

hydrated supporting cushion for membrane deposition was chosen for investigation. Polyelectrolyte multilayered films were prepared using layer-by-layer physisorption with either terminating positively (CHIT) or negatively (HEP) charged PE layers. Thereafter the vesicle fusion technique was applied to deposit model membranes onto the support. In this study giant unilamellar vesicles (GUV) and small unilamellar vesicles (SUV) composed of a mixture of zwitterionic POPC and its cationic derivative E-POPC were used, the latter providing a positive surface charge density in the lipid bilayer. The topology and integrity of the lipid layer on its PEM-support were investigated by a combination of confocal fluorescence microscopy and atomic force microscopy.

#### 1420-Pos

##### Mechanics of POPC Bilayers in Presence of Alkali Salts

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Membranes mechanical properties are affected by solvent properties, i.e. the salt content. In this study, we use POPC GUVs (Giant Unilamellar Vesicles) as model membranes and we measure the membrane mechanical moduli by flickering analysis and micropipette technique for a series of alkali salt solutions. Salt concentration effects and ion specificity are investigated in these measurements. Membrane mechanical moduli are shown to display a complex dependence on the salt solution composition.

#### 1421-Pos

##### Reproduction of Fatty Acid Vesicles

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Compartmentalization is an essential step for the origin of life to allow for the formation of more complex biotic building blocks. Possibly in early life preliminary compartments were formed out of prebiotic molecules, such as fatty acids. These molecules organize in bilayers at neutral pH and they show intriguing behavior with respect to self-reproduction of vesicles [1], in that fast addition of fatty acid at high pH to preexisting seed vesicles at neutral pH results in a fast formation of new vesicles with a size distribution that is closely related to that of the seed vesicles. The mechanism behind this so-called matrix effect is still a puzzle. One possibility would be that the fatty acids insert in the outer monolayer of the vesicle and that an excess of material in the outer leaflet with respect to the inner leaflet is then the driving force for budding and subsequent fission. In order to test this possible mechanism, we varied the rate of addition (insertion) of the new material. Slow addition would give the system time for movement of fatty acids from the outer leaflet to the inner leaflet and thus to remove this imbalance. Our results show that such a decrease of the addition rate indeed leads to growth of the vesicles instead of division, supporting our hypothesis. We also found, by including a fluorescent dye which is self-quenching at high concentrations, that during the fission process the content of the vesicles does not leak to the exterior. These observations agree well with results and predictions from coarse-grained molecular dynamics [2] and provide a plausible mechanism for the matrix effect [1].

[1] Luisi et al. J. Phys. Chem. B 2008, 112, 14655-14664 [2] Markvoort et al., in preparation

#### 1422-Pos

##### Effect of Solubilization on Rhodopsin Thermal Denaturation in Rod Outer Segment Disk Membranes

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The photoreceptor, rhodopsin is a GPCR in rod outer segment disk membranes. Activation by light converts the dark-adapted form, rhodopsin to the bleached form, opsin. Differential scanning calorimetry (DSC) studies showed that rhodopsin and opsin each exhibit an irreversible scan rate dependent endothermic transition ( $T_m$ ) at approximately 72°C and 55°C respectively as well as a scan rate dependent exothermic transition. Solubilization was used to examine the contribution of the bilayer. Disk membranes were subjected to sub-solubilizing and solubilizing concentrations of octylglucoside (OG) until rhodopsin was completely delipidated. DSC experiments were performed using a MicroCal VP-DSC microcalorimeter. Samples were scanned at 15, 30, 60 and 90°/hr. Because the protein transitions are irreversible, a second scan was used to determine the baseline. As the OG partitioned into the bilayer the endothermic  $T_m$  and EACT (activation energy of denaturation) rapidly decreased. Both then remained constant following rhodopsin solubilization. At low detergent concentration the exothermic  $T_m$  increased rapidly then remained constant after solubilization. Unlike the endothermic EACT, the degree of solubilization

had little effect on the exothermic transition EACT. Digitonin was also used to examine the effect of solubilization. Unlike OG, this detergent binds to cholesterol which constitutes approximately 10% of the disk lipids (average). The endothermic transition was less affected by digitonin than by OG. The EACT was also determined by thermal bleaching and was in agreement with the DSC data. These results indicate an endothermic transition is observed due to a weakening of the tertiary structure interactions as rhodopsin is heated. This may be accompanied by changes in the packing of the trans-membrane helices as well as changes in protein-lipid interactions. It is likely the exothermic transition results from aggregation.

#### 1423-Pos

##### A Coarse Grained Molecular Dynamics Study of Self-Reproduction of Fatty Acid Vesicles

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The formation of self-reproducing fatty acid vesicles is believed to be a quintessential building block required for (the origin of) life. In literature a number of vesicle reproduction experiments have been reported [1]. Of particular interest is the so called matrix effect where the final size distribution of vesicles formed upon addition of new surfactants is strongly biased toward the size distribution of pre-existing vesicles. However, the mechanism behind this is poorly understood. Here, we regard this mechanism using coarse grained molecular dynamics simulations with a parameter set based on a previously published force field [2]. These simulations show fission of a vesicle on continuous addition of new fatty acid molecules to the vesicle exterior. The new molecules are incorporated in the outer leaflet of the vesicle's membrane. As the rate of fatty acid redistribution among the leaflets by means of flip-flop is lower than the rate of fatty acid uptake in the outer leaflet, an excess of molecules in the outer leaflet compared to the inner leaflet is formed. This results in spontaneous membrane curvature, causing the vesicle to deform into twin-vesicles. Eventually, the built-up spontaneous curvature induces the formation of a narrow neck, that finally breaks, resulting in full fission. Importantly, no leakage from the interior of the vesicles was observed. The reproduction pathway shown in these simulations agrees with published experimental data, as well as with new data from our group (see abstract Nicole Pfleger). Our coarse grained molecular dynamics simulations offer further insight at the molecular level of the self-reproduction pathway of fatty acid vesicles.

[1] Luisi et al. (2008) J. Phys. Chem. B 112, 14655-14664.

[2] Markvoort et al. (2005) J. Phys. Chem. B 109, 22649-22654.

#### 1424-Pos

##### On the Miscibility of Cardiolipin with the Major Lipid Components of the Bacterial Inner Membrane

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The thermotropic phase behavior and organization of model membranes derived from binary mixtures of tetramyristoylcardiolipin (TMCL) with dimyristoyl phosphatidylethanolamine (DMPE) and dimyristoyl phosphatidylglycerol (DMPG) were studied by differential scanning calorimetry (DSC) and Fourier transform infrared (FTIR) spectroscopy. Cardiolipin-containing DMPE and DMPG model membranes all exhibit complex multi-component hydrocarbon chain-melting ( $L_\beta/L_\alpha$ ) phase transitions upon heating and cooling. This suggests that TMCL is poorly miscible with both DMPE and DMPG and that the domains formed prior to the onset of the  $L_\beta/L_\alpha$  phase transitions are probably retained in the liquid-crystalline state. For all mixtures, the temperatures of the  $L_\beta/L_\alpha$  phase transitions are generally higher than those predicted by an ideal mixing of the components, and the enthalpies of these phase transitions seem to be better correlated with the component mol fraction of hydrocarbon chains than with the molar composition of the mixture *per se*. Finally, when cooled to low temperatures, cardiolipin-rich (i.e., > 30 mol % TMCL) membranes tend to form lamellar-crystalline phases which exhibit spectroscopic characteristics comparable to those exhibited by the lamellar crystalline phases of pure cardiolipin. Together, our experimental observations indicate that cardiolipin is poorly miscible with major lipid components of one of the biological membrane systems (*Escherichia coli*) in which it occurs naturally. The possibility that it may also be poorly miscible in the biologically relevant liquid-crystalline phase also has interesting structural and functional implications.

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