Possibilities of SAXS to soft-condensed matter

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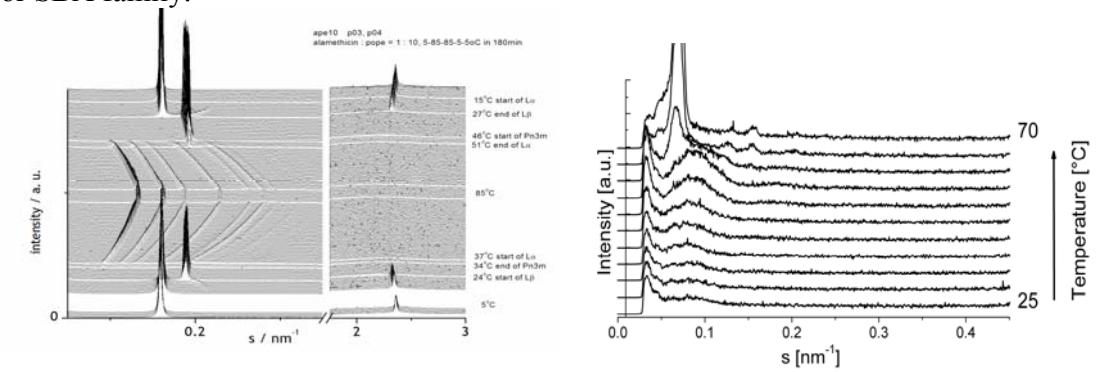
Soft condensed matter is a term that covers a very wide range of materials and their properties. They normally are composed of light non-metallic atoms, carbon most of the times (organic substances). Therefore with an inherent low electron density and consequently a low X-ray scattering power.

In order to obtain structural information on these materials, rather than the molecules forming them, we need either very long exposure times, very often causing radiation damage, or very intense X-ray beams; nowadays easily available at different synchrotron sources worldwide.

Such studies gave a boost to the understanding of structural aspects of liquid crystalline materials and polymers, as well as lipid based model membranes, where different aspects of cellular membranes can be studied on an artificial similar model constructed under controlled specifications. If these models are much simpler than a real cell membrane, they have the advantage of allowing studies of individual parameters in detail, contributing to the comprehension of a real membrane in a later stage.

We shall illustrate this with examples of thermal behaviour of a wide range of additives into a lipid matrix.

Another aspect of this powerful technique is the possibility to follow in real time the structural evolution of organized domain formation. This shall be illustrated by the formation of highly ordered mesoporous materials. Organic units can be incorporated into pore walls by hydrolysis and condensation of bissilylated organosilica precursors of the formula $(OR)_3Si\text{-}R'\text{-}Si(OR)_3$ (R: methyl or ethyl, R': any organic unit, mostly containing aromatic molecules) instead of pure silica precursors such as tetraethyl orthosilicate (TEOS), as it is often used for the synthesis of mesoporous silica materials of the M41S or SBA family.



Left. Diffraction patterns of POPE membranes with alamethicin at L/P = 10 on heating and cooling from 5 to 85 to 5°C. Scaning rate was 1°C/min. Onsets of thermotropic phases are marked

Right. SAXS patterns of a solution containing Pluronic® P123 ($PEO_{20}PPO_{70}PEO_{20}$) as structure directing agent and 1,4-bis(triethoxysilyl)benzene (BTEB) as organosilica precursor under acidic conditions (pH ≈ 1). The experiment was started at 25 °C and the solution was heated up to 70 °C under vigorous stirring. The solution was pumped through a capillary which was placed in the beam with a flow rate of 26 mL/min.