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Preparation and Characterization of PANI/PVA Electrochromic Membrane ⋆

Xiangqin Wang [a], Binjie Xin [a,*], Jian Xu [b]

[a] *College of Fashion, Shanghai University of Engineering Science, LongTeng Road Shanghai 201620, China*

[b] *Shangtex Holding Co., Ltd, Pingliang Road, Shanghai 200082, China*

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Abstract

A facile strategy for obtaining Polyaniline (PANI) composites was reported wherein the reaction is oxidation polymerization using Dodecylbenzene Sulfonic Acid (DBSA) as the initiator, Polyvinyl Alcohol (PVA) as the emulsifier, and the Ammonium Peroxydisulfate (APS) as the oxidizing agent. The structure and performance of PANI composites were investigated. The results indicated that PANI particles can be dispersed evenly in the PVA matrix, the conductivity and electrochemical properties of the PANI/PVA composites were affected by the protonic acid content, When n(DBSA)/n(AN) = 1.0 under the same condition, the conductivity of PANI membrane is up to 1.28 S/cm. From the FTIR spectrum, the characteristic peaks of PANI at 1459 cm^{-1} and 1697 cm^{-1} are attributed to the C = C stretching vibration peak of the quinone ring and the benzene ring and the C = N stretching vibration peak of the quinone ring. The asymmetric ECD of PANI/PVA composites with copper and silver fabrics have both three brilliant colors (green - blue - yellow primary colors).

Keywords: Polyaniline; Elusion Polymerization; Electrochromic

1 Introduction

Under the influence of the external environment, the molecular structure of photochromic material had changed. The photochromic material simultaneously produces the role of light selective absorption or reflection characteristics. The macroscopic of materials presents a variety of color, and also possesses reversible color transformation. It has been found that photochromic materials can be divided into five categories: photochromic, electrochromic, thermochromic, pressure photochromic and thermosensitivy change color, the research of electrochromic [1-4] is of the most

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*Corresponding author.
Email address: xiaobo2000@gmail.com (Binjie Xin).

concern. Compared with other conductive polymers, the study and development of PANI was relatively late. The polymerization mechanism, soluble, conductive mechanism of PANI is still undergoing further research, therefore the study of the electrochromic properties of PANI still is an important and popular research topic.

At present, the PANI synthesis ways [5] can be roughly divided into five categories, including electrochemical synthesis method [6], chemical polymerization [7, 8], template polymerization [9, 10], nano-PANI polymerization and enzymatic Polymerization. The chemical synthesis and electrochemical polymerization are the most common. However, the large area of electrochromic film is difficult to be obtained through the electrochemical polymerization, and the disadvantages of film are relatively poor mechanical properties and the weak adhesion between film and conductive material substrate. Thus chemical synthesis method, the emulsion polymerization synthesis regarded as an efficient method for the preparation of the PANI/PVA composites can be used in this thesis. This method is based on pollution-free, low power consumption, low cost of water as heat carrier, the choice of macromolecular organic sulfonic acid acts as surfactant, and proton acid doped one step; preparation of PANI emulsion can be used directly for the post-processing and prevent the re-use of other solvents, while the film formability, mechanical properties, electrical conductivity and other characteristics of the PANI have been modified by the chemical polymerization, so to get more extensive application [11].

In this paper, the emulsion polymerization method successfully achieved conductive PANI emulsion. The PANI/PVA electrochromic membrane and electrochromic devices (EC) have been prepared. And scanning electron microscopy, infrared spectroscopy, thermal gravimetric analysis and other methods are used to test the characterization of PANI/PVA composites, the electrochemical workstation is used to research PANI electrochromic property.

2 Experimental

2.1 Material

Aniline monomer AR (Shanghai test); the ammonium persulfate AR (Shanghai test); Polyvinyl Alcohol (PVA) AH-26 (Shanghai test) and the ethanol from Sinopharm Chemical Reagent Co., Ltd., Dodecylbenzene Sulfonic Acid (DBSA) TCI produced from Tokyo Kasei Kogyo Co., Ltd.; ITO film purchased from Kaivo beads Haikai Electronic Components Co., Ltd., hydrochloric acid (mass percentage of 36.5%) and PMMA gel electrolyte was prepared in the laboratory. All reagents were used directly without further purification.

2.2 The Emulsion Polymerization Mechanism of PANI

The most obvious feature of the emulsion polymerization reaction is a reaction system, which consists of the aqueous phase, the phase and the droplets of the micelles of three phases (Fig. 1), and the polyaniline synthesis system is also true. Under the mixing of the two emulsifiers of non-ionic polyvinylalcohol (PVA) and anionic Dodecylbenzene Sulfonic Acid (DBSA), a very small amount of PVA and DBSA in form of molecular is dissolved in water, constituting the aqueous phase; most of the emulsifier exist in micelles form, the micellar phase; under the joint action of the hydrophobic alkyl groups, the hydrophilic hydroxyl group and sulfonic acid group,