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Micropatterning of diacetylenic liposomes on glass surfaces

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Abstract

We report the results on the immobilization of polydiacetylene liposomes on glass substrates obtained by the use of micro-contact printing (μCP) technique. Micro-patterned self-assembled monolayer of 3-aminopropyltriethoxysilane (APS) was formed at contact regions of a polydimethylsiloxane (PDMS) stamp with the clean glass surfaces. Polydiacetylene liposomes were then covalently attached to the APS regions, by amidization between surface amine groups of the pattern and *N*-hydroxy succinimide moieties of the liposomes. Fluorescence images revealed that the polydiacetylene liposomes were successfully immobilized on glasses forming patterns of squares with a width of 70 μm and dots with diameters of 15 to 50 μm. The results would be potentially useful for developing stable liposome-array sensors based on glasses.

Keywords: Micro-contact printing; Polydiacetylene; Liposomes; Micro-pattern; Fluorescence

1. Introduction

Cell membranes being capable of recognition are attractive structures from a material science point of view. Diacetylene molecules have been of great interest to mimic the self-organization and functionalization of the cell membranes [1]. Polymerized diacetylene liposomes formed by diacetylene monomers are stable and show a unique property to change color from blue to red upon environmental perturbations including heat, mechanical stress, pH, and solvent [2–7]. This color change has been also exploited in the construction of biosensors visually capable of detecting influenza virus, cholera toxin, *Escherichia coli*, glucose and cyclodextrin [8–12].

Most of the studies previously reported have mainly focused on developing polydiacetylene-based chemosensors in the form of aqueous liposome solutions or films on solid supports. In the present study, we propose for the first time a stable liposome-array pattern on a glass substrate that would be of potential interest for developing polydiacetylene-based array sensors. Micro-contact printing (μCP) method, one of soft lithographic techniques, was utilized for immobilization of polydiacetylene liposomes on glasses. The μCP is simple and convenient to pattern substrate surfaces on micro- to sub-micrometer scales by forming self-assembled monolayers in localized surface regions [13–15]. In this study, we demonstrate a novel route to formation of patterns of immobilized polydiacetylene liposomes on the glass substrates.

2. Experimental

2.1. Materials

10,12-Pentacosadiynoic acid (PCDA) and 3-aminopropyltriethoxy-silane (APS) was purchased from GFS chemicals and Aldrich, respectively. PCDA-NHS (*N*-hydroxy succinimide) was synthesized as follows: To a solution of 1.00 g (2.7 mmol) of PCDA in 10 ml of CH_2Cl_2 was added 0.345 g (3.0 mmol) of *N*-hydroxysuccinimide followed by 0.596 g (3.1 mmol) of 1-[3-(dimethylamino)propyl]-3-ethyl-carbodiimide. The solution was allowed to stir at ambient temperature for 2 h followed by rotary evaporation of the CH_2Cl_2. The product was extracted with ethyl acetate and water. The organic layer was dried with $MgSO_4$, filtered,

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