Abstract

This work focuses on synthesis and characterization of conducting Polyaniline (PANI) and PANI-based composite for sensor applications. Polyaniline was synthesized by oxidative polymerization of aniline hydrochloride (AnHCl). HCl doped PANI film was prepared by spin coating from N-methyl -2-pyrrolidone solution, and iodine doped PANI thin film was prepared by thermal evaporation method. Electrical conductivity increased by orders of magnitude when PANI was doped by iodine. Such increase in conductivity is due to formation of polaron. The properties of the HCl doped and iodine-doped films were compared. To overcome the problem of PANI insolubility, synthesis and characterization of PANI - poly (vinyl alcohol) (PVA) composite was done by in situ deposition of PANI emeraldine salt on ammonium persulfate soaked and swollen cross linked PVA substrate by polymerization of AnHCl both on the surface and bulk of PVA hydrogel. The effects of the initiator/monomer mole ratio on the conductivity of the composite films were studied. To increase the conductivity of the PANI composite the films were doped by camphor sulfonic acid (CSA). The dependence of electrical conductivity of the composite films on AnHCl/CSA mole ratio was investigated. The change in conductivity due to the presence of a substituent on the PANI chain was demonstrated by synthesizing poly (aniline-co-m-aminobenzoic acid) deposited on PVA. Finally the materials were used for sensing of (i) ammonia by HCl doped PANI film and HCl doped PANI-PVA composite film, (ii) terpenes (farnesene and linalool) by CSA doped PANI–PVA composite, and (iii) Esters (hexenyl butyrate and hexenyl acetate) by poly (aniline-co-m-aminobenzoic acid). The HCl doped PANI-PVA composite film showed better response to ammonia compared to the HCl doped polyaniline film. This was explained on the basis of the porous nature of the composite film, which enhances adsorption and desorption of ammonia during sensing. For terpene sensing, the CSA doped film was found to be highly selective and sensitive to linalool vapors. For ester sensing the co-polymer film is found to be selective towards hexenyl butyrate vapors. It may be mentioned here that sensors for volatile organic compounds (VOCs) like ester and terpene were realized by enzymes and not by conducting polymers. So, the novelty of this work is the use of conducting PANI-composites for sensing of VOCs. Such materials are not only easy to synthesize but inexpensive as well. Ageing tests revealed that the composite films give a stable response up to a sufficiently long time.

Keywords: conducting polymer, polyaniline, composites, electrical conductivity, sensor, volatile organic compounds