8. CONCLUSIONS

The thesis presents the preparation of polyimide films and nanofiber composites. The PMDA-ODA polyimide and modified PMDA-ODA-IDDA polyimide were synthesized. The polyimide films were prepared by solution casting method and characterized. The thermal stability and tensile strength decreased for PMDA-ODA- IDDA PI system. However, elongation at break %s increased, this indicates the flexibility of iso-propylidene bridge in IDDA which lead to more elongation and less rigidity. This flexible PI can be utilized in high temperature flexible electronic circuits.

Functionalization of SWCNTs was carried out using acid treatment. The acid-functionalized SWCNTs were incorporated in PAA nanofibers and were thermally imidized into PI/f-SWCNT nanofiber webs. The presence of oxygen in f-SWCNTs and nitrogen in poly(amic acid) were confirmed by XPS studies. The thermal stability increased from 482 °C (neat PI) to 585 °C (PI/f-SWCNT 2 % w/w) at 10 % w/w decomposition. Storage modulus, tensile strength and elongation at break of nanofiber webs reached 2.29×10^8 Pa, 8.84 MPa and 109 %, respectively, for PI/f-SWCNTs (2 % w/w). The electrical conductivity of the fibers improved effectively from 1.40 ± 0.03 x 10^{-18} (neat PI) up to 6.17 ± 0.12 x 10^{-14} (PI/f-SWCNT 2 % w/w) with the incorporation of f-SWCNTs in polyimide.

Graphene oxide was prepared from graphite by modified Hummer's method and characterized. PMDA-ODA polyimide nanofiber composites with GO (0, 0.1, 1, and 2 % w/w) were prepared. The presence of graphene oxide in the composites and the complete conversion of poly amic acid to polyimide were confirmed by Raman spectroscopy and FTIR. The graphene oxide cluster is formed as bead or spindle-shaped structures in the nanofibers as observed by HRSEM and HRTEM. The composites showed a significant improvement in the storage modulus, glass transition temperatures, thermal stability, and electrical conductivity of the nanofiber composites with increasing of GO loading in polyimide nanofiber.
Acid functionalized MWCNTs reinforced polyimide nanofiber webs were prepared. The polyimide nanofiber webs were carbonized using RF-induction heating method. The SEM micrographs of CNFs confirm that the fusion of fibers occurred during the carbonization at 1000 °C. There was an increase in electrical conductivity with increase in carbonization temperature and also the loading level of f-MWCNTs in polyimide. The f-MWCNT may facilitate the electrical conductivity by providing a path to transfer of electrons through the fused fibers after the carbonization to result in significantly higher conductivity than neat PI/CNF web.

To conclude the outcomes of this research work will be highly suitable for development of polymer nanofiber membrane, polymer electrolyte, flexible polymer electrode, super capacitor, fuel cell and other potential applications.