Fast formation of low-defect-density tethered bilayers by fusion of multilamellar vesicles

Tadas Ragaliauskas, Mindaugas Mickevicius, Bozena Rakovska, Tadas Penkauskas, David J. Vanderah, Frank Heinrich, Gintaras Valincius

PII: S0005-2736(17)30015-9
DOI: doi:10.1016/j.bbamem.2017.01.015
Reference: BBAMEM 82397

To appear in: *BBA - Biomembranes*

Received date: 13 October 2016
Revised date: 19 December 2016
Accepted date: 10 January 2017

Please cite this article as: Tadas Ragaliauskas, Mindaugas Mickevicius, Bozena Rakovska, Tadas Penkauskas, David J. Vanderah, Frank Heinrich, Gintaras Valincius, Fast formation of low-defect-density tethered bilayers by fusion of multilamellar vesicles, *BBA - Biomembranes* (2017), doi:10.1016/j.bbamem.2017.01.015

Fast formation of low-defect-density tethered bilayers by fusion of multilamellar vesicles

Tadas Ragaliauskas [1*], Mindaugas Mickevicius [1*], Bozena Rakovska[1], Tadas Penkauskas[1], David J. Vanderah [2], Frank Heinrich [3,4] and Gintaras Valincius [1#]

[1]Institute of Biochemistry, Vilnius University, Mokslininku 12, Vilnius, LT-08662, Lithuania

[2]Institute for Bioscience and Biotechnology Research, Rockville, MD 20850, U.S.A.

[3]Center for Neutron Research, National Institute of Standards and Technology, Gaithersburg, MD 20899, U.S.A.

[4]Department of Physics, Carnegie Mellon University, Pittsburgh, PA, 15213, U.S.A.

ABSTRACT

A facile and reproducible preparation of surface-supported lipid bilayers is essential for fundamental membrane research and biotechnological applications. We demonstrate that multilamellar vesicles fuse to molecular-anchor-grafted surfaces yielding low-defect-density, tethered bilayer membranes. Continuous bilayers are formed within 10 min, while the electrically insulating bilayers with less than 0.1 μm^{-2} defect density can be accomplished within 60 min. Surface plasmon resonance spectroscopy indicates that an amount of lipid material transferred from vesicles to a surface is inversely proportional to the density of an anchor, while the total amount of lipid that includes tethered and transferred lipid remains constant within 5% standard error. This attests for the formation of intact bilayers independent of the tethering agent density. Neutron reflectometry (NR) revealed the atomic level structural details of the tethered bilayer showing, among other things, that the total thickness of the hydrophobic slab of the construct was 3.2 nm and that the molar fraction of cholesterol in lipid content is essentially the same as the molar fraction of cholesterol in the multilamellar liposomes. NR also indicated the formation of an overlayer with an effective thickness of 1.9 nm. These overlayers may be easily removed by a single rinse of the tethered construct with 30% ethanol solution. Fast assembly and low residual defect density achievable within an hour of fusion makes our tethered bilayer methodology an attractive platform for biosensing of membrane damaging agents, such as pore forming toxins.

* These authors contributed equally

Corresponding author