

University of Maryland
Dept of Materials Science and Eng.
ENMA 489L/698D

Liquid Crystals and Other Monomeric Soft Matter Materials

Did you know that a cholesterol derivative was the first molecule identified as a liquid crystal? Did you know that the walls of the cells of ALL living creatures consist of a liquid crystal phase?

Want to learn more about liquid crystals?

- ...their role in applications
- ...their role in biology (all living creatures)
- ...their nanometer structure (ordered LC's)

Preliminary syllabus

Texts: (< \$90 dollars for the two) 1. Peter J. Collings, *Liquid Crystals: Nature's Delicate Phase of Matter*, Princeton, 2nd edition, 2002; 2. Peter J. Collings and Michael Hird, *Introduction to Liquid Crystals*, Taylor and Francis, 1997.

A partial exam, a short presentation and final will be required of this class (dates TBD, except final).

I. Introduction

A. Liquid crystals – What are they?

II. Types of liquid crystals –

A. Phases:

1. Nematic
2. Smectic

B. Types by phase change:

1. lyotropic (amphiphiles)
2. thermotropic

C. Other types of liquid crystal: polymeric, discotic

1. **Demo: transformation in a sample consisting of tubelike molecules – a lyotropic suspension that bears a relation to carbon nanotubes.**

D. Brief history of Liquid Crystals

III. More detailed look at the different types of liquid crystals

A. order parameter

IV. Effects in liquid crystals

A. Elastic energy – How LC's deform

B. How to observe this under an electric or magnetic field

1. **Demo: Liquid crystals under an electric field – polymer dispersed liquid crystal I**

V. How to determine phases in the liquid crystal and other changes

A. Demo: liquid crystal transformations

B. Techniques

1. Polarizing light microscopy
2. Light scattering
3. X-rays
4. Differential Scanning Calorimetry
5. AFM

C. How are they related → complementary information

VI. Chemistry of liquid crystals

A. Structure – property characteristic

VII. Some applications of liquid crystals

A. Demo: alignment of liquid crystals

B. Demo: Polymer dispersed liquid crystal II

VIII. Lyotropic liquid crystals

A. Nematic emulsions

B. Relation to biology

IX. Biological importance of Liquid crystals

A. Phases in the molecules of living matter

B. How is the balance and response affected by things that affect the environment (see IV)

1. Effect of nanoparticles on liquid crystals – relation to possible health effects
2. **Demo: nanoparticles and liquid crystals**