Pore formation by alamethicin in planar bilayers below lipid phase transition temperature

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Planar bilayer membranes were formed according to the method of Montal and Mueller using 1-stearoyl-3-myristoyl-glycero-2-phosphocholine (1,3-SMPC). Lipid phase transition temperature is T_C = 29°C for the cooling and T_C =31°C for the heating process. The properties of the 1,3-SMPC/alamethicin multi-pore and single-pore systems were studied within the temperature range 14-4o°C.

At constant applied voltage the current/temperature characteristic of the multi-pore system shows a pronounced maximum at ~ 24°C and a shoulder at ~ 18°C. These two effects are explained in terms of single-pore parameters in the following way.

1. the maximum: A second population of alamethicin pores with anomally long mean pore lifetime ($\tau^*_p \gtrsim$ 1os) is observed between 24-3o°C besides the usually observed population of short living pores ($\tau_p \sim$ o.4s). The maximum current induced by this second population is found at ~27°C. The simultaneous existence of two different pore populations at $T \lesssim T_C$ seems to result from a lateral separation of the membrane components into a fluid 1,3-SMPC/alamethicin phase and into a frozen 1,3-SMPC phase containing only a small amount of alamethicin.

2. the shoulder: Pore state conductances Λ_ν show a temperature dependence according to an activation energy of ~25 kJ mol^{-1} within the considered temperature range. The mean pore lifetime τ_p, on the other hand, increases with decreasing temperature. This increase is stronger below 21°C than above. The pore formation rate f_p of the short-living population shows maximum values in the range 27-22°C and decreases steeply below ~ 19°C.

Single-pore and multi-pore data are consistent, if one takes into consideration the physico-chemical rule that a larger concentration of the solved component (alamethicin) leads to a larger freezing point depression of the solution.