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Charge Effects on Surfactant Membrane Thickness Fluctuations

ROBERT BRADBURY, MICHIHIRO NAGAO, Indiana University — The mechanical properties of surfactant bilayer membranes have been measured over a range of surface charge densities using small-angle neutron scattering and neutron spin echo spectroscopy. An increase in the surface charge density leads to a stiffening of the membrane, which is consistent with classical theory of charge effects on membranes. The fluctuations in the membrane thickness, however, become slower with increasing charge density, which can be explained by an increase in the membrane viscosity as predicted by Bingham *et al.* We suggest that an increase in the repulsive interactions between the charged headgroups is responsible for this increased membrane viscosity. Furthermore, the amplitude of the thickness fluctuations is observed to remain almost constant with variation in surface charge density which suggests almost constant values for the total compressibility modulus of the bilayer and the optimum fluctuation wavelength. This indicates that the time scale and amplitude of membrane thickness fluctuations are controlled by different membrane effects. This work demonstrates that charge stabilization of lamellar bilayers is not merely affected by inter-membrane interactions but that intra-membrane dynamics also have a significant contribution.

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