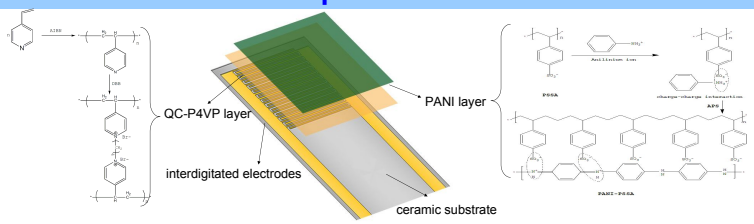
INTRODUCTION

Low humidity measurement plays an important role in gas drying, production of transformer and lithium battery, safe operation of insulating gases in switchgear in power industry, etc. However, detection of low humidity (typically < 10%RH) remains a challenge for the widely-applied polymer resistive-type humidity sensors. Here we report a bilayer-structured composite polymer humidity sensor based on polyaniline and polyelectrolyte for the detection of low humidity with high sensitivity.

Experimental



Scheme 1. Illustration of the bilayer-structured composite humidity sensor

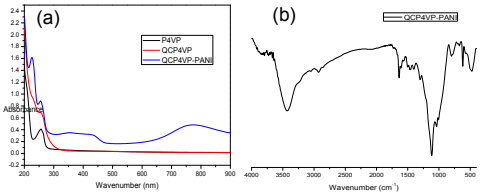


Fig.1. (a) UV-vis spectra and (b) FT-IR spectra of QC-P4VP/PANI

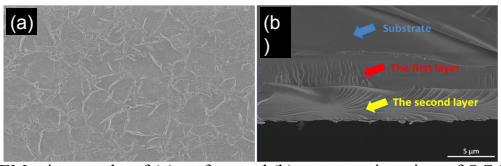


Fig. 2. SEM micrographs of (a) surface and (b) cross-section view of QC-P4VP/PANI

UV–vis spectra and FT-IR spectra show that QC-P4VP/PANI has been formed, with thickness of ~3.5 μm for each layer as revealed by SEM images.

Results and discussion

Humidity Sensing properties

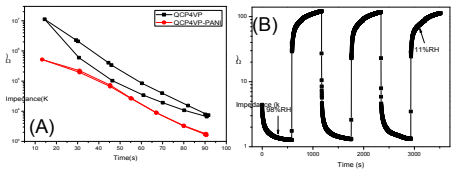


Fig. 3. (A) Calibration curves during humidification and desiccation processes of QC-P4VP and QC-P4VP/PANI (B) Transient responses of QC-P4VP/PANI.

Calibration curves show that the composite exhibited lower impedance and smaller hysteresis than QC-P4VP alone. Moreover, it displayed fast response.

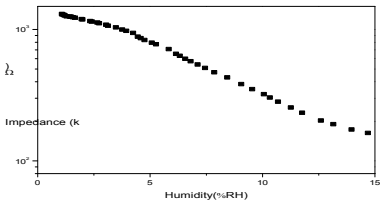


Fig. 4. Calibration curves of QC-P4VP/PANI composite in the low humidity range.

The composite showed high humidity sensitivity even at dry atmosphere (impedance change of ~700% between 1-15%RH), demonstrating its capability of sensibly detecting very low humidity.

Conclusions

The bilayer-structured composite of PANI and QC-P4VP exhibited much lower impedance at dry atmosphere, and thus could detect vey low humidity (down to 1%RH) with high sensitivity. Furthermore, the composite demonstrated much smaller hysteresis and faster response than QC-P4VP alone, and shows potentials of being a high performance humidity sensor for accurate measurement of low humidity.

ACKNOWLEDGMENTS

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