Preface

Conductive polymer composites with random conductive networks generally require high loadings of filler at the insulator/conductor transition. But highly loaded polymer composites exhibit inferior mechanical properties. A new class of polymer composites namely segregated conductive polymer composites (s-CPCs) have been emerged to solve this problem. s-CPCs contain conductive fillers segregated in the perimeters of the polymeric granules instead of being randomly distributed throughout.

Carbon nanotubes (CNTs) have attracted great deal of interest among researchers since their discovery due to their unique mechanical, electrical and thermal properties. Due to large surface energy and strong interaction, CNTs are difficult to be uniformly dispersed in polymer matrix by simple mechanical mixing. But good dispersion is essential for ensuring enhanced mechanical and electrical properties at low filler loadings.

In the present work both non covalent modification and covalent modification of the Multiwalled carbon nanotubes (MWCNTs) have been done to get their stable aqueous dispersions. Sonication assisted latex stage mixing of the aqueous dispersions of the fillers to the rubber has been done to get uniform and homogenous distribution of fillers in the rubber. Composite preparation was done by film casting. It is expected that the nanofillers will be pushed to the periphery of rubber particles when water gets evaporated. This ensures the formation of a web like segregated network of fillers in the composite.

Processing methods may influence the filler morphology and properties of the composites. To compare the filler morphology under different processing methods an alternate method involving co-coagulation of the rubber latex with nanofillers followed by mixing the dried coagulum in Haake mixer was also tried. The web-like network of nanofillers present in the coagulum is likely to be broken by the intense shear forces inside the internal mixer. The final sample will contain uniformly distributed filler particles in the rubber matrix. To investigate the role of polarity of rubber in determining the filler morphology, the study was also conducted using polar XNBR latex.

The thesis entitled "**Segregated and Random Network formation of MWCNT and Nanosilica in NR and XNBR**" consists of 8 chapters. The chapters from 3 to 7 are divided into two parts.

The significance of fabricating polymer composites having segregated network of conducting nanofillers is discussed in **Chapter 1.** An introduction on the polymers viz. NR and XNBR and nanofillers viz. MWCNTs and nanosilica, used in the study is also included. The specific objectives of the work are also presented in this chapter.

A detailed description of the materials used and the methods employed for the present study is given in **Chapter 2**.

Natural rubber/multiwalled carbon nanotube composite with segregated network is described in **Chapter 3**. **Part A** is focussed on noncovalent modification of MWCNTs using non-ionic surfactant and optimization of surfactant concentration and sonication energy. The fabrication of NR composites having segregated network of surfactant coated MWCNTs by latex stage processing followed by film casting and curing is described in **Part B**. The evaluation of microstructure, morphology, mechanical and electrical properties of the composites is also reported.

Natural rubber/carboxylated multiwalled carbon nanotube composite with segregated network is presented in **Chapter 4**. Covalent modification of MWCNTs by H_2SO_4/HNO_3 treatment in order to disperse the nanotubes in water without adding any surfactant is explored in **Part A.** The preparation of NR/carboxylated MWCNT composites through latex stage processing and the studies on morphology, mechanical and electrical properties are described in **Part B**

The use of nanosilica as reinforcing filler in natural rubber latex is discussed in **Chapter 5**. The role of processing method in determining filler morphology inside a polymer and its effect in the properties of the composites is also given in the chapter. The preparation and mechanical properties of NR/nanosilica composites with segregated network is presented in **Part A**. The effect of Haake mixing on the silica network in NR is discussed in **Part B**.

The effect of hybrid filler on the dielectric properties of NR/MWCNTR composites is described in **Chapter 6**. Nanosilica decorated MWCNTs (CS hybrid) were prepared and characterized by TEM, FTIR and UV-vis spectroscopy and utilized for the fabrication of composites with NR resulting in segregated (NRCSF) and random filler network (NRCSH). The study of mechanical and electrical properties of the NR/CS hybrid composites with segregated hybrid filler network is given in **Part A** and the NRCSH composites with random network of hybrid fillers are studied in **Part B.**

The preparation and evaluation of mechanical and electrical properties of the MWCNTR composites with carboxylated acrylonitrile butadiene rubber (XNBR) are presented in **Chapter 7**. The XCF composites with segregated structure are discussed in **Part A** and XCH composites with random structure are described in **Part B.**

The summary and conclusions of the study are given in **Chapter 8**.