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Title of Thesis : **Synthesis and Characteristion of Polyaniline Nanocomposites**

Abstract

The research work in the thesis was mainly aimed at the development of Polyaniline (PAni) nanocomposites. Literature in the area provides enormous research on the PAni nanocomposites especially on PAni/TiO_2, PAni/Ag and PAni/Au, but the studies on the nanocomposites of PAni with chalcogens are really scarce. Keeping this in view PAni/Se has been selected for study in the current thesis work. To achieve even better field emission properties of PAni/MWCNTs than earlier reported few novel synthesis methods have been developed which led to interesting and fascinating results. Nanocomposites of PAni with MgB_2 have been synthesized using chemical/modified methods and have been studied in detail for their field emission behaviour. Results obtained have been analyzed with the help of necessary characterizations. The important findings out of thesis have been given below:

1) PAni has been synthesized by chemical oxidation method and doped with different concentrations of Se. DC conductivity measurements on the samples have been carried out in the temperature range 300-450 K. The results show increase in the conductivity by three orders of magnitude after doping. Thermal and structural properties were studied by DSC, UV-visible and FT-IR.

2) In continuation of this, Se nanowires were prepared from SeO_2 under assistance of vitamin C. The effect of composition of Se nanowires on the properties of PAni was investigated and five orders increase in conductivity after doping was observed. The electrical properties of the nanocomposites showed that conduction is through hopping process due to the wide range of localized states present near fermi level. FT-IR and UV-visible studies confirmed the occurrence of PAni in conducting emeraldine salt form in the composites and suggested incorporation of Se in polymer. The thermal stability of composites was ascertained on the basis of DSC measurements.

3) Detailed studies on the field emission for PAni/Se nanocomposites were performed in an indigenously fabricated set up at room temperature and analysed with & Fowler-Nordheim plots. Comparative field emission results showed that 10%(w/w) doped PAni/Se nanocomposite depicts highest emission characteristics, current density and field enhancement factor with very low turn-on field and operation voltage.

4) Novel synthesis of PAni/Magnesium boride (MgB_2) composites was carried out in a simple two step process. The effect of MgB_2 doping on electrical and optical properties of PAni was studied. It was observed that DC conductivity of all the samples increased with the increase in MgB_2 contents in the sample obtaining a maximum value of 5.35×10^{-7} S/cm for the 10% doped sample.

5) MgB_2 nanowires of 50–100 nm in diameter grown by the sol-gel technique were incorporated in the PAni to prepare PAni/MgB_2 nanocomposites. The amount of dopant was varied and the effects on various parameters were observed by different techniques. The temperature dependence of the conductivity results showed an enhancement of conductivity by 5 orders of magnitude for the 10% doped sample. The molecular structure of the nanocomposites was further characterized by FT-IR spectroscopy. I−V measurements showed that the current increases on increasing MgB_2 content.

6) Field emission results for PAni/MgB_2 nanocomposites were found to be in good agreement with the properties of the nanocomposites and show the good field enhancement at low turn on field. The experimental results revealed that very good field emitters can be produced in a simple two-step process without the need of any sophisticated equipment. It was evidenced that the doping of PAni with MgB_2 will lead to lower emission threshold, higher emission density, and better emission stability. Results showed that PAni/MgB_2 nanocomposites are excellent electron emitters with reproducible stability.

7) Detailed studies on field emission characteristics of PAni/MWCNTs nanocomposites prepared by different methods were described. The average outer diameter of MWCNTs increased from 7–15 to 50–80 nm upon PAni coating. Field-emission study showed that there is decrease in the value of turn-on field and increase in the value of field enhancement factor of the nanocomposites as we go from direct solid-state mixing method to in-situ chemical polymerization method.

The study in Thesis work was to achieve efficient and stable PAni based nanocomposites and has led to some useful conclusions. The experimental work, presented in the thesis, and the conclusions drawn from it, may be seen as a part of an ongoing extensive research in this area, all over the world, where researchers are drawing different possible variations in the experimental parameters in order to optimize field emission in the nanocomposites of the material of choice. Work of the thesis on the PAni/Se and PAni/MgB_2 heterojunctions and PAni/CNT nanocomposite was an initiative and leaves enormous scope for future research to achieve even better field emission. The method presented in this thesis can be used to develop flexible field emission sources.