



CHAPTER I

INTRODUCTION

Conductive polymers continue to have a growing interest because of the wide range of potential applications: optical display, rechargeable battery, electrochromic devices, and light emitting diodes. Among organic molecules, the conductive polymers have attracted a significant interest in the field of electrochromism.

The electrochromism is the reversible and visible change in the light transmittance that is associated with an electrochemically induced oxidation-reduction reaction. The applications of such material are mirrors of vehicles (Sonmez *et al.* 2005), electrochromic displays (Bange *et al.* 1999), smart windows (Kim *et al.* 2009), earth-tone chameleon materials (Brotherson *et al.* 1999), ink-jet printers (Peters and Freeman 1991), and recently E-paper.

The earlier reports indicated using inorganic compounds or the metal oxides such tungsten trioxide (WO_3) and iridium dioxide (IrO_2) which are mix-valence metal complexes. However, these transition metal oxides electrochromically exhibited a slow response time (ten of seconds) with high processing cost. Compared with these materials, electrochromic polymers have shown several merits: low processing cost, power requirement only during switching, low operating voltage, great repeatability, no dependence with angle of vision, good UV stability, high coloration efficiency, fast switching ability, and ability for the fine-tuning of the band gap through the modification of polymer's chemical structure (Sonmez *et al.* 2005).

Potential conducting polymers are comprised of a number of functionalized polythiophenes, polypyrroles, polyanilines, and etc. They have become recognized as an interesting class of electrochromic materials (Sapp *et al.* 1998). An important issue in the study of electrochromic polymeric materials has been that of controlling their colors by main-chain and pendant group structural modifications.

Polyaniline (PANI) is one of the most promising conducting polymers due to its straightforward polymerization and excellent chemical stability combined with relative high levels of conductivity (Khan *et al.* 2003). Poly(2,5-dimethoxyaniline) or

PDMA film showed reversible color changes from yellow to green representing the switching between the reduced state to the oxidized state through an application of potentials. Cyclic voltammetry results showed that PDMA can be easily switched from the leucoemeraldine state to the emeraldine state relative to PANI. PDMA also showed a shorter response time (9 s), which is smaller than the electrochemically prepared PANI (22 s) (Huang *et al.* 2002).

Thin-films can be created by several methods including the chemical vapor deposition, the electron beam deposition, the Langmuir–Blodgett technique, and the layer-by-layer (LbL) self-assembly technique (Sarkar *et al.* 2000). In the case of electronically functional thin-films, thinner films are generally preferred because of the shorter electron and ion transport path length (Montazami *et al.* 2010).

The present study aims to investigate the effect of the applied potentials and the electrolyte concentration on the electrochromic properties of PDMA electropolymerized on the ITO plastic via oxalic, nitric, and hydrochloric acids.

In this study, a 2,5-dimethoxyaniline (DMA) was polymerized via the electropolymerization in oxalic, nitric and hydrochloric acids with various dipping times (3, 6, and 10 minutes). The synthesized polymer films were characterized for the electrochromic properties via the UV-visible spectrophotometer. The FTIR and TGA were utilized to investigate the structural and thermal properties of the electropolymerized PDMA. The morphology of PDMA coated ITO surface was studied via FE-SEM. The cyclic voltammetry was used to study the oxidation-reduction properties of PDMA/ITO plastic.