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BIOENGINEERING/MATERIALS SCIENCE/PHARMACEUTICS 751
Principles of Surface Science
Fall, 1988 - 3 credits

Lectures - M W F - 7:45 AM - Room EMCB 124
Discussion - T Th - 4:30 PM - Room MEB 2475

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Lecture Topic Schedule

Sept. 26	Course objectives: Intro. to Surface Science; Interface Thermodynamics	
28	Surface tension, wetting, contact angles	
30	Interface energetics, approximations/adsorption	
Oct. 3	Intermolecular forces 1 - Electrostatic — Chap 3-5, 12	Demo C
5	" " 2 - Dispersion Chap 6, 11	Demo A.
7	" " 3 - Solvent Effects Chap 7-8, 13	Demo B.
10	~~" " 4 - Steric Exclusion Chap 13-14~~	Demo D
12	Film	
14	~~Monolayers (1)~~	Demo E
17	Monolayers (2)	Demo N
19	Midterm Exam I (Comprehensive)	
21	Electrical aspects of conductor surfaces	~~Demo A~~
24	Electrical aspects of semiconductor surfaces	
26	Electrical aspects of insulator surfaces	
28	Electrical double layer - V. Hlady	
31	Wetting and spreading - Brouchard tape	
Nov. 2	Wetting and spreading - Brouchard tape	
4	Surface modification	Demo G
7	Gradient surfaces - V. Hlady	Demo J
9	Photoresponsive surfaces - J. N. Lin	Demo K
11	Surface dynamics	~~Demo H~~
14	Midtern Exam II (Comprehensive)	
16	Adsorption - gas	Demo M
18	Adsorption - liquid	Demo F
21	Adsorption - polymer / Steric Exclusion (5)	Demo I
23	Adsorption - Protein - Intro to Proteins	Demo L
28	Adsorption - Protein "simple" model system	Demo O
30	Adsorption - Protein competitive adsorption/complex proteins	Demo P
Dec. 2	Industrial Applications: Diapers and sanitary napkins	
5	Industrial Applications: Contact lenses and cleaning solutions	
7	Industrial Applications: Cell and tissue culture/adhesives and tapes	Q
9	Review/Discussion	
Dec. 12	Final Exam: Comprehensive	

Exams and Grading:

Midterms	25/25
Final	30
Experiment/ Demonstrations	15
Seminars	5

15

Exams - are closed book. One 3" x 5" card of notes will be permitted during the exam . The card must be turn in with the exam. No calculators allowed.

Experiment Demonstration - Each student will be randomly assigned an experiment demonstration to present and show to the class. The demonstration will illustrate one or more important surface science principles and will use readily available materials, including consumer products. A 3-5 page summary and description of the demonstration and of the basic principles must be distributed to the class at the beginning of the demonstration. The write up must include a list of materials and sources.

Seminars - Each student must attend, question, critique and summarize at least 4 surface science-related seminars during the quarter. A one page report on each seminar must be submitted.

Texts and Readings/Reserve Books: See separate list.

Surface Science Demonstrations and Experiments

Objective: To clearly and easily demonstrate one or more important surface science principles using materials easily available in the home, supermarket, hardware store or drug store; to explain the observation using fundamental surface science models and theories.

Report/Hand Out - Should be in typical lab report format; summary, objectives, methods and materials, results, discussions, conclusions, references. Must be no more than 5 pages. The report must be clear, concise, and complete so that anyone could successfully repeat the demonstration using only the information in the report.

Demo Presentation - In addition to the report, prepare overheads, teaching aids, etc. so that the demo and your explanation can be as clear, efficient, and effective as possible. Rehearse and conduct the experiment several times before class to be sure it will work. The complete demonstration and explanation is to take 8 to 10 minutes. Each person in the class will write a brief critique and evaluation of your demonstration and report.

Materials and Equipment - This must be a "kitchen sink" experiment. DO NOT USE any laboratory chemicals or equipment. Use only chemicals and materials which you can find in a well-stocked kitchen, bathroom or workshop and can be found in a supermarket, drugstore or hardware store. You may use an overhead projector or slide projector to magnify and project your experiments.

Safety - Do not use any chemicals, materials, or methods which are considered hazardous or dangerous. Be sure to include a brief safety discussion in your report/handout.

A. Liquid Surface Tensions: Measure via capillary rise, demonstrate surface tension force, demonstrate surface tension gradients and Morangoni and related effects.

Bakhtiar

Sibul

B. Wetting: Demonstrate liquid wetting and spreading on different surfaces; measure contact angle; demonstrate capillarity and wicking.

Muthuvan SV

C. Charges: Demonstrate static charge and electrets. Use particles, such as xerographic toners, to show charge and charge distribution on surfaces.

D. Oil on Water: Demonstrate Neumann's triangle and 3-phase L-L-V equilibria; demonstrate coalescence of oil droplets; demonstrate colloid stabilization.

Marra

E. Monolayers: Demonstrate monolayer formation at the water/air interface, demonstrate spreading pressure, do a simple Π-A experiment and measure area/molecule.

Chu

F. Adsorption from Solution: use paper chromatography and various food dyes to demonstrate adsorption from solution and chromatography. Use different carrier liquids and different papers and textiles to show the effects.

Perry

G. Surface Modification: Demonstrate polymer surface modifications using thermal oxidation and liquid phase oxidation. Show how to make hydrophobic surfaces hydrophilic and hydrophilic surfaces hydrophobic. Use breath/vapor pattern to crudely show surface heterogeniety.

Cooper

H. Surface Dynamics: Show how polymer surfaces are affected by formulation and processing additives, demonstrate "blooming", demonstrate surface restructuring using several materials and environments.

Chang ~~Bibette~~

I. Adsorption from Solution: Show how porous high surface area materials like activated carbon are used for cleaning and purifying solutions; demonstrate heat of adsorption; demonstrate surface area measurement via adsorption.

Fareed Ansari

J. Disposable Diapers: Thoroughly dissect, explain, and demonstrate, using various dye solutions, the surface chemical concepts and principles of at least two different brands of disposable diapers.

I/zoo Lee

K. Pens and Ink: Thoroughly dissect, explain and demonstrate how writing pens work, including old fashioned fountain pen, ball point pen, a "rolling-writer" pen, a "flair pen", and a marker or "high-liter" pen.

Bruckner

L. Band-Aids: Demonstrate and explain the surface chemistry, capillarity/repellancy and surface dynamics phenomena involved in "band-aids" and related adhesive medical bandages. Do some self testing with regard to adhesion properties and skin irritation.

Zhang

Yeh M. Water Repellancy

Ho N. Detergents and Soaps (?) Surfactants

Lin O. Paints and Coatings

Hevin P. Cosmetics

Wang Q. Ski/Wax/Ice

JDA/38/cf

Gower ? ~~(R) Batteries~~

Evaluation Table

Average total ~10

Subject	Student	Date	Notes 0-5	Lecture 0-5	Demo 0-5	Tot 0-
Electrostatics and Charges	M-H Su	10/3/88	3	3	4	10
Liquid Surface Tension	S Bakhtiar	10/5/88	3	3	3	9
Wetting & Contact Angles	C. Sibrell	10/7/88	3	2	3	8
Liquid-Liquid Interfaces	M. Marra	10/12/88	2	3	3	8
Monolayers	T-J Chu	10/14/88	3	3	3	9
Detergents & Surfactants	C-H Ho	10/17/88	3	2	3	8
Surface Modification	B. Cooper	11/4/88	3	2	2	7
Diapers	I-Z Lee	11/7/88	2	3	3	8
Pens and Ink	Bruckner-Lea	11/9/88	3	2	3	8
Water Repellancy	P-Y Yeh	11/16/88	2	3	2	7
Adsorption/Chromatography	G Parry	11/18/88	3	3	3	9
Adhesives & Tapes	J Zhang	11/23/88	3	3	2	8
Paints & Coatings	Y-S Lin	11/26/88	2	3	2	7
Cosmetics/Dispersions	J Hevia	11/30/88	3	3	3	9
Friction/Ski Waxing	T-L Wang	12/5/88	2	2	3	7
Surface Dynamics	I-N Chang	12/2/88	3	3	2	8