CH 62052 Instability Date: 10.01.2022

Instability and Patterning in Thin Polymer Films.

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Soft Nano Technology

About the course

It's a state of art Elective at the interface of Nano Technology, Micro/Nano Fluidics and Materials Science *(particularly, Surface Physics)*.

Most Concepts from 80's 90's or so.

What is so special about "Nano".

10^{-9} m

Surface to Volume ratio increases.

NT 70002

Course Content

1. Extended Introduction:

   What are Patterns

   What type of Patterns: Meso and Nano Patterns

   Application of Patterned Surfaces and Films → Thin Film.

   Instability: What type of Instability!

2. Some Basic Concepts

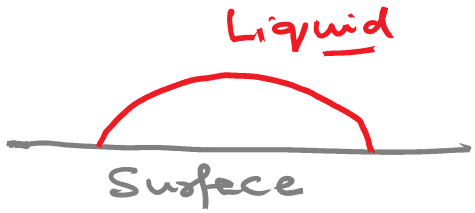
   Surface, Interface, Surface Tension; Young's Equation, Neumann Configuration → Contact Angle, Contact Line

   Dispersion Forces; Hydrophobicity, Structured Hydrophobicity, Cassie & Wenzel State

   Young Laplace Equation, Laplace Pressure,

   Surfactants, Micelle Formation, Self Assembly etc.

→ Detailed discussion on evaporation of a drop on a surface



Course Content *continued*

3. Fundamentals about surface tension, its components, Determination of surface tension of a solid

4. Interfacial Interaction between two surfaces, Concept of Hamaker Constant, Excess Free Energy in a Thin Film

5. Young – Laplace equation: Force balance across a curved liquid surface at equilibrium, Y-L equation for a axi symmetric surface

6. Hydrodynamics of a free liquid surface, kinematic boundary condition, Thin film instability, Linear Stability analysis, Thin film dewetting, Dewetting of Polymer Bilayers

7. Some idea about dewetting experiments, concept of spin coating and spin dewetting.

8. Atomic Force Microscope (AFM)

9. Nano Patterning Techniques: Photo Lithography, Soft Lithography

Texts:

Wikipedia is a great place to learn!

Generation of Micro and Nanopatterns on Polymeric Materials: Edited by A. del Campo and E. Artz

(Wiley – VCH, ISBN 978–3–527–32508–5)

Nanolithography and Patterning Techniques in Micro Electronics: Edited by D. G. Bucknall

(CRC Press, ISBN 10:0–8493–3447–0)

NPTEL Lectures (Both video and Web courses available) on

Instability and Patterning in Polymer Thin Films

Video Lectures available in YouTube also.

Soft Nano Technology → YouTube.

Reality: Follow the class and lectures

- Refer to Scientific Journals:
  - Nature
  - Nature Materials
  - Science
  - Langmuir
  - Applied Physics Letters
  - Advanced Materials
  - Advanced Functional Materials
  - Small
  - Macromolecules

May refer to Some Journal Papers

What is Special about the Nano Scale:

Physical Feel of How Small is the nano Scale →

Diameter of Humon Hair? → 50 - 70 μm

Typical Size of an inorganic molecule ≈ 1 Å = 10^{-1} nm.

Nano Scale → NOT Limited to 1 nm only

1 - 10 nm

Certain cases 1 - 100 nm

Gold nano particles

What is this?

When you talk about Gold → We identify Gold based on it's color, it's Lusture.

(Surface Plasmon Resonance)

Appearence/Color: Intensive Property

At nano Scale, the Color has changed!!

2·5nm → 5·0nm

Nano Particles of Semi Conducting materials.

(Same material → diff size Particles)

Emitted Light → After they were exposed to UV Light.

→ Same material

(*) Emission property is a function of Size.

Same Concept

⇒ At the nano Scale, Intensive Properties become Extensive.

one of the most unique feature of the Nano Scale.

Unique about Nano

(1) Properties become size dependent.

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Intensive properties

Band Structure of materials → What happens at the nano scale is as size starts to reduce the Band Stru

Valence Band (VB)

Conduction Band (CB)