Journal of Fiber Bioengineering & Informatics 4:2 (2011) 165–175
http://www.jfbi.org | doi:10.3993/jfbi06201107

Preparation and Properties of Photochromic Blue Microcapsules

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Abstract

In this paper photochromic microcapsules were prepared by in-situ polymerization using melamine formaldehyde resin as wall materials and tetrachloroethylene solution with photochromic materials as core materials. In order to attain a suitable particle size of microcapsules to be used in fabric by blending or coating, high emulsifiers were used to produce smaller oil drop. The factors affecting the properties of microcapsules were discussed in detail, such as emulsification time, PVA concentration and acidification time. The experiments revealed that the average particle size of microcapsules increased firstly then decreased with the increase of emulsification time. The same trend was observed when different concentrations of emulsifiers were used. Acid conditions directly affected the airproof and transparency of microcapsules. Finally, the optimum process condition was determined. The results showed that the particle size of microcapsules ranged from 1 μm to 20 μm and the photochromic blue microcapsules prepared at the optimum process condition could carry the color change quickly and reversibly. The knit fabric with photochromic property was obtained by coating with photochromic blue microcapsules, and the fabric thus formed could change its color quickly and as well as be reversed back to its original color for many times. The knit fabric had good washing fastness and rubbing fastness. Therefore photochromic blue microcapsules showed signs of potential application in the textile field.

Keywords: Photochromic; Microcapsules; In-situ Polymerization; Melamine-formaldehyde Resin; Coating

1 Introduction

Photochromic space needed a kind of new functional material, are tasteless, non-toxic and not harmful to the people and the environment. Photochromic materials have broad application in many areas, such as information industry, garment, plastic products, decoration materials, tourism products, paint, ink, printing and dyeing, and military covert materials [1-3]. Organic photochromic materials are in nature consisting of characters of color sensitive and bright color. As one of the organic photochromic materials, Lo oxazine has attracted tremendous attention

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because of the high chemical stability and high resistance to fatigue, and it has the potential applications in the commercial and military fields.

Microcapsules, as a micro-container, are prepared by using natural or synthetic polymers as wall materials. It cannot only protect the core materials of droplet, particles or gases, but can also improve the performance of core materials by selecting suitable wall materials. The methods of film forming and microencapsulation can be used to improve the photochemical stability and fatigue resistance of the photochromic materials. Through the microcapsule technology, coated by the transparent materials or translucent materials, photochromic compounds can be isolated from the outer environment, such as acid, alkali, air and impurities affecting the optical performance, which can improve their fatigue resistance [4-7].

This study mainly used the in-situ polymerization to wrap the photochromic materials with transparent capsule wall to increase the fatigue resistance of Lo oxazine. In order to obtain the good photochromic properties of microcapsules, the factors affecting the properties of photochromic microcapsules were discussed in detail, such as the emulsified time, PVA concentration and the acidification time. At last, the optimum process condition was determined and the photochromic blue microcapsules prepared at the optimum process condition could carry the color change quickly and in reversibility. The photochromic blue microcapsules for textile finishing must have good closure, small particle size, transparent capsule wall and chemical stability.

2 Experiment

2.1 Materials

Melamine, formaldehyde solution, Sodium Dodecyl Sulfate (SDS) and tetrachloroethylene used in this paper were all purchased from Chemical Reagent Beijing Company, and polyvinyl alcohol (PVA1788) was purchased from chemical factory of Beijing. Lo oxazine was purchased from chemical factory of Naikai University. All reagents were used without further purification.

High-shear emulsifier (D-500, WIGGEN HAUS, Germany) was used to disperse the oil into small droplet. Size and size distribution were analyzed by particle size analyzer (Mastersizer2000, Malvern, England). The Scanning electronic microscope (SEM, JSM-6360, Japan) was used to investigate the surface morphology of photochromic microcapsules.

2.2 Preparation of Photochromic Microcapsule

The photochromic microcapsules were prepared by the in-situ polymerization in two-steps. Firstly, melamine-formaldehyde pre-polymer was prepared by solution polymerization. Certain amount of melamine and formaldehyde with molar ratio of 1/2.5 was added into a three-neck flask with agitation, thermometer and condensator. After the melamine dissolved, the pH value of the system was adjusted to 8∼9 with the sodium hydroxide solution and the reaction temperature kept at 70 ℃. The reaction stopped until the solution changed to be transparent, and the pre-polymer solution of MF was obtained.

Then, O/W emulsion was obtained by high shear emulsification using tetrachloroethylene solution with photochromic materials as oil phase and sodium dodecyl sulfate solution as water