Summary: The effects of cyclodextrins (CDs) on the formation and color changes of polymerized 10,12-pentacosadiynoic acid (PCDA) vesicles have been investigated. The strategy used in this study focuses on three different stages in which the CDs can play a role. Among the cyclodextrins investigated, α-CD had most prominent effect on the perturbation of the ordered structures of the PCDA vesicles. Solid precipitates, formed by the PCDA vesicles in the presence of α-CD were shown to be PCDA - α-CD inclusion complexes by using DSC, FTIR and ^{1}H NMR analysis. The results of studies using 4-nitrophenol as an inhibitor and the consideration of inner and outer diameters of cyclodextrins have led to the conclusion that the color induced by the cyclodextrins is due to the formation of inclusion complexes with the polydiacetylene.

Photograph of the polydiacetylene liposomes after 1 h in the presence of 10 mM of the three different cyclodextrins in a HEPES buffer solution.

Unique Effects of Cyclodextrins on the Formation and Colorimetric Transition of Polydiacetylene Vesicles

Jong-Man Kim,*[1] *Joo-Seob Lee*,[1] *Ji-Seok Lee*,[1] *Sang-Yoon Woo*,[1] *Dong June Ahn**[2]

[1] Department of Chemical Engineering, Hanyang University, Seoul 133-791, Korea
Fax: +82-2-2298-4101; E-mail: jmk@hanyang.ac.kr
[2] Department of Chemical and Biological Engineering, Korea University, Seoul 136-701, Korea
Fax: +82-2-926-6102; E-mail: ahn@korea.ac.kr

Received: July 20, 2005; Revised: September 12, 2005; Accepted: September 16, 2005; DOI: 10.1002/macp.200500331

Keywords: color transition; cyclodextrin; inclusion complex; polydiacetylene; vesicles

Introduction

Since the first report of the colorimetric detection of the influenza virus, using a polydiacetylene film,[1] the development of efficient sensory systems, based on polydiacetylenes (PDAs) has continued to be a subject of great interest.[2–18] Unlike other conjugated polymers, polydiacetylenes are very unique in terms of their preparation and structure, as well as the output signals they produce upon environmental stimulation. In most cases, polydiacetylene-based chemosensors are prepared by UV irradiation of self-assembled monomers in aqueous solutions or of Langmuir-Blodgett/Langmuir-Schaefer films on solid substrates. Recently, we reported a new approach for the synthesis of immobilized polydiacetylenes on modified glass substrates.[19,20] A major advantage of the use of nanostructured polydiacetylenes as sensing elements comes from the fact that a visible color change from blue to red occurs in response to environmental perturbations. As a result of their unique properties, a variety of functionalized polydiacetylene films and vesicles have been prepared and tested as potential chemosensors to monitor ions, glucose, proteins, as well as the influenza virus[1] and *E. Coli*.[10] We also reported cyclodextrin-induced color changes in a polymerized diacetylene Langmuir-Schaefer film.[21]

In continuing efforts aimed at developing new polydiacetylene-based chemosensors,[19–22] we have recently uncovered the first example of the unique effects of cyclodextrins (CDs) on the formation and colorimetric response of polydiacetylene vesicles. Cyclodextrins are intriguing molecules because they form inclusion complexes with a variety of substrates.[23–31] In addition, different binding specificities of α-, β-, and γ- cyclodextrins make these substances attractive model systems for studying ligand-receptor interactions. Thus, we felt that it would be intriguing to investigate the interactions between cyclodextrins

