Soft Matter Physics

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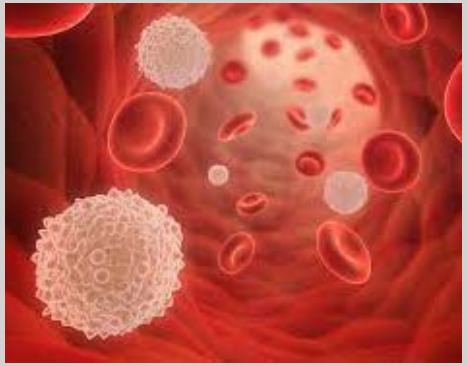
Soft Matter Physics

(MOD11, 5EC)

What is soft matter?

Passive Materials

Living systems



Blood

Gut Bacteria

Soft Matter Physics

What is soft matter?

Soft matter

From Wikipedia, the free encyclopedia

For the journal, see Soft Matter (journal).

Soft matter or **soft condensed matter** is a subfield of condensed matter comprising a variety of physical systems that are deformed or structurally altered by thermal or mechanical stress of the magnitude of thermal fluctuations. They include liquids, colloids, polymers, foams, gels, granular materials, liquid crystals, pillows, flesh, and a number of biological materials. These materials share an important common feature in that predominant physical behaviors occur at an energy scale comparable with room temperature thermal energy. At these temperatures, quantum aspects are generally unimportant.

-easy to deform (soft)

-(reversible) assembly via kT

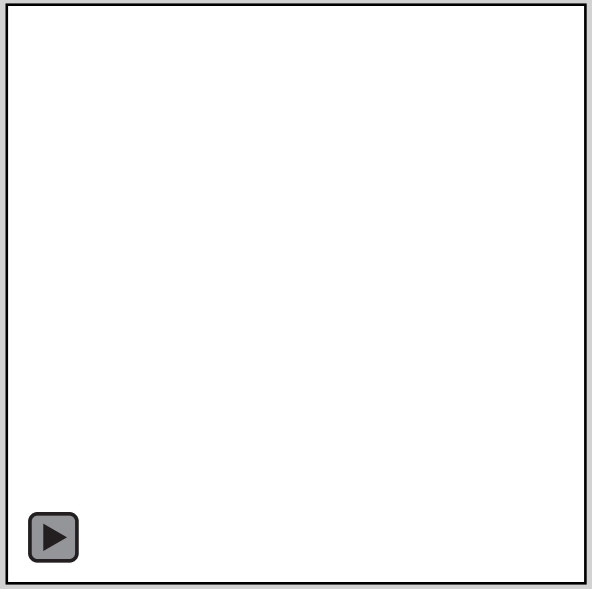
-timescale of (de)formation

Soft Matter Physics

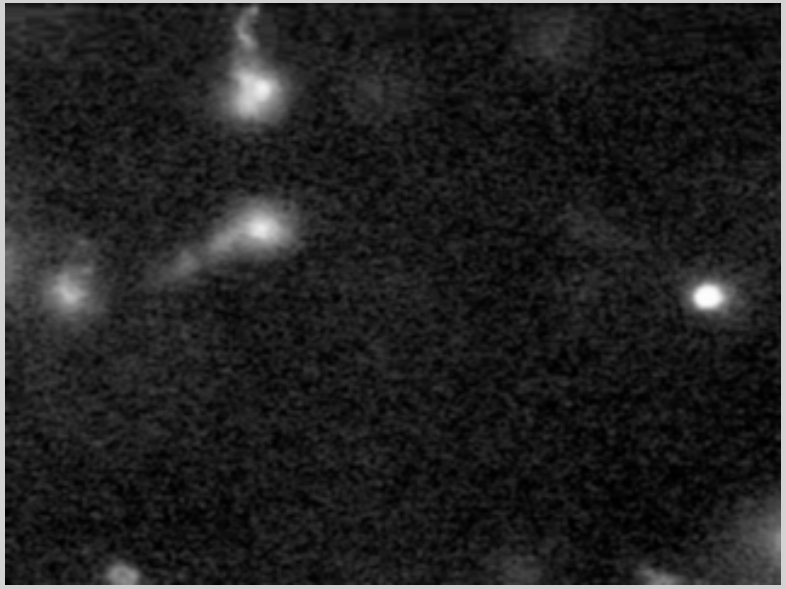
What do we need to study/understand?

Theoretical Description - Brownian motion:

Colloids



E.Coli



Soft Matter Physics

What do we need to study/understand?

Main Topics (from the book)

Thermal fluctuations
- ❑ Brownian motion
- ❑ Molecular machines

Out of equilibrium
- ❑ Active soft matter

Self-Assembly
- ❑ Micelles
- ❑ Gels
- ❑ Crystals

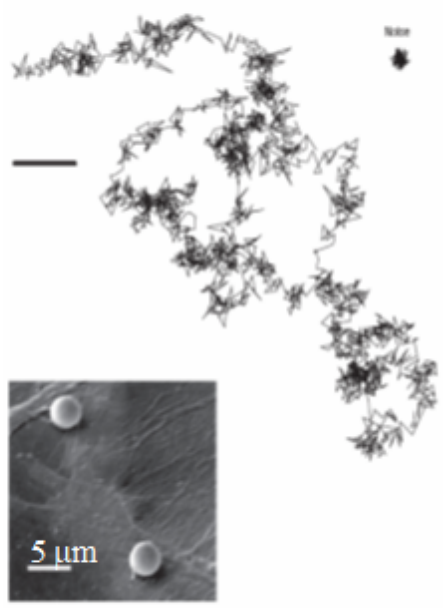
Charges in liquids
(Electricity, salt and water!)
- ❑ Colloids
- ❑ Polyelectrolytes

Visco-elastic behavior
- ❑ Rheology

Added Topics (beyond the book)

What do we need to study/understand?

Microrheology



'Passive microrheology': Use of a microscope or dynamic light scattering setup to 'measure' rheological properties of the medium via the Brownian motion of colloidal particles dispersed in it.

Forms: Particle Tracking (single particle or ensembles), dynamic light scattering (e.g. Diffusing Wave Spectroscopy)

Topics:

- Langevin equation (modified by Mason)
- Laplace transform to reach expression for MSD=J(τ)
  a.k.a. Generalized Stokes-Einstein relation
- 'Proof' from publications
- Requirements/assumptions
- How 'soft' must materials be?

Not in book of Doi

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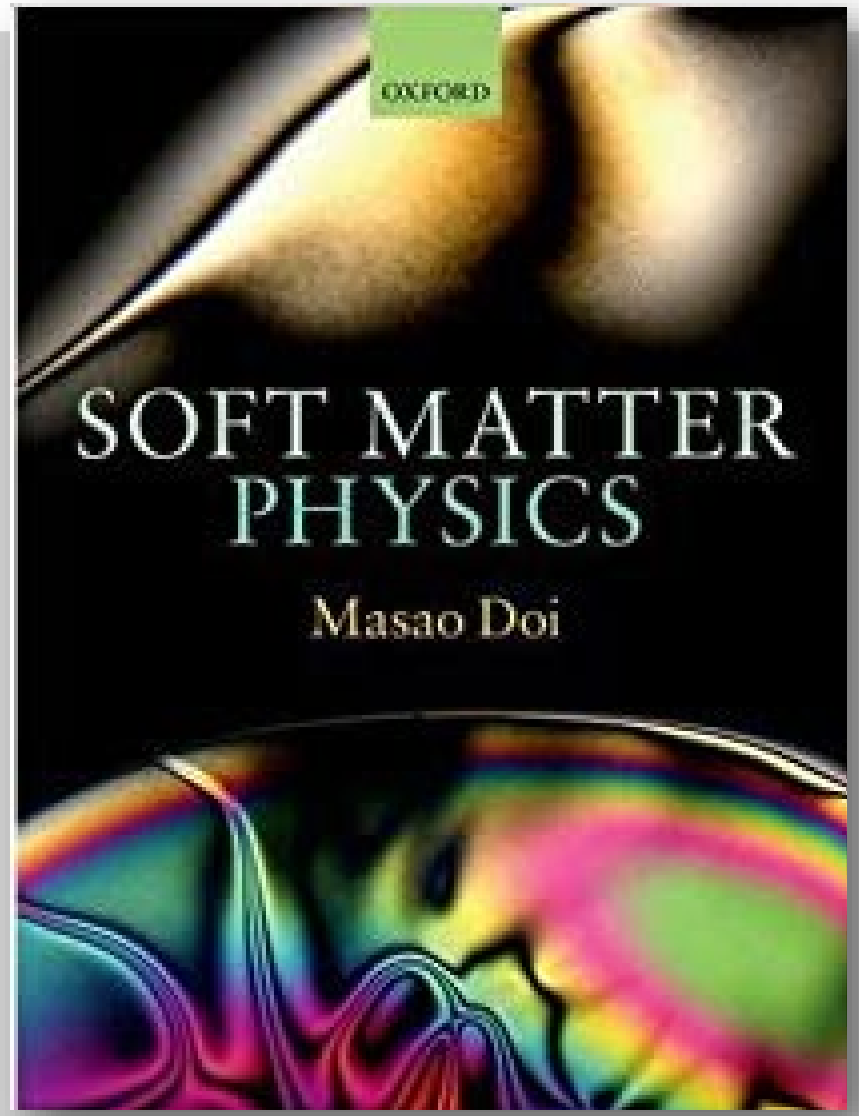
Extension: active soft matter

Study Material and Format

Study Format:
-book club (Doi + handouts)
-tutorials
-paper discussion
-(oral) exam

Connections:
-elements of StaFy
-elements of Fluid Mechanics



Learning goals

•Explain the link between microscopic descriptions of Brownian motion and macroscopic diffusion laws.

•Describe and solve common physical models of soft matter systems such as polymers, viscoelastic media, surfactants and ionic solutions.

•Describe the key physical characteristics of active soft matter.