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Spreading of giant liposomes on anisotropically patterned substrates

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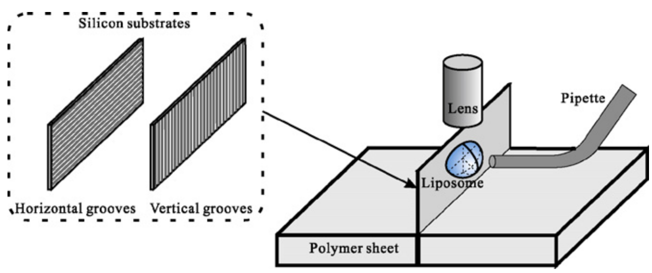
HIGHLIGHTS

- ► This work provides a new method to study liposome shape transformation behaviors.
- ► Characterization of the evolution of liposome shapes with time is enabled.
- ► Effect of surface patterns is studied, which lays a foundation for further studies.

GRAPHICAL ABSTRACT



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ABSTRACT

The dynamic spreading of giant liposomes on anisotropically patterned substrates is investigated experimentally on vertically fixed spreading substrates. The giant liposomes are prepared through electroformation method. The substrates with anisotropic grooves on the surfaces are fabricated on silicon wafers by photolithography and dry etching. The gravitational force of giant liposomes is negligible. The spreading is investigated dynamically, and the evolution of the contact radius, specifically in the directions parallel and perpendicular to grooves, is traced. The effect of surface patterns on spreading is studied and the anisotropy in spreading behaviors is characterized by the contact angle difference and liposome elongation.

1. Introduction

Liposomes, also referred to as lipid vesicles, can be spontaneously formed from lipid bilayers [1]. Bilayers in liposomes exist with the hydrophilic "head" facing aqueous solutions and the hydrophobic "tails" lining up away from water. According to the size of liposomes, there are giant liposomes, large liposomes, and small liposomes with their diameters larger than 10 μm, in several hundred nanometers, and of several tens of nanometers, respectively. Liposomes can be used as drug delivery vehicles and biomimetic reactors [2,3]. Besides, liposomes, especially giant liposomes whose size is similar to real cells, can serve as models to study cell behaviors [4,5]. Most of these applications are related to the spreading of liposomes, one of the shape transformations of lipid bilayers.

Spreading is a universal phenomenon in nature, and it is intrinsically about surfaces and interfaces. Not only normal liquids, but biological systems can be involved in such interfacial phenomena. The wetting and spreading of a biological fluid interface is often considered in the research of drug delivery, biomaterials processing, and tissue engineering [6,7]. Fluid interfaces, playing a crucial role in cellular or physiological behaviors, are

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