Biomaterial Interfaces
Room 117 - Session BI2-TuM

Characterization of Biological and Biomaterial Surfaces II

Moderators: Morgan Hawker, California State University, Fresno, **Sapun Parekh**, University of Texas at Austin

11:15am **BI2-TuM-14 Native Supported Lipid Bilayers: A Bioanalytical Tool to Study and Detect Viruses***, **Marta Bally**, H. Pace,* Umea University, Sweden **INVITED**

Cellular membranes are complex dynamic structures consisting of a lipid bilayer containing a multitude of biomolecules, including a variety of lipids, proteins and carbohydrates. Systematic investigations of biomolecular processes at the cell surface call for the development of bioanalytical platforms capable to recapitulate, in vitro and under well-controlled experimental conditions, this compositional complexity while maintaining the membrane´s basic physico-chemical properties (e.g. membrane fluidity). In this context, we present native supported lipid bilayers (nSLBs), two-dimensional fluid planar bilayers produced from purified cellular plasma membranes and mounted on a solid support as a promising tool. [1,2] These cell-free systems provide the compositional complexity of nature, yet they are free from metabolic feedback loops. They are a snapshot of the membrane's composition at the moment of cell lysis, providing hundreds of experiments with the exact same membrane composition. They further allow for optimal instrumental accessibility, being compatible with a broad range of surface-sensitive biosensing tools.

In our work, we take advantage of nSLBs to characterize virus- membrane interactions [2]. The combination of nSLBs with total internal reflection fluorescence microscopy allows us to quantitatively assess the attachment, detachment, and diffusion behavior of individual virus particles at the cell membrane and to address a variety of fundamental questions related to viral attachment and entry. Specifically, this experimental approach was used to (i) study how SARS-CoV-2 changes its interaction with the plasma membrane when evolving and mutating [3], (ii) investigate the role of a cellular factor in modulating HSV-1 interactions at the cell surface [4] and (iii) to study how different carbohydrate moieties modulate the dynamics of norovirus-membrane interactions [5].

Taken together, our research contributes to a better understanding of the mechanisms regulating the interaction between a virus and the surface of its host. Such insights will without a doubt facilitate the design of more efficient antiviral drugs or vaccines.

[1] Pace at al., Analytical Chemistry, **87(18)** (2015)

[2] Peerboom, N. et al., ACS Infect. Dis. **4 (6)**, (2018)

[3] Conca, D. et al., Biorxiv (2024), https://doi.org/10.1101/2024.01.10.574981

[4] Liu, L. et al., Biorxiv (2023) ¸https://doi.org/10.1101/2023.02.10.526562

[5] Pace, et al., In manuscript.

11:45am **BI2-TuM-16 Force Probe Techniques for Probing Biologic and Lipid Bilayer Interactions Under Physiological Conditions***, **Markus Valtiner**, L. Mears, I. Peters,* TU Wien, Austria

Quantification of biologic interactions - from single molecular to macroscopic interfaces - is essential for understanding function in living systems. We will provide a short overview of force probe techniques (AFM, SFA, and optical tweezers) and will then discuss lipid bilayer interactions, and single molecular interaction measurements (under potential control) in detail. These are essential to a vast range of biological functions, such as intracellular transport mechanisms. Surface charging mediated by concentration dependent ion adsorption and desorption on lipid headgroups alters electric double layers as well as van der Waals and steric hydration forces of interacting bilayer and molecules. Two examples will be discussed:

First, we characterized the interaction between single hydrophobic molecules quantitatively using atomic force microscopy, and demonstrated that single molecular hydrophobic interaction free energies are dominated by the area of the smallest interacting hydrophobe. The interaction free energy amounts to 3–4 kT per hydrophobic unit. Also, we find that the transition state of the hydrophobic interactions is located at 3 Å with respect to the ground state, based on Bell–Evans theory.

Further, we directly measure bilayer interactions during charge modulation in a symmetrically polarized electrochemical three-mirror interferometer surface forces apparatus. We quantify polarization and concentration dependent hydration and electric double layer forces due to cation adsorption/desorption. Results demonstrate that exponential hydration layer interactions effectively describe surface potential dependent surface forces due to cation adsorption at high salt concentrations. Hence, electric double layers of lipid bilayers are exclusively dominated by inner Helmholtz charge regulation under physiological conditions. These results are important for rationalizing bilayer behavior under physiological conditions, where charge and concentration modulation may act as biological triggers for function and signaling.

We will finally provide an outlook on combining all force probe techniques with electrochemical potential modulation.

Author Index

Bold page numbers indicate presenter