SUMMARY

The piece of work presented in the thesis deals with the synthesis and characterization of transition metal (Pd, Au and Ag) nanoparticles as well as metal-polyaniline (Pani) nanocomposites and further these nanocomposites have been utilized as sensors for chemical vapours. Metal nanoparticles were prepared by γ-radiolysis and nanocomposites were obtained by chemical oxidative polymerization of the nanosol containing the monomer i.e. aniline. The objective of this work, was to obtain a sensor material exhibiting selectivity towards specific chemical vapour.

The thesis comprises of four chapters. The first chapter covers the introductory account on the research related to the polymers as sensors especially polyaniline citing references of previous research publications along with the historical background of sensors. The content of the chapter also gives an idea about the methods of preparation of nanoparticles and a brief description about each method. Further, the advantages of using metal-polymer nanocomposites as sensing materials are discussed. The second chapter describes the details of the experimental procedures used and the instrumentation of the various analytical techniques that have been used for the characterization of the synthesized metal nanoparticles and nanocomposites. The results and

discussion related to the characterization of synthesized metal nanoparticles and nanocomposites followed by their sensing performances towards particular analyte vapours are incorporated in the third and fourth chapters respectively. The brief overview of the contents of each of the chapters is as given below :

The ***first chapter*** reviews the importance of polymers in sensing applications and the advantages of using nanocomposites of polymers as sensors in comparison with the conventional conducting polymers. The details about the various types of the sensors and the materials which have been used as sensors to detect particular chemical vapours are also included in the same chapter. The first chapter ends with the merits of using tailor-made (polymer based nanocomposites) materials for sensing applications.

The ***second chapter*** describes the detailed experimental procedure employed for the preparation of metal (Pd, Ag and Au) nanoparticles and the metal-Pani (Pd-Pani, Ag-Pani and Au-Pani) nanocomposites. Metal nanoparticles were obtained by γ-radiolysis by using ^{60}Co γ-ray source. The aniline stabilized metal nanosols were oxidatively polymerised with the help of ammonium persulphate as an oxidizing agent to obtain metal-Pani nanocomposites. The synthesized products were characterized by UV-Visible spectroscopy, FT-IR spectroscopy, X-ray diffraction analysis and transmission electron microscopy (TEM). The two probe method was used for the conductivity measurements of the nanocomposites. The instrumental and experimental details related to the sensing measurements are also discussed in this chapter.

Chapter three describes the results revealing the role of aniline as a stabilizer for the metal nanoparticles. Various monomers such as aniline, *N*-methyl aniline, *N*-ethyl aniline, *o*-anisidine and *o*-toluidine were added during the preparation of metal nanoparticles to serve as a stabilizer. It was found that aniline stabilized metal nanoparticles exhibit stability up to a period of ~ 4 days for Pd, Au and ~ 7 days for Ag respectively. The stability studies and the preliminary confirmation of the nanoparticle formation were carried out by recording UV-Visible spectra. The concentration of aniline as well as metal salts were varied for the selection of optimum concentrations of each, at which fine sized and monodispersed nanoparticles were formed. The crystallinity and the presence of zero valent metal in the Pani matrix was confirmed from X-ray diffraction analysis. The spherical morphology of aniline stabilized nanosols and the dark spots of metal nanoparticles embedded in the Pani matrix (nanocomposites) were seen when the materials were observed under TEM microscope.

The ***chapter four***, accounts for the results on applicability of the synthesized nanocomposites as sensors towards organic chemical vapours. The Pd-Pani and Au-Pani nanocomposites were found to be selective to methanol vapours and Ag-Pani nanocomposite towards ammonia vapours respectively. The responses were observed to be reproducible and reversible up to several on-off cycles. The response time has found to be inversely proportional to the concentration of the analyte and the nanocomposites exhibit the magnitude of the response of the order of one i.e. change in resistance is observed from kΩ-MΩ. The response of the nanocomposites have been found to exhibit long term stability up to a period of ~ 120 days. On being used to sense analyte vapours, they show exactly identical responses as that for freshly prepared samples. The nanocomposites have been found to exhibit selective response to a single analyte even in presence of mixtures. The sensing mechanism has been explained on the basis of FT-IR spectroscopy.

The thesis ends with the conclusion that the incorporation of metal (Pd, Ag and Au) nanoparticles in the Pani matrix to form transition metal-Pani (Pd-Pani, Ag-Pani and Au-Pani) nanocomposites renders selectivity in sensing behaviour of polyanine.