Hierarchical Structure and Dynamics of Softmatters

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'Softmatter' is a general name of materials including polymers, liquid crystals, amphiphilic molecules and colloids, and so on. These materials are used in every day life as industrial products. Also, lives themselves are composed from softmatters. Thus investigations of this category of materials widely spread from physics, chemistry, biology and industrial application.

The term 'soft' originates from macroscopic mechanical properties; displacement of atoms is relatively large comparing with solid state materials when an external force is applied, and sometimes non-equilibrium ordered states appear under energy flow. The most important feature in common is that the ordering is generally intermediate between that of a crystalline solid and that of a liquid. This lack of crystalline order leads to the 'soft' mechanical response of the materials. Another feature common to the ordering of soft materials is the periodicity of the structure formed, typically in the range 1-1000nm, which corresponds to 'nanoscale' ordering. This scale of structure is based on a regular arrangement of molecules in the range of 0.1 nm. The self-organization and dynamics of such the structure extends from molecular scale to nanoscale, so called "hierarchical structure", should be clarified in order to understand physical properties of softmatters.

Small-angle neutron scattering (SANS), small-angle X-ray scattering (SAXS) and Neutron Spin Echo (NSE) are powerful tools for investigating hierarchical structure and dynamics of softmatters. SANS can highlight a part of materials by substituting isotopes. SAXS is useful to observe fast processes in the order of ms. By using NSE, collective motion of molecules can be seen in the temporal scale of ns. I will show complementary use of these methods in the investigation of amphiphilic membranes.