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Peculiarities of lateral diffusion of lipids in three-component bilayers

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Abstract

The lateral diffusion of lipid molecules in macroscopically oriented bilayers of mixed dioleoyl phosphatidylcholine (DOPC), egg sphingomyeline (SM), and cholesterol (CHOL) and its dependence on cholesterol concentration and temperature was studied by NMR with pulsed field gradient. The system forms a lamellar liquid crystalline (LC) phase; in a certain range of temperatures and concentrations of cholesterol the system is separated into two subphases: a disordered LC phase (I_d) enriched with DOPC, and an ordered phase (I_o) enriched with SM. These are characterized by their own lateral diffusion coefficients (LDCs), which differ from one another by a factor of 1.5-5. The dependence of the LDCs in the phases on the cholesterol concentration was analyzed. There was no clear dependence for the disordered LC phase, but we found that LDCs tend to grow in the concentration range of 15-35 mol % of CHOL. This behavior could be due to the redistribution of lipid components as the concentration of CHOL increases, eventually leading to a rise in DOPC concentration in the I_o phase. In the range of liquid-phase domains, we observed no dependence of LDCs on the diffusion time typical of the restricted diffusion regime, due to spatial restraints in the system. This could be associated with the relatively large size of the domains, and with the domain capability of lateral diffusion in a surrounding continuous phase. © 2011 Pleiades Publishing, Ltd.

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Keywords

Cholesterol, Domains, Lipids, NMR, Ordered phase, Self-diffusion