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Using nanocomposite films as a gas sensor for organic compounds

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This research concerns the physical and structural properties of carbon nanotube/conductive polymer composites and their use in gas sensors. A good sensor should be sensitive, reliable, low cost, with fast response and a short recovery time. Carbon nanotubes (CNTs) are well-suited because of their unique properties; their small size, hollow centre, large surface area and good electric conductivity. However, it has been shown that pristine carbon nanotubes have a low response for volatile organic compounds – our target analyse - therefore we attempted to improve this property of CNTs by templating pyrrole on CNTs. Polypyrrole is simple to prepare by oxidation of the monomer and its resistance is very sensitive to organic vapours, although much larger than that of CNTs. TEM and AFM of polypyrrole/CNT composites prepared from single-walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs) show polypyrrole coated the CNTs successfully. There are significant changes in the range of diameters of nano tubes for SWCNTs from (7-10) nm to (8-35) nm and from (2-10) to (21-50) nm for MWCNTs. The composites were tested for the variation in their resistance upon exposure to a range of organic vapours (acetone, chloroform) and to water. The sensing devices comprised simple two-terminal devices over which a layer of the composite was applied by drop-coating. We investigated the effect of the CNT: polypyrrole ratio on the sensor response, S= (R-R0)/R0) where R0 is the resistance in an air atmosphere and R is the resistance at steady-state after exposure to an air/analyte mixture. In general, pure CNTs show a rapid response time, but very low response (typically S< 0. 1) at room temperature. As the amount of polypyrrole in the composite is increased, S increases, the response time deteriorates. Interestingly, the response of the composites may even change sign as a function of target analyse concentration; this suggests that a simple mechanism based on swelling and its effect on the percolation behaviour of CNTs in the polypyrrole matrix is insufficient to explain the data.

Biography

Shams B Ali has completed her MSc from University of Technology/Iraq and she is PhD student at Newcastle University/UK. She is a member in Royal Society of Chemistry and the Iraqi Students Society IQSS. She has published 5 papers in reputed journals.

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