Nanostructered Multilayers of Redox Polymers and Enzymes for Molecular Recognition and Electrical Signal Generation

Ernesto J. Calvo

INQUIMAE. Departamento de Quimica Inorganica, Analitica y Quimica Fisica. Facultad de Ciencias Exactas y Naturales

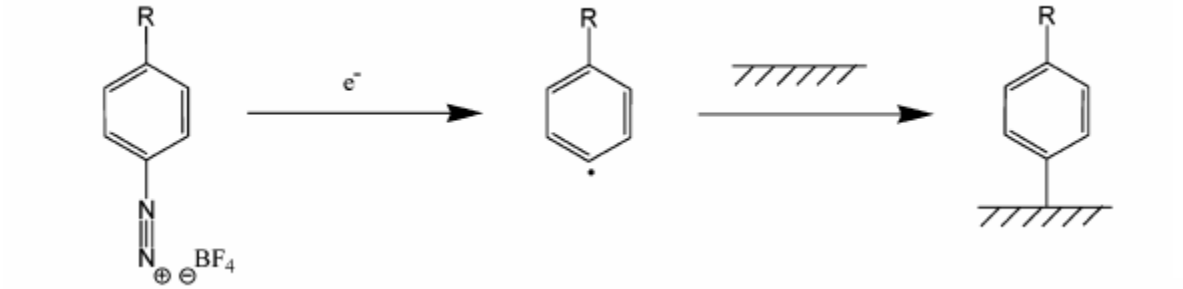
Universidad de Buenos Aires, Argentina

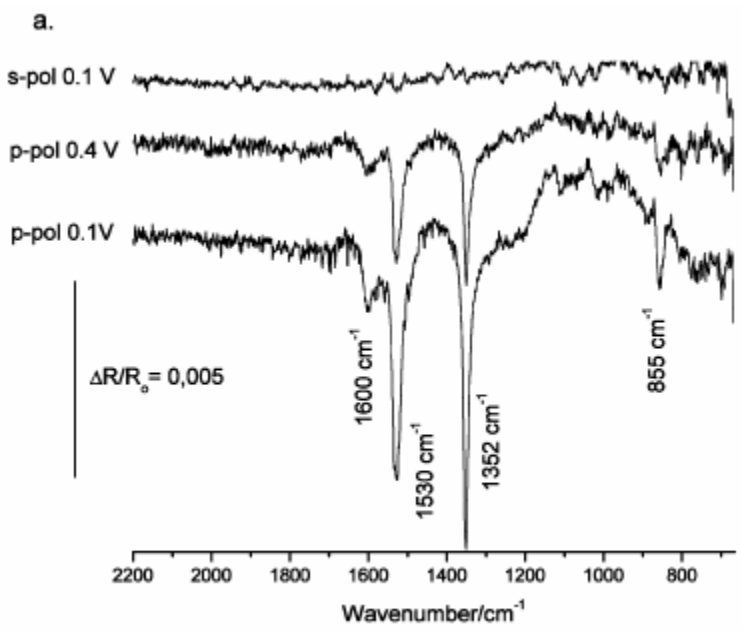
An FT-IRRAS study of nitrophenyl mono- and multilayers electro-deposited on gold by reduction of the diazonium salt

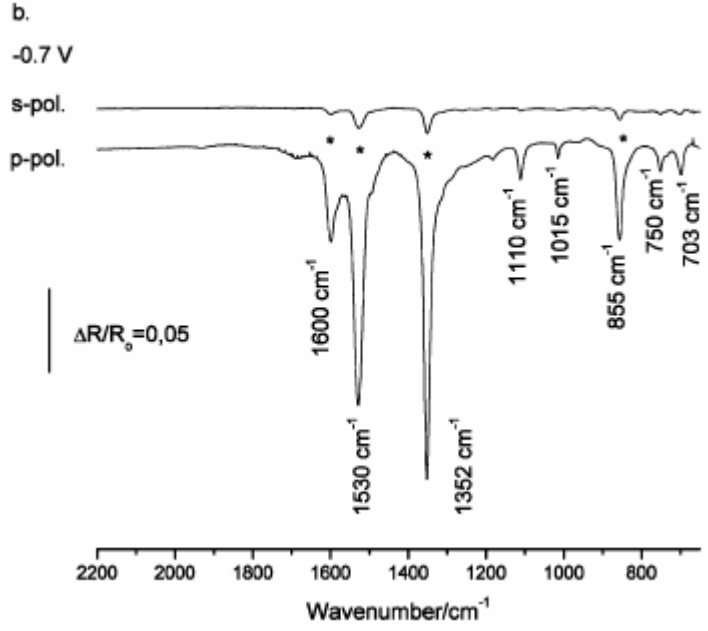
Alejandra Ricci, Cecilia Bonazzola and Ernesto J. Calvo*

Phys. Chem. Chem. Phys., 2006, **8**, 4297–4299

Scheme 1. Two-step Process Deposition via the Reduction of a Diazonium Cation



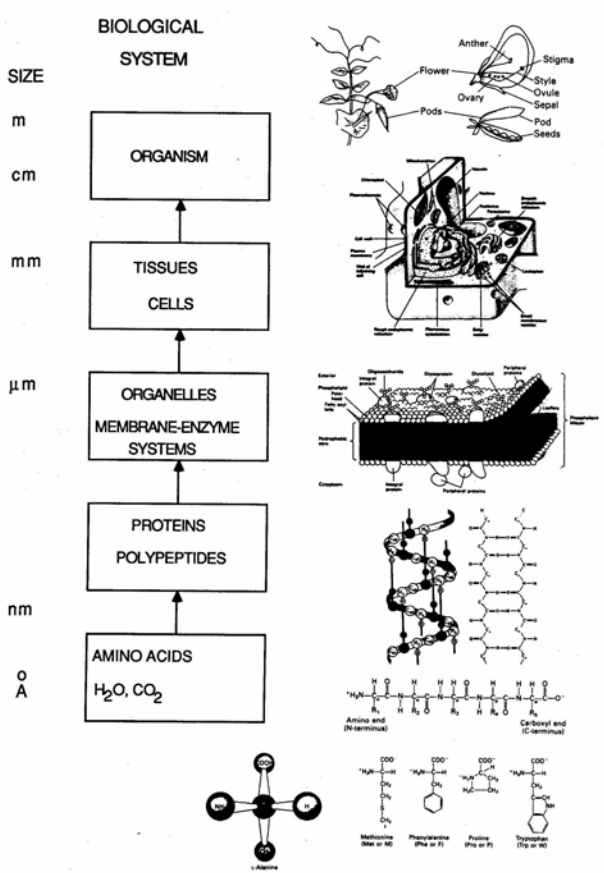


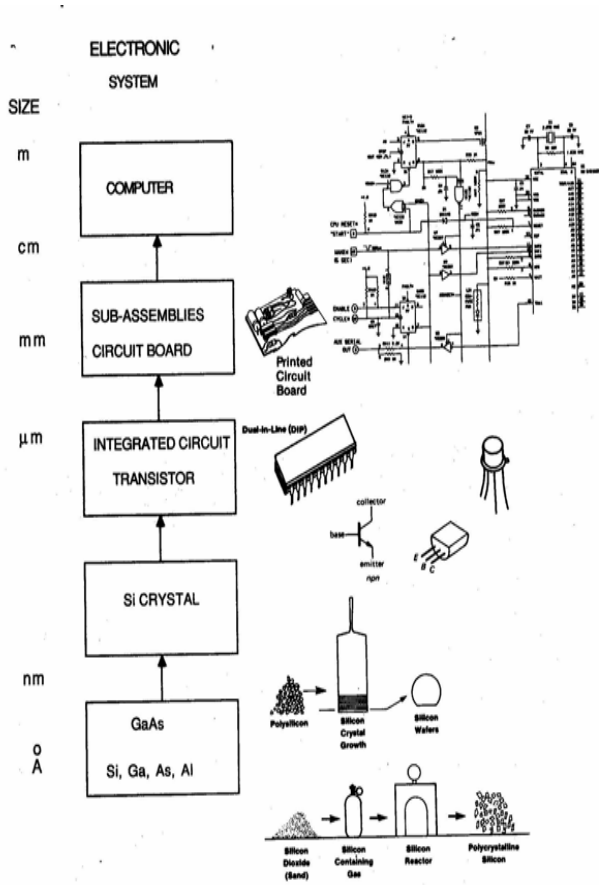


BIBLIOGRAPHY

- A. Ulman. *Introduction to Thin Films: From Langmuir–Blodgett to Self-Assembly*, Academic Press, Boston (1991).
- G. Decher. *Science* **277**, 1232 (1997).
- Decher, G.; Schlenoff, J. B. *Multilayer Thin Films: Sequential Assembly of Nanocomposite Materials*; Wiley-VCH: Weinheim, 2003.

INTEGRATED CHEMICAL SYSTEMS





A.J. Bard, Integrated Chemical Systems, John Wiley & Sons, 1994

Nanostructured Multilayer Films

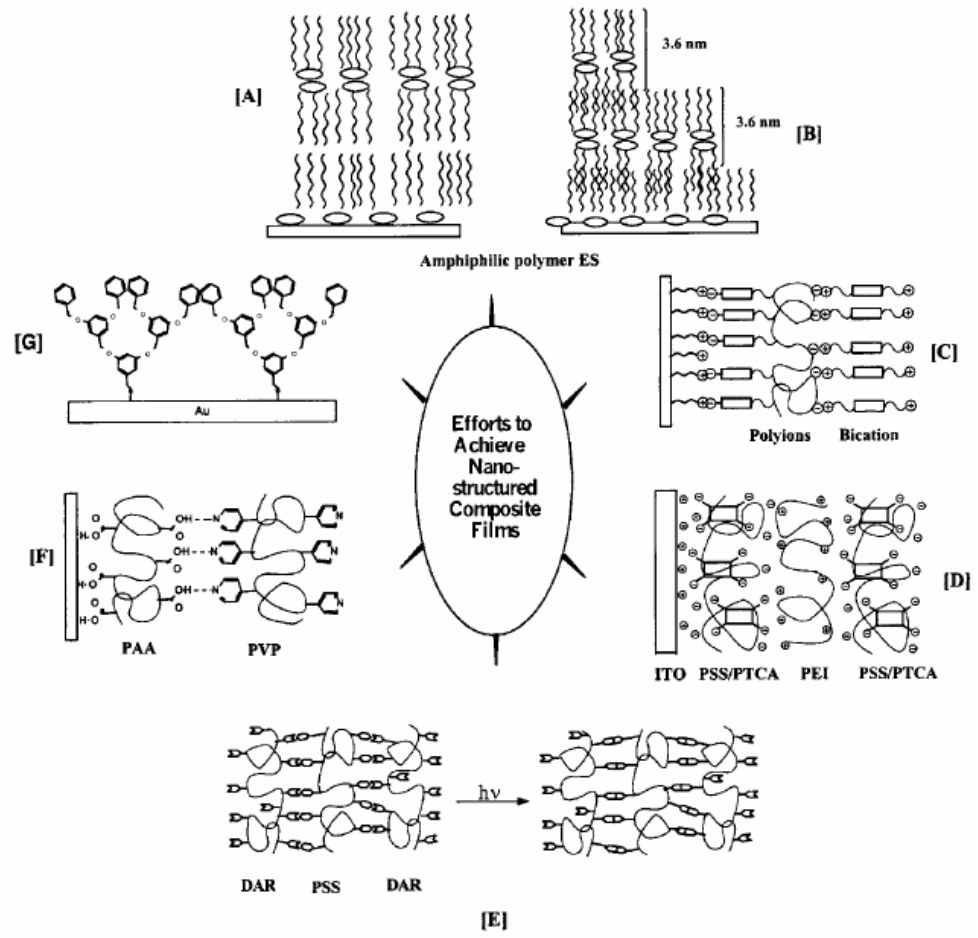
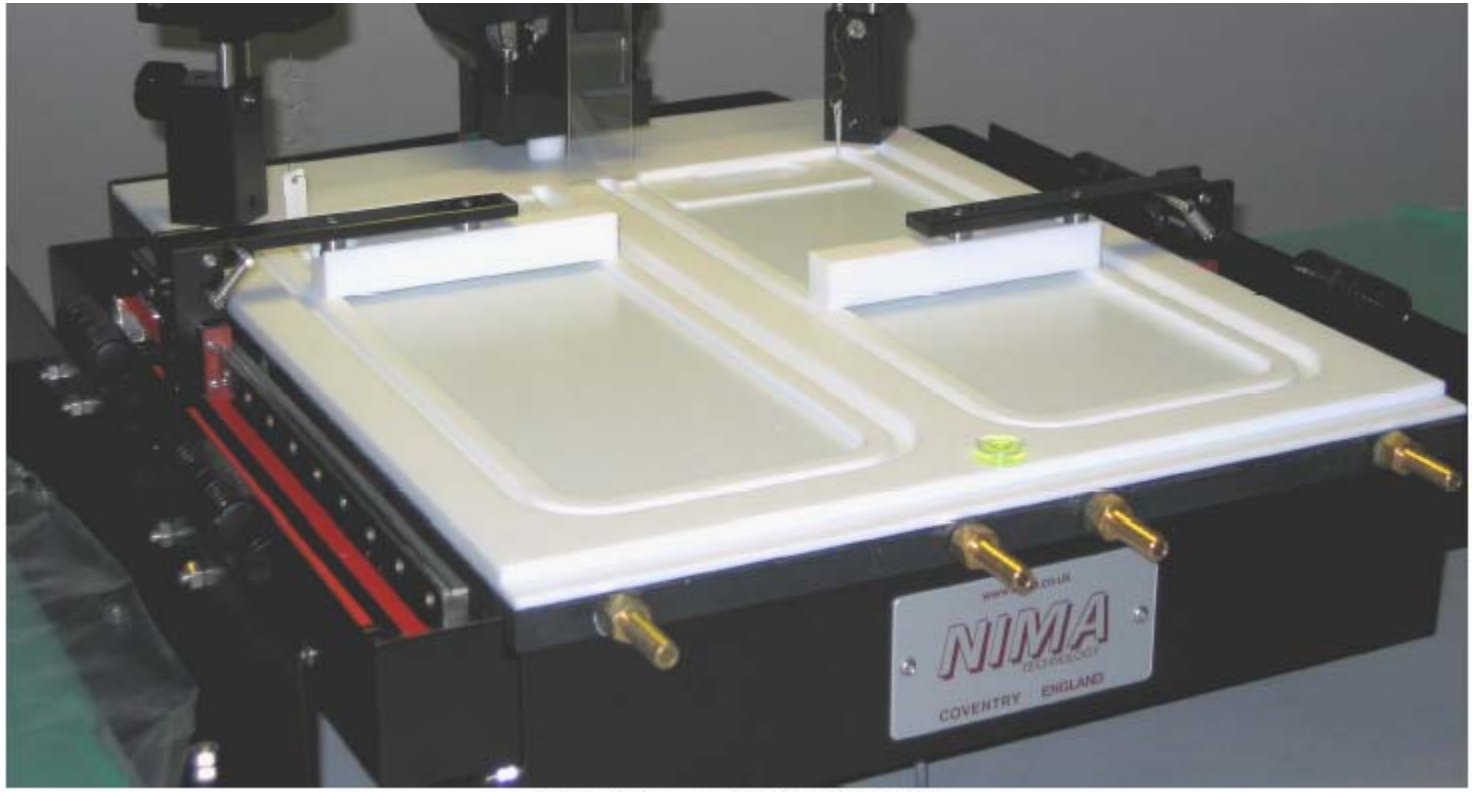


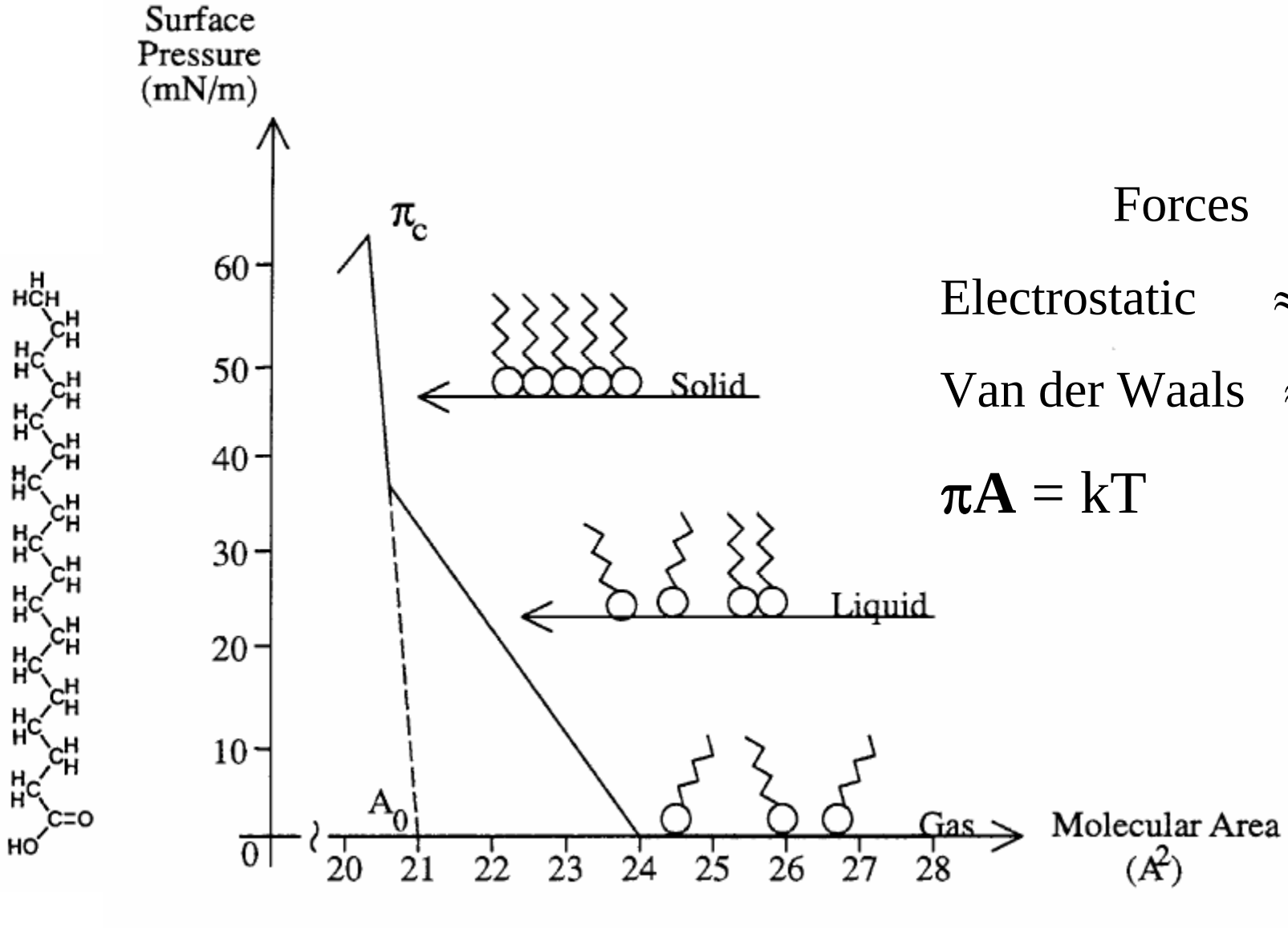
Fig. 1 Illustration of building blocks used in the assembly process: (A) reversed "duckweed" LB film, (B) self-organizing film with interdigitated structure, (C) electrostatic multilayer assemblies of polyelectrolyte and bication, (D) electrostatic multilayered assemblies of PEI/(PSS+PTCA) on ITO substrate, (E) conversion of the DAR/PSS film from ionic to covalent structure, (F) multilayer assemblies of PAA and PVP based on hydrogen bonding, (G) self-assembled monolayer of dendron thiol (D2) on gold surface.

Langmuir-Blodgett Films

Langmuir-Blodgett Trough



Assembled 622D/Shuttle



Forces

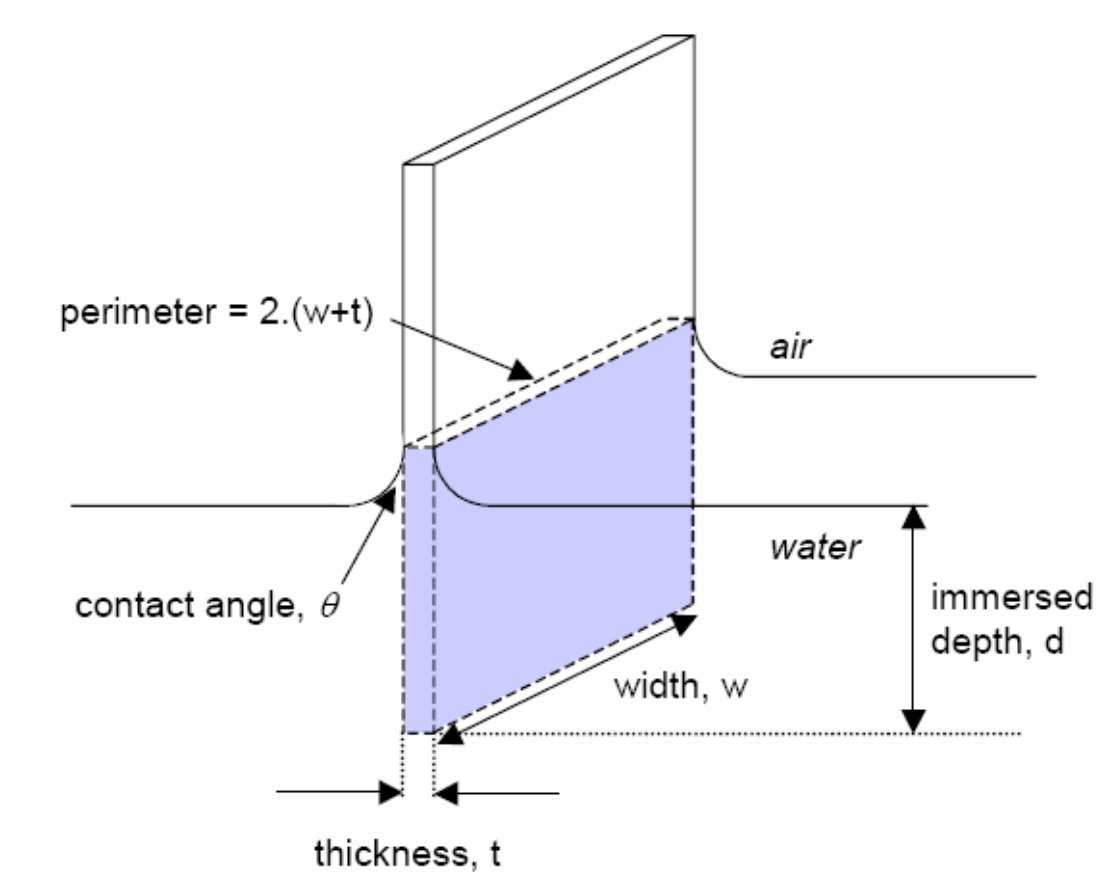
Electrostatic $\approx 1/r^2$

Van der Waals $\approx 1/r^6$

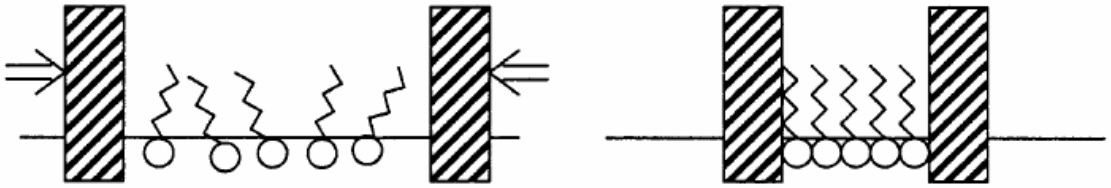
$\boldsymbol{\pi A} = kT$

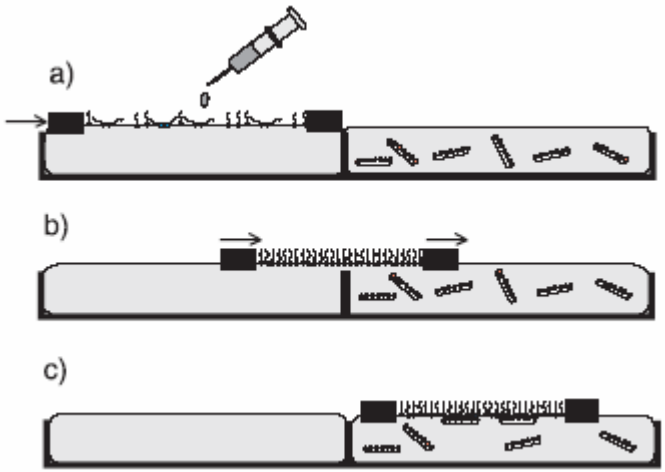
A stearic acid isotherm

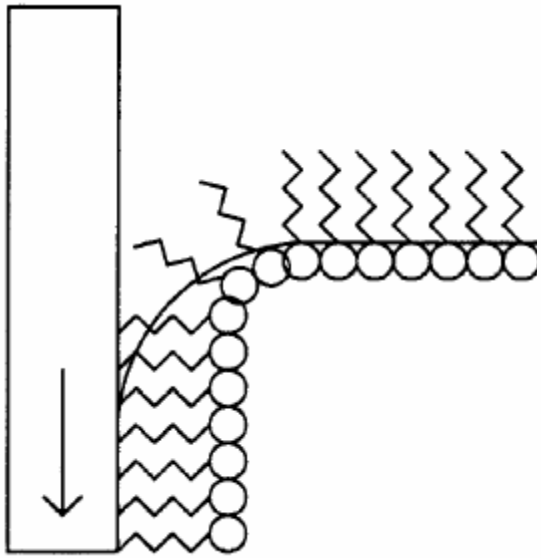
Molecular Film Transfer to a Surface



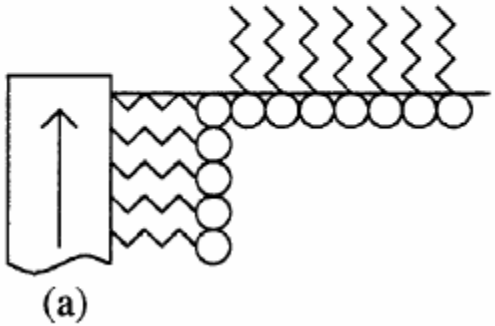
Langmuir-Blodgett Films

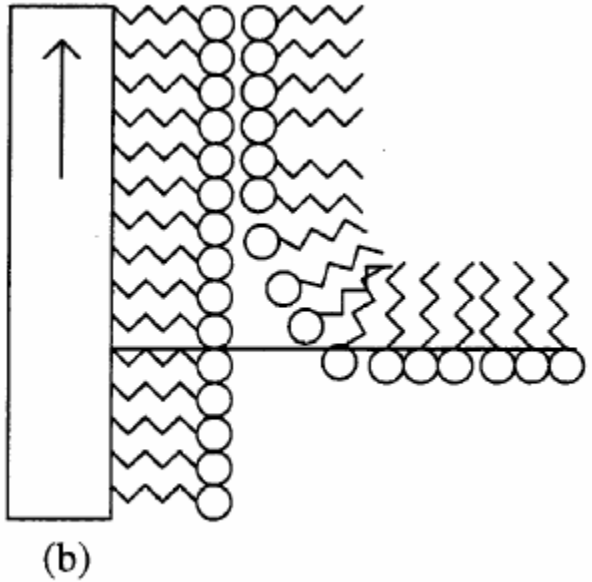




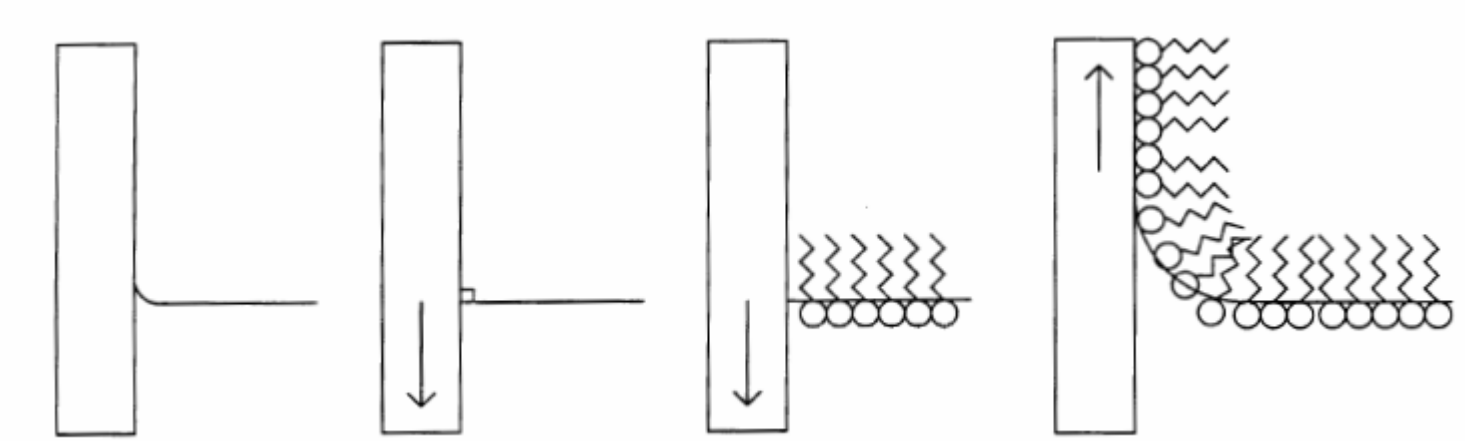


Hydrophobic Surface



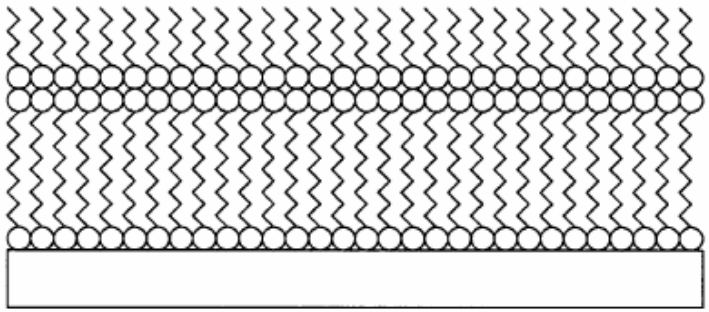


Formation of a second layer

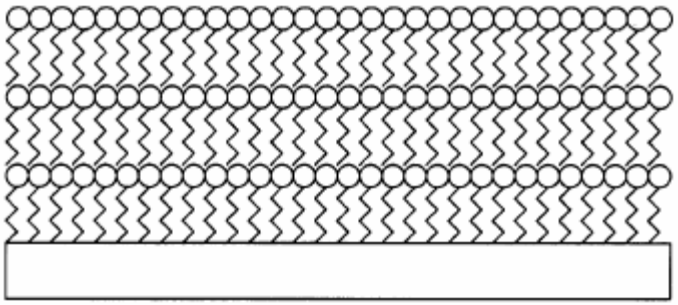


Hydrophillic surface

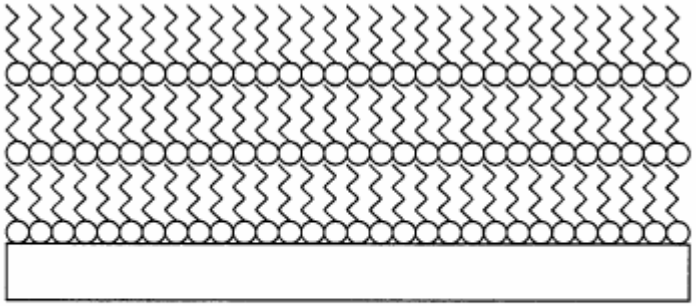
Types of LB films



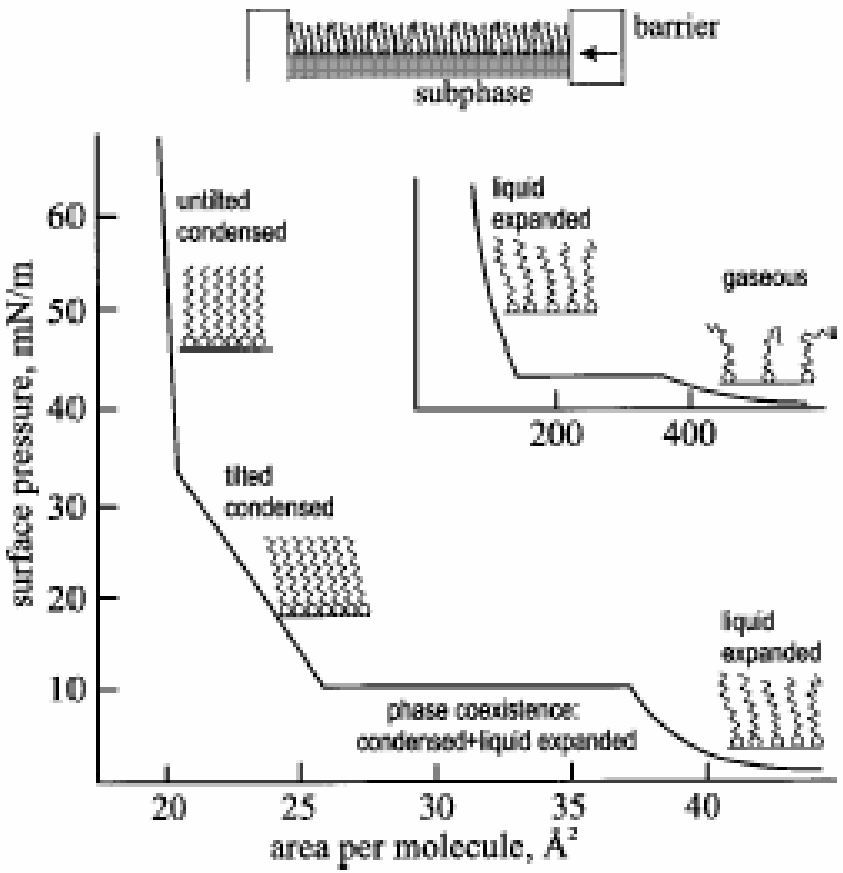
Y



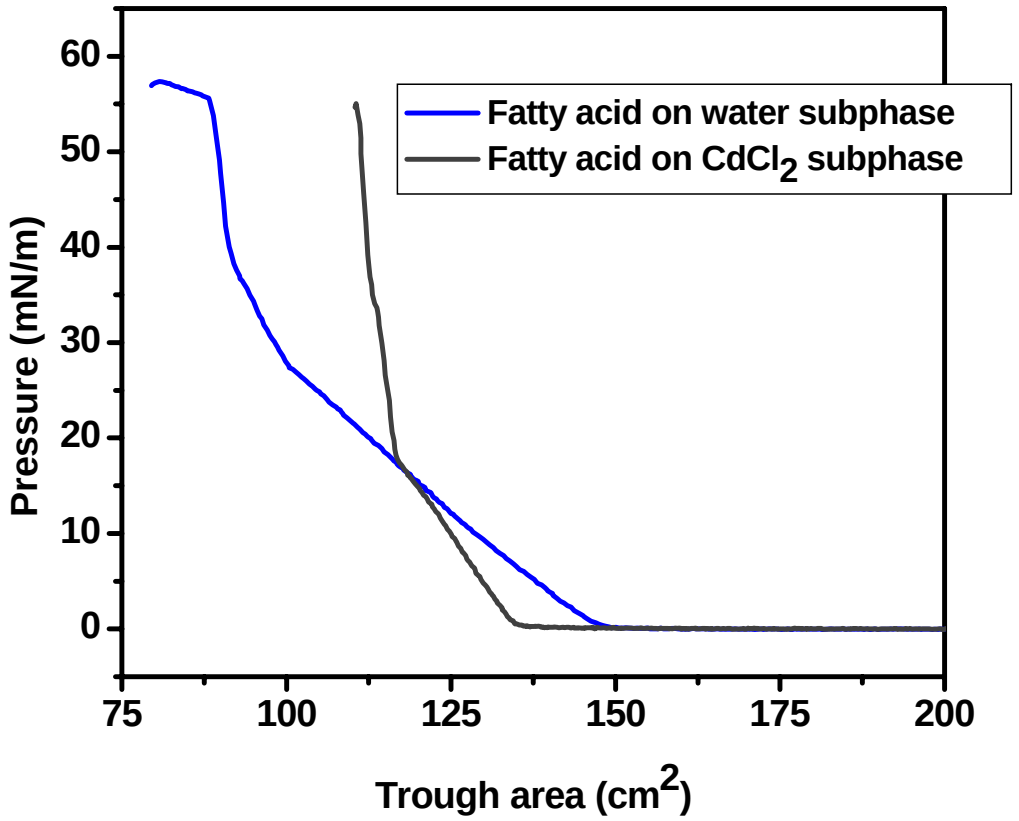
X

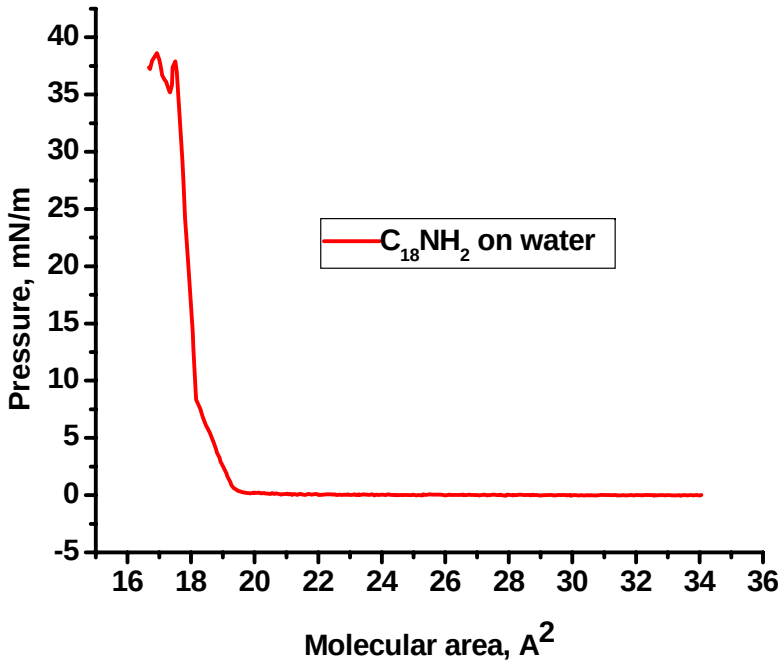


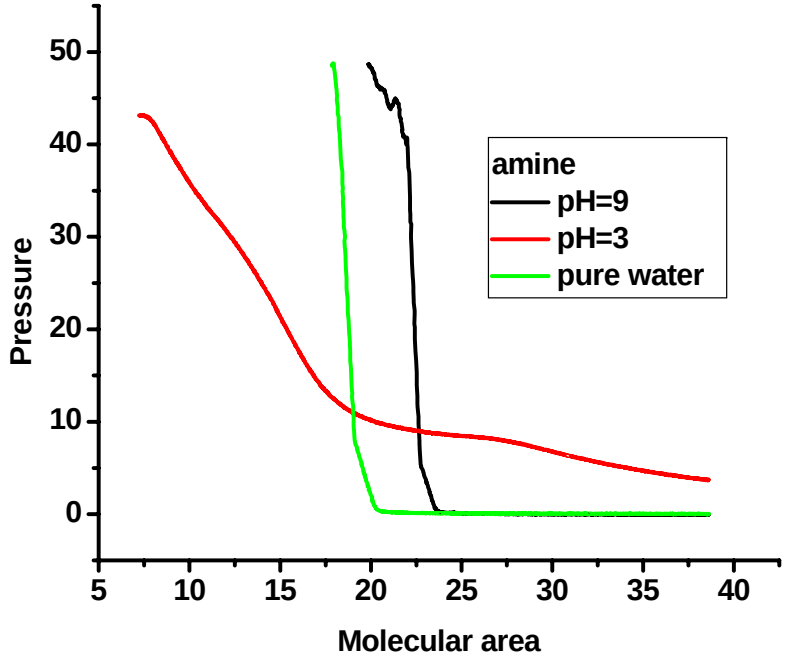
Z


barrier
subphase
surface pressure, mN/m
60
50
40
30
20
10
untilted
condensed
liquid
expanded
gaseous
200
400
tilted
condensed
liquid
expanded
phase coexistence:
condensed+liquid expanded
20
25
30
35
40
area per molecule, Å²

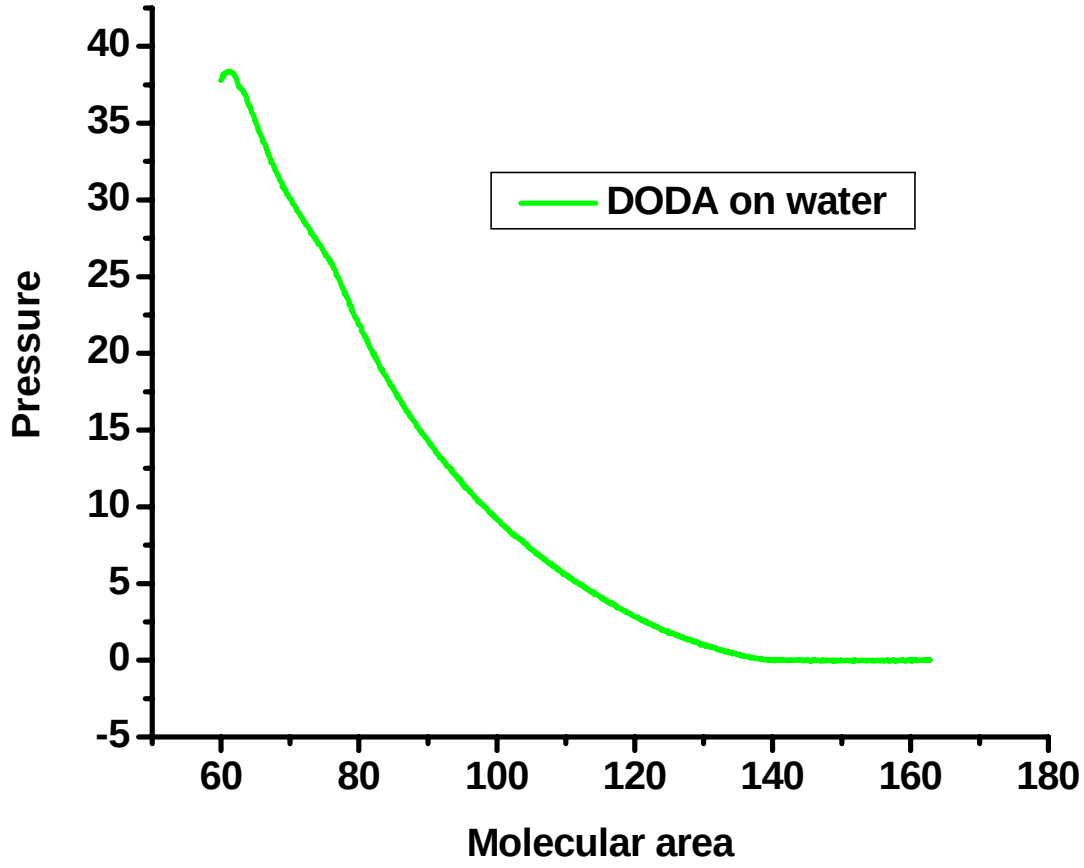
Isotherm of Fatty acid in the water-air interphase



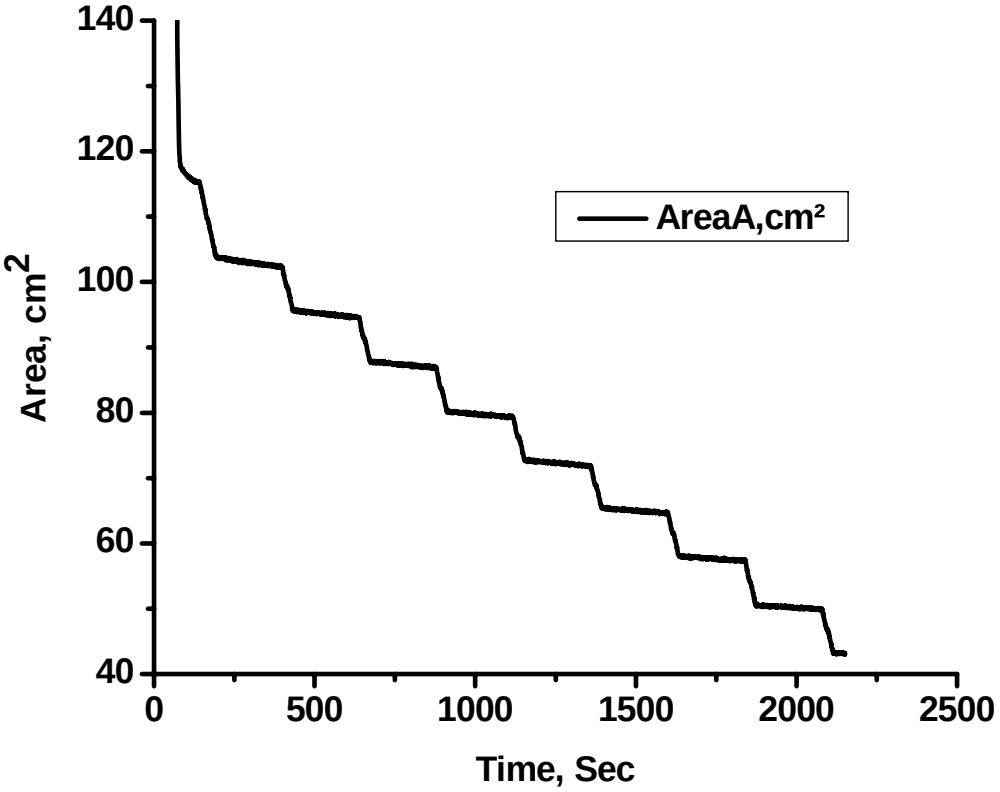

Pressure, mN/m
Molecular area, A2
C18NH2 on water


Pressure
Molecular area
amine
pH=9
pH=3
pure water

Effect of Molecular Structure



Transfer of Molecular Layer to a Solid Hydrophobic Surface

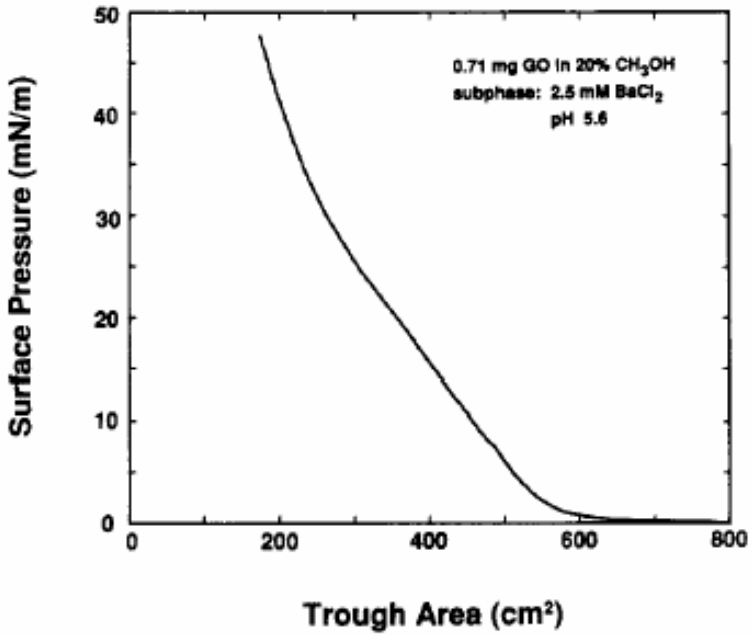


Langmuir 1991, 7, 727–737

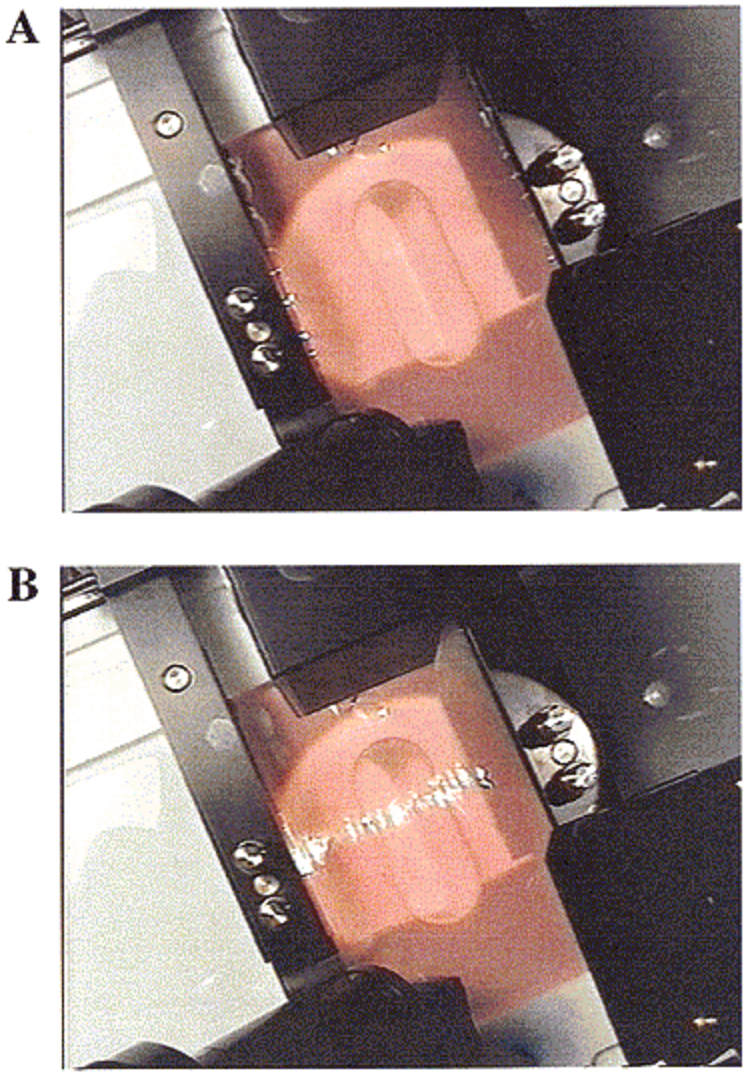
Preparation of Active Langmuir–Blod ett Films of Glucose Oxidase

Songcheng Sun, Phuoc-Hoa Ho-Si, and D. Jed Harrison*

Department of Chemistry, University of Alberta, Edmonton, Alberta, Canada T6G 2G2



Nanoparticles LB Film



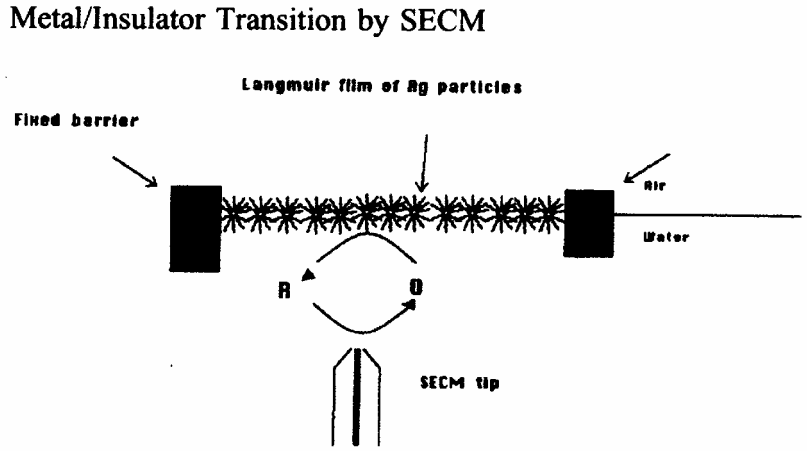


Figure 1. Schematic representation illustrating positive feedback at an inverted SECM tip on compressing a Langmuir film of Ag MPCs through the I−M transition at the air/water interface (not to scale)

Gil Markovich, C. Patrick Collier, Sven E. Henrichs, Francoise Remacle, Raphael D. Levine, and James R. Heath*

Acc. Chem. Res., **32** (5), 415 -423, 1999