

Soft Condensed Matter

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Soft matter is a term used to describe the wide range of materials that deform easily under applied stress with viscous, viscoelastic or plastic behaviour rather than the usual elastic response of most crystalline materials. Soft matter includes polymers (in bulk or solution), colloidal dispersions, liquid crystals and granular matter. Typical structures involve length scales of 1 nm to a few micrometres and there is a very wide spectrum of relaxation times. These materials are found widely as foods, in personal care products, in industrial processes for example as paints and in ceramic processing, as delivery agents for pharmaceuticals and in domestic applications such as detergents.

The lecture will first provide a basic description of these materials and a simple guide to the theoretical models that are used to explain their properties in terms of molecular and particulate interactions, scaling theories, and the conformation and entanglement of polymers. The broad range of synchrotron and neutron techniques that are used to study structure and dynamics (motion, chemical changes, etc.) will be briefly mentioned.

The second part of the lecture will illustrate the application of neutron scattering and synchrotron X-ray radiation to the study of polymers and colloids and show how simple models can be used to understand everyday materials and important technical processes. Examples will include the use of small-angle scattering to study structure and hence derive information about interactions in colloids, and the use of wide-angle diffraction to study alignment. The traditional techniques of small-angle scattering will be discussed in relation to other techniques. The range of complementary techniques that use synchrotron and neutron facilities will also be illustrated with examples of experiments that exploit diffraction and reflection from interfaces. Case study examples of applications of scattering to studies of flocculation related to water purification, rheology and chemical changes will be shown.