MEMBRANE MIMETIC CHEMISTRY pdf

1: Membrane dictionary definition | membrane defined

(The term membrane mimetic is more restrictive than the term biomimetic. Biomimetic chemistry is directed at the mechanistic elucidation of biochemical reactions and at the development of new compounds modeled on, and expected to mimic, specific biological systems.

Doria , Catania, Italy Address for correspondence: This article has been cited by other articles in PMC. Abstract Insight into the forces governing a system is essential for understanding its behavior and function. Thermodynamic investigations provide a wealth of information that is not, or is hardly, available from other methods. These methods can be successfully applied to the study of lipid vesicles liposomes and biological membranes. With respect to instrumentation, differential scanning calorimetry, pressure perturbation calorimetry, isothermal titration calorimetry, dilatometry, and acoustic techniques aimed at measuring the isothermal and adiabatic processes, two- and three-dimensional compressibilities are considered. Applications of these techniques to lipid systems include the measurement of different thermodynamic parameters and a detailed characterization of thermotropic, barotropic, and lyotropic phase behavior. Many thermodynamic assays are available for studying the effect of proteins and other additives on membranes, characterizing non-ideal mixing, domain formation, bilayer stability, curvature strain, permeability, solubilization, and fusion. Studies of membrane proteins in lipid environments elucidate lipidâ€"protein interactions in membranes. Finally, a plethora of relaxation phenomena toward equilibrium thermodynamic structures can be also investigated. The systems are described in terms of enthalpic and entropic forces, equilibrium constants, heat capacities, partial volume changes, volume and area compressibility, and so on, also shedding light on the stability of the structures and the molecular origin and mechanism of the structural changes. Biomembrane, DSC, thermodynamics Impressive progress has been made in detecting and imaging structural properties of biological systems. Structure data, however, represent only the first step toward an understanding of physiological processes. A deeper insight into the functions of biological macromolecules and their supramolecular assemblies requires additional information both on the interactions and on the dynamics governing their behavior. Nowadays, there is renewed interest in addressing the collective behavior of the biological system, shifting the focus from a detailed description of the single isolated molecule to the properties of assemblies of idealized simple objects. Such issues are typically tackled by bio-thermodynamics. At the variance of the classical thermodynamics, where the ultimate goal is the macroscopic properties of a single system sometimes isotropic and macroscopically homogeneous, such as a liquid solution , biological phenomena involve a variety of multiple scale subsystems, each of them defined over a particular size and time scale. These subsystems, spanning from the angstroms to the micron, and from the pico-second to hours, are not isolated, but strongly interact with each other giving rise to new and challenging phenomena. In this review we focus on a typical collective system, the biological membrane, selected both for its fundamental role in cell biology and for the different, but closely connected, space and time scales. In order to be more specific, we list here, a few open questions in membrane science that could be answered only by considering a multiscale approach: Coupling between different fluctuating fields e. Active lipid transport and non-equilibrium membrane processes in live cells â€" how is energy efficiently deposited into a membrane to drive processes such as raft domain formation, pore formation, vesicle fusion, membrane invagination, and protein activity? Hydrodynamic effects on membrane dynamics â€" when are hydrodynamic effects indispensable in membrane dynamics, and how can their effects be quantitatively captured across different scales? Large-scale membrane remodeling events studied through a hierarchy of scales â€" how do we connect single-molecule diffusion studies to the collective migration of lipid domains or patches? Cross-coupling between lipids and proteins â€" Membranes move proteins and proteins reshape membranes: What do such experiments reveal about membrane structure and dynamics?. On the experimental side, excellent microcalorimeters and other techniques measuring heats, volumes, pressures, and related properties have been developed over the last decades and are now available to a broad spectrum of users. On the theoretical side, there is an explosion of analytical and computational techniques, which have shown potential usefulness in understanding the collective properties of model membranes. Besides the methods of classical and statistical thermodynamics, new ideas have been proposed, for instance: Also on the computational side, a variety of approaches have been suggested in the field of Molecular Dynamics and Dissipative Dynamics. They range from highly idealized coarse-grained pictures of lipids, proteins, and water, to complete simulations at an atomistic level. Simulations are gaining broader and broader applications because they provide, with a steady increasing level of accuracy, information on both the structural details geometry and the collective property of the system e. This review is mainly directed to researchers working in the field of lipid membranes in biological as well as model e. The broad scope of the review makes it impossible to explain the thermodynamic background or technical details of the methods[4 â€" 9] or to discuss the results obtained by using them. Instead, the article must be limited to making one aware of the calorimetric assays that are available to tackle a certain problem and to giving a few selected references. One current trend in membrane thermodynamics seems to be the consideration of increasingly complex systems. Vesicles of uncharged DMPC or DPPC dimyristoyl- and dipalmitoyl-phosphatidylcholine have yielded important information, but there are many other problems for which these lipids are rather poor model systems. Furthermore, the great interest in lipid rafts has led to a much broader consideration of complex mixtures of glycero-, sphingo-, and glycolipids and sterols. Calorimetry of biological membrane extracts, viruses, organelles or whole cells is being further developed. Another important development is the ongoing introduction of new instruments, techniques, and assays. The crucial challenge is to combine insights from biochemistry and physiology with those from structural biology and from bio-thermodynamics to derive an integral picture of membranes and their functions. The great amount of experimental data must be interpreted on the basis of approximate, but not over-simplified, models. This issue is too large and cannot be contained in the space of a review. We will mention only the main ideas behind the various thermodynamic models developed to investigate the membrane properties. Brief Survey of the Main Thermodynamic Techniques Calorimeters measure the heat consumed or released by a sample on re-equilibration after a perturbation. Such perturbations can be caused by a change in temperature Differential Scanning Calorimetry , addition of material Isothermal Titration Calorimetry , a change in pressure Pressure Perturbation Calorimetry or in water activity sorption calorimetry. Heat flow calorimeters can provide better long-term stability of the temperature and baseline signal, which is particularly important if slow processes are investigated. For first order or weakly first-order phase transitions, such as the bilayer gel to liquid-crystalline transition, the transition temperature, Tm, is where the heat capacity, Cp, reaches its maximum value.

2: The thermodynamics of simple biomembrane mimetic systems

(chemistry) the study of processes and reactions whose developments have been inspired by the biological membrane.

3: membrane mimetic chemistry - Wiktionary

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7: Chhabil Dass - Department of Chemistry - The University of Memphis

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