CHAPTER I
INTRODUCTION

Conducting polymers have been widely investigated because of their excellent electrical and optical properties and many potential applications. Conducting polymers have shown not only unusual conducting behavior which presents a strong theoretical challenge for fundamental study, but also a great potential for technological and commercial exploitation which have been reported to be applicable to batteries, electronic devices, functional coatings, chemical and biological sensors, etc. Increase in coated fabrics demand will be stimulated by growth in many industrial areas especially motor vehicle market, which is the largest market and is primarily driven by advance in the air bag segment. Above average growth is also expected in the protective clothing, non-motor vehicle transportation, and awning and canopies market. These fabrics are mainly used for industrial material like filters, electrostatic discharge and electromagnetic interference (EMI) shielding materials for personal computers and home electronics devices, flooring, ceiling materials, deelectrifying cloths, and dust and germ-free clothing. They also can be used in fields where their microwave absorption characteristics are highly desirable, which is the case for military applications like camouflage and radar cross-section reducing protective fabrics for stealth technology. At present, many companies have marketed the conductive textile such as Contex® (made by Milliken and Company).

Recently, several kinds of conducting polymers have been discovered such as poly(p-phenylene) (PPP), polypyrrole (PPY), polythiophene (PTH), polyaniline (PANI) and their deivatives. The important distinguished structures of these chemicals are the conjugation of π-electrons, which are formed by the overlaping of carbon p-orbital along the backbone. The high electrical conductivity can be accomplished after the 'doping process', which can be divided into two different processes: protonic acid doping and oxidative doping.

Among the electrically conducting polymers, polypyrrole and its derivatives, such as poly (*N*-methylpyrrole), have attracted the most attention because of its high stability in the oxidized state, low potential for polymer formation and ease of synthesis in aqueous solution. Nonetheless, the difficulties in the chemical synthetic procedures and its limited solubility have limited polypyrrole commercial applications. Advancements in synthesis techniques have created safe, simple and cost effective methods of producing this conducting polymer. Polypyrrole and its derivatives are brittle polymers and have dark color so it is called "pyrrole black". Most of the linkage between pyrrole rings occur through the α,α'-position. The relative yield of polymer compared to oligomer is dependent on the reaction condition.

Polyaniline (PANI) is a unique polymer in that it has a nitrogen heteroatom incorporated between phenyl rings along polymer chain. This structure provides flexibility and allows the existence of four distinguished oxidation states that are leucoemeraldine, emeraldine, polyaniline salt and pernigraniline. Leucoemeraldine and pernigraniline forms of PANI are not stable and they will return to the state of emeraldine under atmospheric environment. Polyaniline is an inexpensive monomer, it has good environmental stability, moderately high value of dc conductivity and excellent chemical stability in conductive form both in aqueous and ambient media. Due to its relative ease of synthesis, polyaniline can be synthesized via both chemical and electrochemical oxidative polymerization of aniline in aqueous acid media by variety of oxidizing agents. Polyaniline has a general structure in emeraldine base, which consists of alternating reduced and oxidized repeating unit. The emeraldine base (EB) form of PANi is intractable, infusible, and unprocessable while it can be dissolved only in 1-methyl-2-pyrrolidinone (NMP) or in concentrated sulfuric acid.

Another conducting polymer that has been of interest for charge dissipation is polythiophene. Polythiophene is utilized in a variety of applications where its conducting properties pose an advantage. It is presently used as antistatic coatings and films. Polythiophene exists in two structures, which are aromatic and quinoid. It has an extended π-bonding system, which imparts electrical properties to the polymer, doping either p or n can enhance these properties. They also exhibit other interesting properties such as electrochromism, thermochromism, and pressure induced color change. A number of chemical and electrochemical routes for synthesizing polythiophene and its derivatives have been studied. These include electrochemical polymerization, chemical polymerization with an oxidant such as iron trichloride, and polymerization by metal-catalyzed coupling of 2,5-dihalothiophenes. To enhance the conductivity, polythiophene can be doped by many dopants such as iodine, $FeCl_3$, $NOSbF_6$, $NOPF_6$, and SO_3CF^-.

In this research, the admicellar polymerization technique is applied for coating cotton and polyester fabrics with four types of conductive polymers: polypyrrole, polyaniline, polythiophene and poly(*N*-methylpyrrole) in order to increase the electrical conductivity of the fabrics.