Preface

Light emitting polymers (LEPs) are considered as the second generation of conducting polymers. A Prototype LEP device based on electroluminescence emission of poly(\(\pi\)-phenylenevinylene) (PPV) was first assembled in 1990. LEPs have progressed tremendously over the past 20 years. The development of new LEP derivatives are important because polymer light emitting diodes (PLEDs) can be used for the manufacture of next-generation displays and other optoelectronic applications such as lasers, photovoltaic cells and sensors. Under this circumstance, it is important to understand thermal, structural, morphological, electrochemical and photophysical characteristics of luminescent polymers. Our goal was to synthesize a series of light emitting polymers that can emit three primary colors (RGB) with high efficiency.

Three major objectives of the present study are listed hereunder:

- To synthesis and characterize blue, green, orange-red light emitting polymers
- To study structural and physical properties of synthesized polymers
- To explore the suitability of these polymers in the field of optoelectronic devices

The thesis is divided into six chapters.

A concise introduction to the subject is presented in the first chapter. Chapter begins with a short review on conducting polymers, followed by a review on light emitting polymers. After the introductory section, different synthetic techniques used for the preparation of light emitting polymers such as poly(phenylenevinylene)s and poly(thiophene)s are explained. It includes brief
notes on fully-conjugated PPV derivatives, segmented block PPV copolymers and light emitting hybrid polymers. Optoelectronic applications of light emitting polymers with special emphasis on organic semiconductor lasers (polymer laser) and PLEDS (polymer based light emitting diodes) are also included in this chapter. This chapter concludes with identification and outline of scope and objectives of the research problem selected by us.

Chapter 2 is focussed on the synthesis, characterization and photophysical studies of low polydispersity index orange-red light emitting MEH-PPV. MEH-PPV was purified by using sequential extraction method. Fluorescent quantum yield of the purified MEH-PPV in different organic solvents is discussed in this chapter. Preliminary LASER emission studies (ASE studies) in tetrahydrofuran (THF) solvent using Nd:YAG laser (532 nm, 10 Hz) is also presented.

Substituent effects on two new segmented PPV block copolymers are presented in Chapter 3. Two new well defined segmented block copolymers consisting of substituted distyrylbenzene (DSB) block containing bulky side groups with different kind of steric characteristics were synthesized in good yields. Copolymers were synthesized by Horner-Emmons condensation polymerization reaction and purified by using sequential extraction method. Structure of the synthesized copolymers was confirmed by elemental analysis (CHN), ¹H NMR, ¹³C NMR and FT-IR spectroscopy. Molecular mass of the copolymers was determined by gel permeation chromatography (GPC). Glass transition temperature, thermal transitions and thermal stability were studied using DSC and TGA analysis. The lowest unoccupied molecular orbital (LUMO) and highest occupied molecular orbital (HOMO) of the copolymers were evaluated by using cyclic voltammetry. XRD studies disclose the structural characteristics of both copolymers. Photophysical properties such as UV-Vis absorption and photoluminescence characteristics are included
Surface smoothness of spin coated films of the newly synthesized polymers was analyzed by using AFM. Current-voltage measurements (I-V characteristics) and their corresponding band structure diagrams are also presented.

Chapter 4 deals with the synthesis and characterization of a new blue light emitting bulky ring substituted segmented PPV block copolymer. Copolymer was synthesized by Horner-Emmons condensation polymerization reaction and purified by using sequential extraction method. Structure of the synthesized copolymer was confirmed by elemental analysis (CHN), $^1$H NMR, $^{13}$C NMR and FT-IR spectroscopy. Molecular weight of the copolymer was determined by gel permeation chromatography (GPC). Thermal behaviour of the copolymer was studied by using DSC and TGA analysis. Electrochemical behaviour of the copolymer was investigated by cyclic voltammetry analysis. Optical studies were done by using UV-Vis spectra and photoluminescence spectra. Semi crystalline nature of the copolymer was revealed by using XRD. Surface smoothness of the spin coated film was analyzed by AFM. Schottkey diode characteristics were determined by using current-voltage measurements and its energy band diagram also presented.

Chapter 5 deals with the synthesis and characterization of novel intense green light emitting thienylene- biphenylenevinylene hybrid polymers. Polymers were synthesized by Stille coupling polymerization reaction and purified by using sequential extraction method. Structure of the freshly synthesized polymers was confirmed by elemental analysis (CHN), $^1$H NMR, $^{13}$C NMR and FTIR spectroscopy. Molecular weight of the polymers was determined by gel permeation chromatography (GPC). Thermal properties of the polymers were investigated by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). Electrochemical properties of the polymers were studied by using cyclic voltammetry. Structural and morphological studies were done by
using XRD and SEM techniques. UV-Vis absorption spectra and PL spectra provide information on the electronic structures of these new polymers. Surface smoothness of the spin coated film was analyzed by using AFM. Schottkey diode formation has been confirmed from the I-V characteristics of the two polymers synthesized. The corresponding band structure diagrams have also been presented.

Important findings drawn from our investigations are presented in **Chapter 6**. Conclusions and references are given towards the end of each chapter.