Surfactant and phospholipid membranes: an experimental approach

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Amphiphilic molecules in water self-assemble into aggregates such as micelles and bilayers. Examples of these molecules are phospholipids and surfactants. Phospholipid bilayers are the fluid matrix of biológical membranes and are ubiquitous in the cell and its organelles. Surfactant micelles and bilayers are relevant in fields such as detergency, emulsification, foaming, etc. In order to understand these applications, it is necessary a precise knwoledge of the physical properties of the amphiphilic aggregates. Such properties are both structural (shape, characteristic size, interbilayer distance, etc) and dynamical (relaxation times, diffusion coefficients, etc). In addition, it is interesting to understand the effect of natural (protein) or synthetic (alcohols, polymers) additives on the properties of amphiphilic membranes and micelles. In this talk we will present and discuss experimental results obtained with model surfactant and phospholipid membranes. In the first part we will show how Small-Angle X Ray Scattering (SAXS) and Freeze-Fracture Electron Microscopy (FFEM) experiments can give a detailed picture of the structure of lamellar and sponge surfactant phases. In particular, we will describe a surfactant system that can be used as model for the study of the self-diffusion of molecules in the membranes. We then present Fluorescence Recovery Afther Photobleaching results on the diffusion of different molecules (phospholipid, protein, polymers) along or between the membranes of these model systems. We show that using diffusion coefficient measurements it is possible to distinguish between a 2D diffusion (along the membranes) and a 3D diffusion (between the membranes). At the end, we present optical microscopy experiments on the shape of vesicles formed with a mixture of phospholipids (SOPC and SOPS). We show that the relative proportions of these molecules influences the shape of the aggregates. The described experiments open more questions that need to be addressed not only experimentally, but theoretically and with computer simulations.