



SARFUS: Characterization of ultraweak vesicles adhesion

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Abstract

Vesicles adhesion on lectin surface is studied by Sarfus. For glycolipid vesicles, contact area on the surface is clearly observed whereas no contact area is visible for DOPC vesicles. A correlation is done between contact area and vesicles adhesion.

Introduction

Surface flow on soft objects submitted to external shear flow is a problem involved in an increasing number of engineering and biophysical situations: microfluidics, emulsion processing, biomechanics, blood circulation... Here we report the deformation and unbinding of weakly adhering vesicles. In this study, the vesicle adhesion is mediated through a specific recognition: lectin-sugar. Glycolipid vesicles (V.Rosilio et al., Chem.Phys.Lipids, 125 (2003), 147-159) and lectin-grafted substrates are chosen to mimic cells and endothelial surface, respectively.

Experimental part

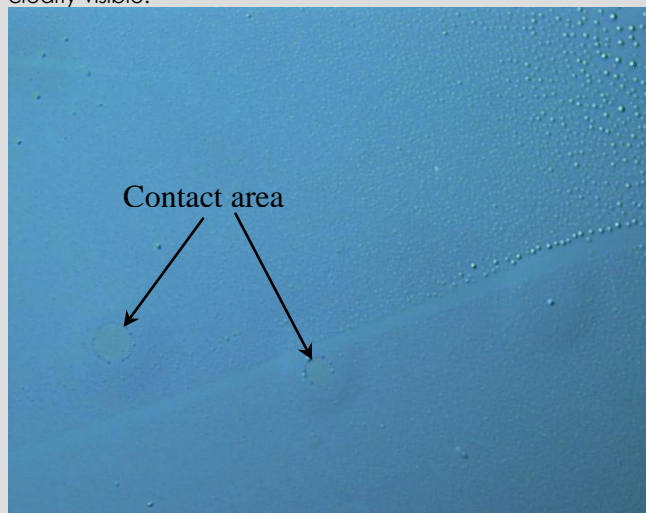
Vesicles are prepared by electroformation by mixing DOPC and glycolipid. Immersion Surfs (Nanolane) have been firstly cleaned with piranha and UV lighting before silanisation (mercapto propyltrimethoxysilane). Then, lectin-PEG molecules have been grafted on mercapto-silane surface. The thickness of the lectin layer is about 12nm and its density, determined by confocal microscopy, is about 500 lectins/ μm^2 .

Results

Figure 1 shows three glycolipid vesicles (DOPC/glycolipid: 2/3) adsorb on the surface of the functionalized Immersion Surf. On the left, the two vesicles display a contact area whereas the vesicle on the right shows no surface contact. Figure 2 showing the same area taken few seconds later, indicates that only the vesicle on the right has moved (Figure 2).

The images sequence hereafter (Figure 3) presents the glycolipid vesicle (DOPC/glycolipid: 2/3) adhesion on the surface vs. time. In the first seconds of the adhesion process, the vesicle vibrates drastically. But after few seconds, most of contact area is still fixed tightly on surface.

Figure 4 shows a similar sequence for DOPC vesicle (DOPC/glycolipid: 1/0) for which no adhesion is expected. Thermal fluctuations of the membrane close to the Surf are clearly visible.



Figures 1 and 2: Glycolipid vesicles (DOPC/glycolipid: 2/3) on functionalized Immersion Surf (t_0 and t_0 +few seconds).

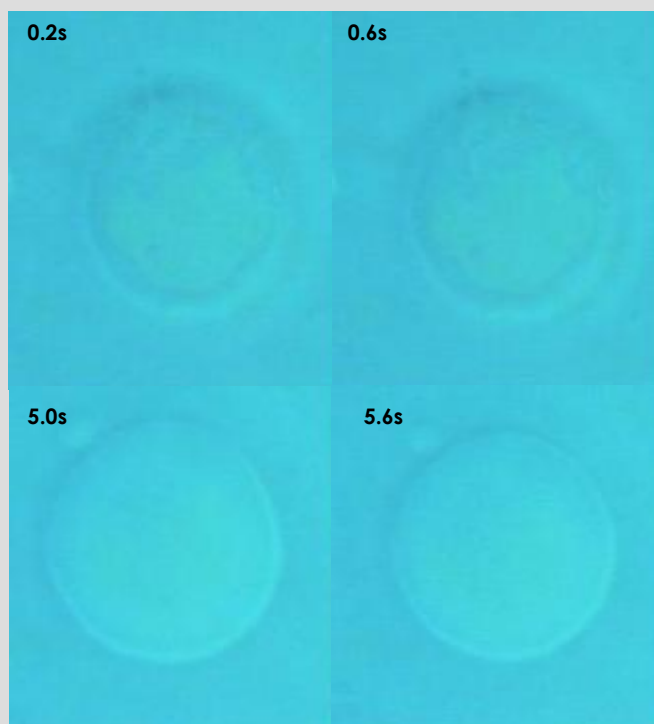


Figure 3: Image sequence of glycolipid vesicle (DOPC/glycolipid: 2/3) vibration (0.2 and 0.6s) and vesicle fixation on the surface (5.0 and 5.6 s).

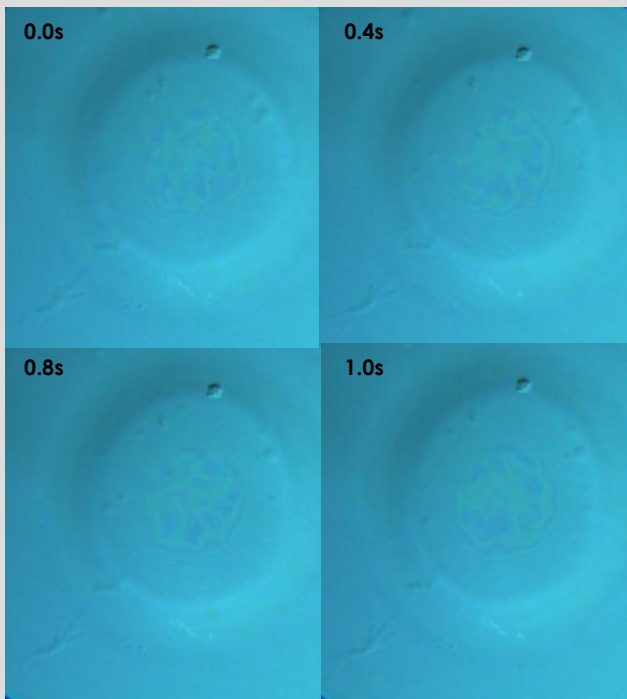
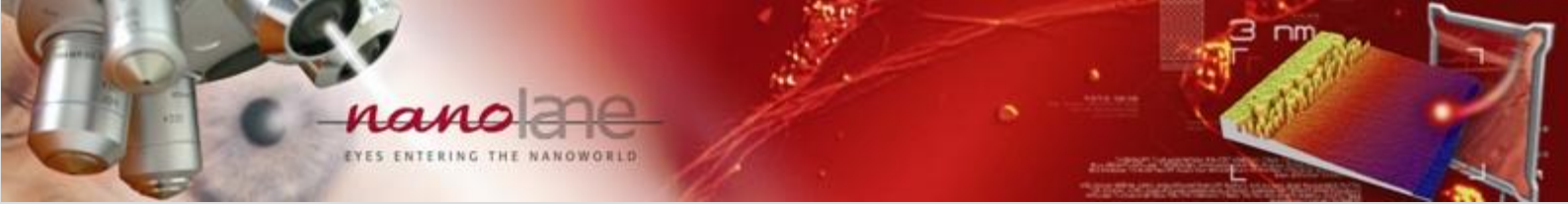


Figure4: Image sequence of DOPC vesicle (DOPC/glycolipid: 1/0) vibration on the surface.

Conclusions

Sarfus has shown that most of glycolipid vesicles are fixed on the surface. In contrary, DOPC vesicles only interacted though fluctuant contact area without any surface contact.

Contribution/advantages of Sarfus

- Work in immersion at ambient conditions
- Non-invasive/non contact technique
- No labelling/pretreatment of the sample
- Direct and fast sample analysis (1 image / 200ms)