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Sizes of lipid domains: what do we know from artificial lipid membranes? What are the possible shared features with membrane rafts in cells?

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Abstract

In model lipid membranes with phase coexistence, domain sizes distribute in a very wide range, from the nanometer (reported in vesicles and supported films) to the micrometer (observed in many model membranes). Domain growth by coalescence and Ostwald ripening is slow (minutes to hours), the domain size being correlated with the size of the capture region. Domain sizes thus strongly depend on the number of domains which, in the case of a nucleation process, depends on the oversaturation of the system, on line tension and on the perturbation rate in relation to the membrane dynamics. Here, an overview is given of the factors that affect nucleation or spinodal decomposition and domain growth, and their influence on the distribution of domain sizes in different model membranes is discussed. The parameters analyzed respond to very general physical rules, and we therefore propose a similar behavior for the rafts in the plasma membrane of cells, but with obstructed mobility and with a continuously changing environment.

Abbreviations

Liquid-ordered phases (Lo), liquid-disordered phases (Ld), Giant Unilamellar Vesicles (GUVs), Large Unilamellar Vesicles (LUVs), Black Lipid Membranes (BLM), Fluorescence Recovery After Photobleaching (FRAP), Fluorescence Resonance Energy Transfer (FRET), Small-Angle Neutron Scattering (SANS), Fluorescence Microscopy (FM), Brewster Angle Microscopy (BAM)

1,2-Dioleoyl-sn-glycero-3-phosphocholine (DOPC), Palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine (POPC), Cholesterol (chol), dihydrocholesterol (Dchol), 1,2-Distearoyl-sn-glycero-3-phosphocholine (DSPC), 1,2- Dipalmitoyl-sn-glycero-3-phosphocholine (DPPC), 1,2-Dimyristoyl-sn-glycero-3-phosphocholine (DMPC), 1,2-Dilauroyl-sn-glycero-3-phosphocholine (DLPC), Galactocerebroside (GalCer), palmitoylsphingomyelin (pSm), stearic acid (SA).