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Yang-Kyoo Han [a] & Seok-Chan Hong [a]

[a] Department of Chemistry, Hanyang University, Seoul, 133-791, Korea

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Preparation and Application of Poly(Vinyl Alcohol) Microcapsules Containing Azo Dye

YANG-KYOO HAN and SEOK-CHAN HONG

Department of Chemistry, Hanyang University, Seoul 133–791, Korea

Poly(vinyl alcohol) microcapsules containing disperse red 1 (DR1), a photoresponsive group, were prepared by a phase separation method (coacervation). The structure of PVA microcapsules was a core/shell type microsphere with DR1 used as a core material encapsulated with PVA. From a SEM analysis, the particle size was in the range of 2–6 μm. We also investigated the possibility of the application of the microcapsules as optical switching device media.

Keywords: PVA microcapsule; disperse red1; optical switching

INTRODUCTION

Liquid crystal display(LCD) using low molecular weight liquid crystals has been widely used as a method to display information. It, however, is difficult, to produce a large-sized screen because LCD method has inherent drawbacks in optical transmission, viewing angle, and driving

voltage for LCD devices. In addition to LCD, polymer dispersed liquid crystal (PDLC) was recently developed. But, this method also has a considerable difficulty in dispersing high concentration of liquid crystals into a matrix polymer from an industrial point of view. Especially, in the case of dispersing low molecular weight liquid crystals over 15%, they form small domains by a coalescence. Such a phenomenon affects the optical sensitivity, resolution, and viewing angle of display devices.

To improve these drawbacks, in this study, we prepared PVA microcapsules containing DR1 as a core material and also investigated the possibility of their application to optical switching device media.

EXPERIMENTAL

Disperse red 1 (0.2 g) in THF was dispersed in water, which surfactants (F-108 and Tween 80) were dissolved in, by a homogenizer. The dispersed solution and PVA (0.4 g) aqueous solution (2 wt%) were poured into a jacket flask and mixed by a mechanical stirrer (350 rpm) at 25 ℃. A sodium sulfate solution (0.8 g, 20 wt%) as a phase separation inducer was added to the flask. The solution was heated to 65 ℃ above a cloud point (60 ℃) in order to produce PVA microcapsules containing azo dye. The microspheres were crosslinked with glutaraldehyde at 35 ℃ for 24h.[1]

RESULTS AND DISCUSSION

Preparation of PVA Microcapsules

We changed experimental conditions such as coacervation temperature and concentration of sodium sulfate, surfactants, and disperse red 1 in order to find an optimum condition for the preparation of microcapsules that have a uniform size. The amount of the PVA microcapsules

increased up to 70 % as the coacervation temperature became close to the cloud point. A cloud point is the temperature at which a homogeneous solution separates into two phases (a polymer-rich phase and dilute one).[2] The cloud point decreased from 60 to 50 ℃ with increase in the concentration of sodium sulfate from 0.8 to 1.6 g. The higher the concentration of sodium sulfate, the larger the size of the PVA microcapsules. We also found that the size of the microcapsule was inversely proportional to the concentration of surfactants. This comes from the fact that a lot of surfactants make micelles smaller in the dispersion step. Figure 1 shows SEM micrographs of the PVA microcapsules. The microsphere size was in the range of 2-6 μ m.

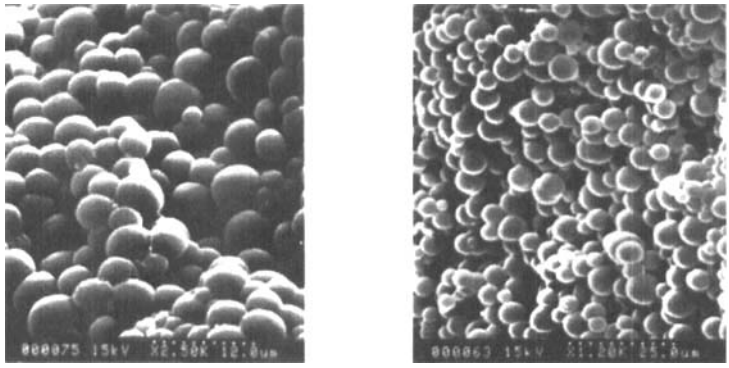

FIGURE 1. SEM micrographs of PVA microcapsules.

Application

We investigated their optical characteristics with irradiating Ar polarized laser on the thin film prepared from the capsules according to our previous method: The film was placed between two crossed polarizers. The laser (488 nm) with an intensity of 15.4 mW/cm^2 was irradiated for 1 minute onto the sample and then switched off.[3] As a result, Figure 2 shows that the core/shell type PVA microcapsules could

be used as a material for optical switching devices. The characteristics of optical switching result from the photo-induced orientation of DR1 existing in the microcapsules. In other words, azobenzene groups are aligned perpendicular to the plane of polarization of the Ar laser irradiated. Such an orientation gives rise to high transmission during a read-out process. Detailed results will be published elsewhere soon.

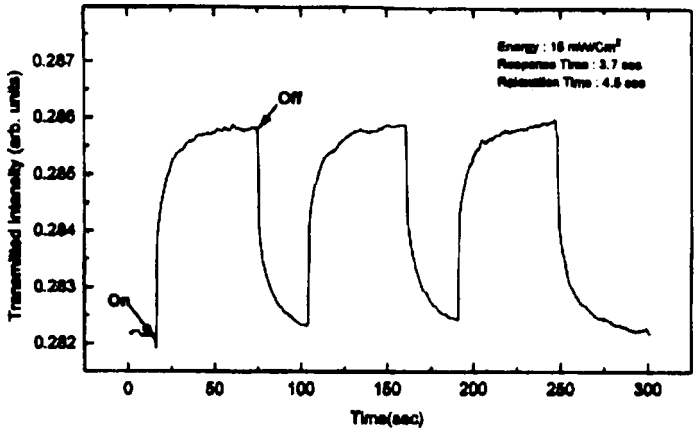

FIGURE 2. Reversibility of transmitted intensity of a probe beam (Ga/As, 847 nm) with Ar laser light-on and off.

Acknowledgment

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