CHAPTER I
INTRODUCTION

1.1 The purpose of the investigation.

One of the most valued properties of synthetic polymers is their ability to act as an excellent electrical insulators. In spite of this, there has been interest for many years in the possibility of producing electrically conducting polymers. Polymers with conjugated π electron backbones display unusual electronic properties, such as low energy optical transitions, low ionization potential, and high electron affinities. The result is a class of polymers that can be oxidized or reduced more easily and more reversibly than conventional polymers. Charge transfer agents (dopants) effect this oxidation or reduction and in many technological application is limited owing to the fact that they have poor atmospheric stability and processability (see Table 1.1) [1,2,3].

Table 1.1 Applications of Important Conducting Polymer [3].

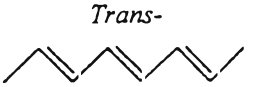
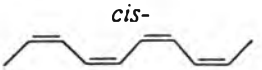
Polymer	Chemical structure	Conductivity (S/cm)	Possible applications
Polyacetylene	*Trans-*  *cis-* 	10^{5} [a]	Rechargeable battery, photovoltaics, gas sensors, chemical indicatos, radiation, detectors, Schottky diode, antielectrorstatic, encapsulation, biotechnology, optoelectronics, solar cells.

Table 1.1(continued)

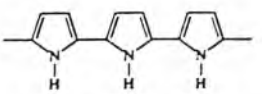
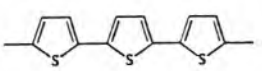
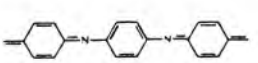
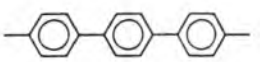
Polypyrrole		1000 [b]	Rechargeable battery, condenser, printed circuitboards, gas sensors, potentiometric glucose sensors, electroplating, Schottky diode electroacoustic device, fillers, adhesive,transparent coating, electromagnetic shielding, electrophotochemical cells, field effect transistor, photocatalyst , physiological implantations, optoelectronics, conductive textiles.
Polythiophene		150 [c]	Rechargeable battery, display device, field effect transistor, optoelectronics, Schottky diode, gas sensor, photocatalysts.
Polyanilene		5 [d]	Rechargeable battery, electrochromic devices, indicator devices, biosensors.

Table 1.1(continued)

Poly(p-phenylene)		500 [e]	Rechargeable battery, fillers, photocatalysts.

[a] Naarmann polyacetylene doped with iodine, [b] BF_4 - doped, [c] AsF_5 doped, [d] Aqueous HCl doped. [e] AsF_5 doped.

Hence, one of the methods to make such polymers into a tough, processable stable form is to make composites with stable possible polymers. Composites have been prepared by vapor phase deposition, electrochemical deposition, plasma deposition, and interface techniques.

Naarmann and Shirakawa **[2]** produced conducting polyacetylene that it has very high electrical conductivity as 10^5 S/cm when doped with AsF_5, but the mechanical properties and electrical properties of polyacetylene when exposed to ambient condition have very poor and it is found to be difficult to process by both melt and solution processes.

De Paoli **[4]** produced electrode from composite PPY/PVC by electrochemical polymerization. The conductivity was obtained about 0.1-0.2 S/cm. The tensile strength of composite PPY/PVC film has lower than original PVC and has poor properties due to the PVC's additive was dissolved into the electrolyte solution.

Bhat and Yasmin **[5]** produced conducting [cello+PPY] composites by interface technique from cellophane plus polypyrrole. Cello has good mechanical properties and imparts flexibility and strength to the composites; PPY is electrically conductivity and makes the composite highly conductivity and stable to ambient

condition. The electrical conduction of composite films was studied as a function of voltage, temperature, and percentage content of PPY in the composite films. An attempt was made to use the [cello+PPY] composite films as electrodes, but the low current was obtained and the composite films was prepared in the long time.

Ogura and co-worker [6] produced PVC/PPY composites by electrochemical deposition and photo-dehydrochlorination. The electrical conductivity of irradiated composite film was revealed: $\sigma = 2.51 \times 10^{-5}$ S/cm, 5.04×10^{-3} S/cm by iodine doping. They found that the anion, NO_3^-, from nitric acid solution of pyrrole doped during the electrodeposition of PPY was photodecomposed to generate radical $NO_2^{\cdot}$. And this species was doped to polene, resulting in the conductive film has a poor mechanical properties due to the PVC film was degraded when irradiated at 90°C.

In this work, CVD method is used for the preparation of conducting plastic films from various substrates plastic film such as PVC, PP, and LDPE and polypyrrole [plastic/PPY]. Plastic film used has good mechanical properties and imparts flexibility and strength to the prepared conducting films. PPY is electrically conducting and stable and makes the prepared conducting film highly conducting and stable to ambient conditions. The electrical conductivity and mechanical properties of the resulting conducting plastic film are studied base on initiator concentration, monomer concentration, reaction temperature, reaction time, doping temperature, and doping time.

1.2 Objectives of this study.

1) To synthesize the conducting plastic film which has the optimum of electrical conductivity and mechanical properties.

2) To distinguish the electrical conductivity and mechanical properties of the various resulting plastic films.

1.3 Scope of the investigation.

This study involves the preparation of conducting plastic films by CVD of pyrrole, and characterization of prepared conducting plastic film. The work plan of this study is focused on the effect of $FeCl_3$ concentration, pyrrole monomer, reaction temperature, reaction time, iodine doping temperature, and iodine doping time on electrical conductivity and mechanical properties of the prepared conducting plastic films.