The Effect of Lipid Phase Transition on Carrier- and Pore-Mediated Ion Transport

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Using mixed-chain lipids, we have recorded cooling and heating curves of planar bilayer membranes while they passed the lipid phase transition range. With unmodified planar bilayers, spontaneous current fluctuations are observed near the lipid phase transition temperature ($t_c \approx 29°C$). This effect coincides with the expected and measured decrease in membrane capacitance. Carrier (valinomycin)-modified planar bilayers exhibit near t_c an abrupt change from a high-conducting state above t_c to the state of bare membrane conductance below t_c. In contrast to this behaviour, planar bilayers modified by pore-forming antibiotics (gramicidin A, alamethicin) do not show any peculiar effect at t_c. However, at 22-23°C a pronounced maximum in pore-induced conductance is seen. Whereas the gramicidin A pore abruptly stops stepwise fluctuations below $\approx$ 16°C, with alamethicin a few long-lasting pore and pore state fluctuations persist down to 10°C. It is suggested that the carrier may freeze out into the membrane/water interface. The effects observed with pore-forming substances, on the other hand, are interpreted in terms of lateral phase separation into pure lipid and lipid/antibiotic domains.