

Improving the Biophysical Activity of Dysfunctional Lung Surfactant

Vanessa Sousa

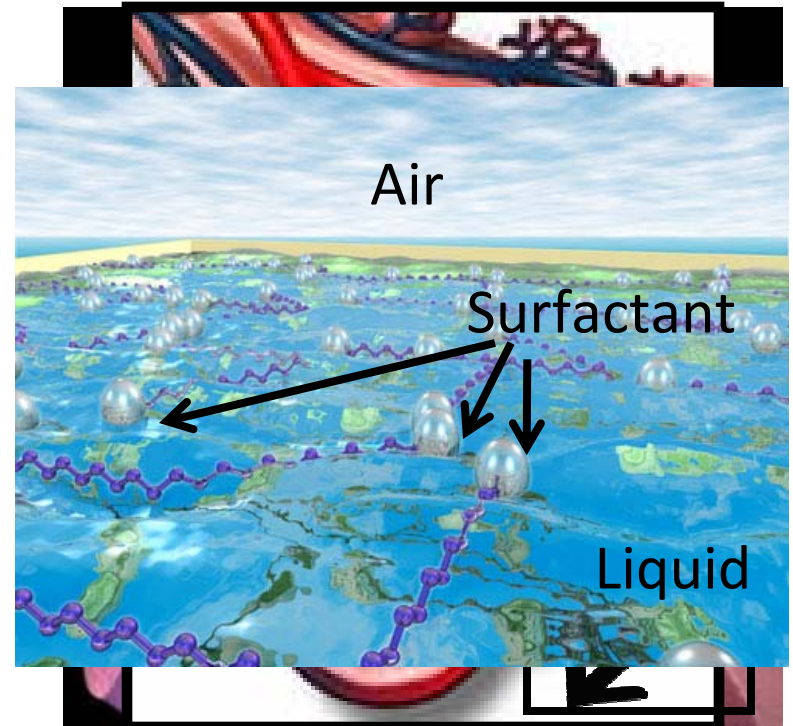
**Ventura College
Chemistry**

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Faculty Advisor: Dr. Joseph Zasadzinski
Chemical Engineering Department, UCSB

Lung Surfactant & ARDS

- **What is Lung Surfactant?**
 - Lowers Surface Tension in Lungs
- **Acute Respiratory Distress Syndrome (ARDS)**
 - Surfactant Deactivation
 - In the U.S., 150,000 cases/year, 40% mortality rate
- **Reversal of Surfactant Deactivation**



Notter, R.H., ed. *Lung Surfactants: Basic Science and Clinical Applications*. 1 ed. Lung Biology in Health and Disease, ed. C. Lenfant. Vol. 149. 2000, Marcel Dekker, Inc.: New York, N.Y. 444.

http://www.lawsonresearch.com/v1.0/website/lung/images/lungs_1.jpg

<http://services.epnet.com/GetImage.aspx/getImage.aspx?ImageID=2547>

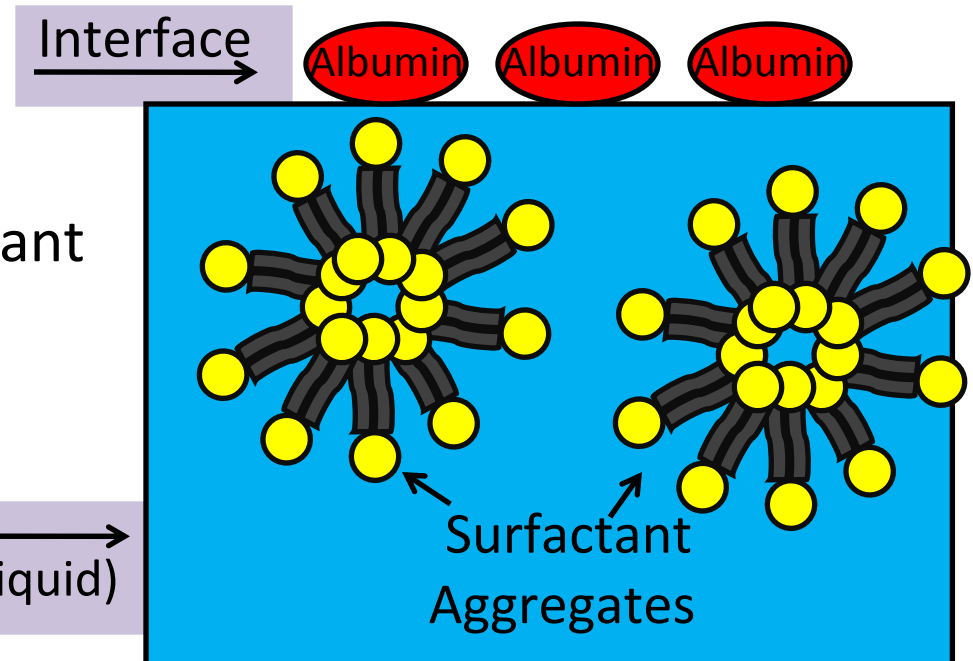
<http://www.scitech.ac.uk/PandS/Gallery/ISISbeauty/ISISlbf0004.jpg>

Albumin & Competitive Adsorption

- **Lung Surfactant Meets Albumin**
 - Main Protein in Blood Serum

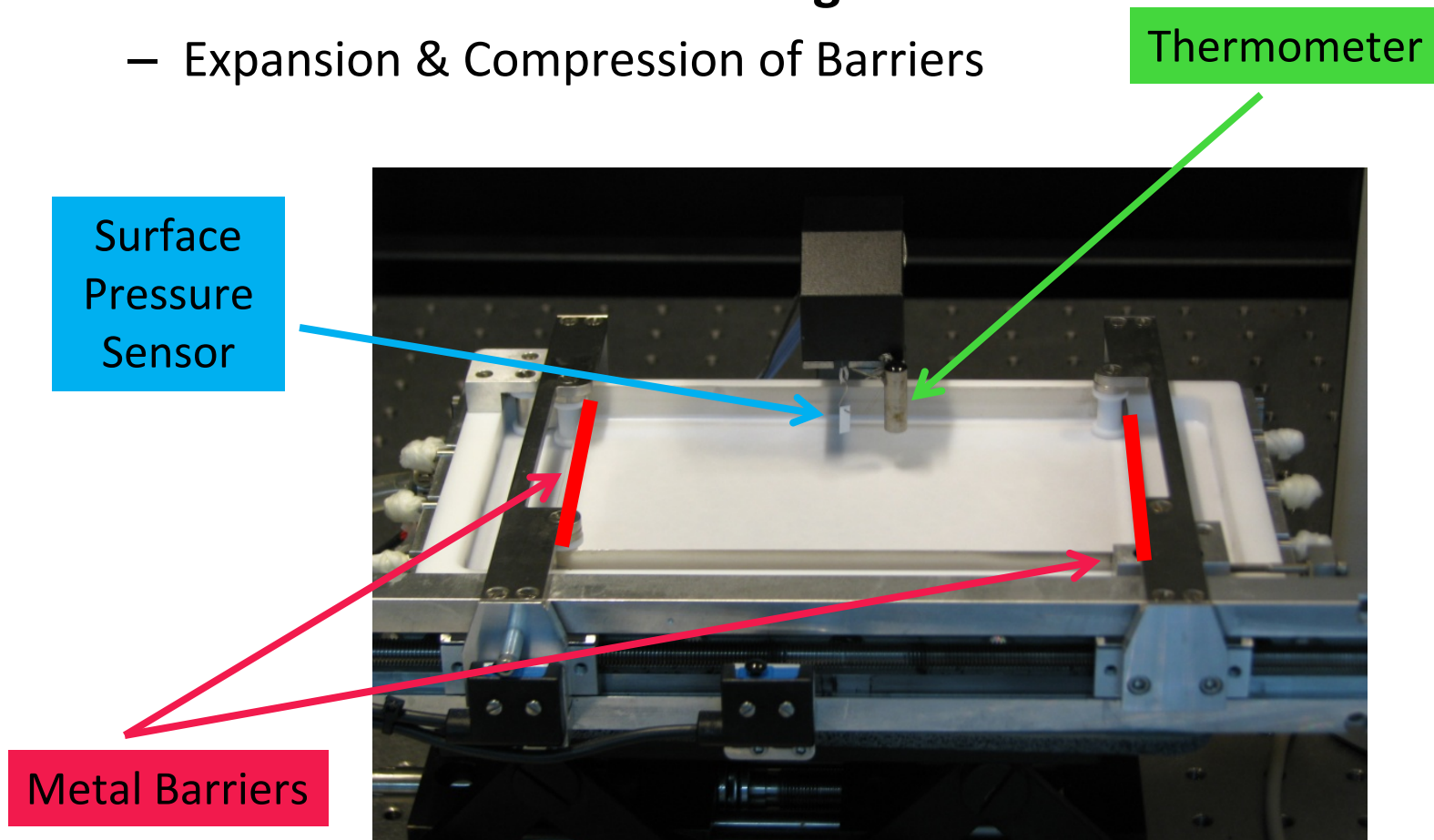


- **Competitive Adsorption**
 - Albumin Blocks Lung Surfactant from Interface



Langmuir Trough

- **Our Model of the Human Lung**
 - Expansion & Compression of Barriers



Modeling Lung Behavior



The Healthy Lung

- Survanta (Lung Surfactant)
- Rapid Adsorption



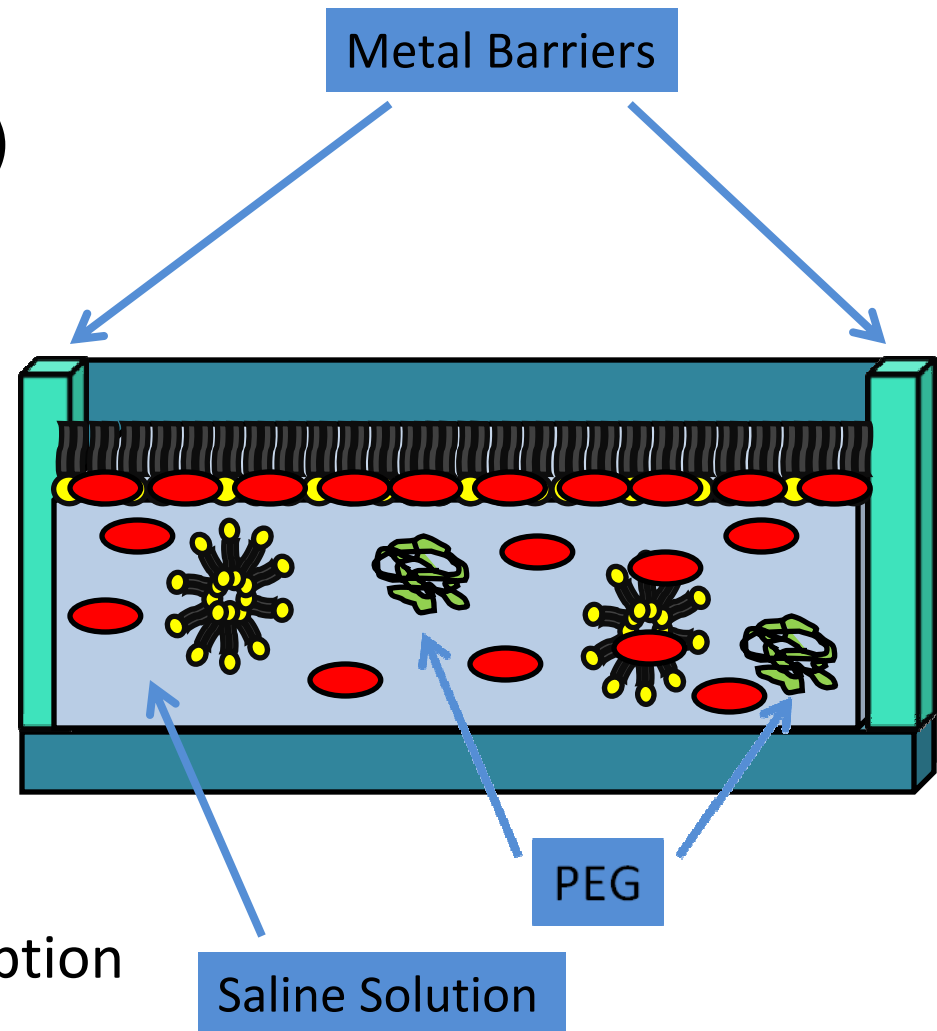
ARDS

- Albumin
- Surfactant Inhibition



Reversing ARDS with Polyethylene glycol (PEG)

- Hydrophilic Polymer
- Shown to enable re-adsorption

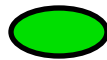


Confocal Microscopy

- **Simultaneous Multiple Imaging**
 - Fluorescently View & Track Three Molecules at the Same Time



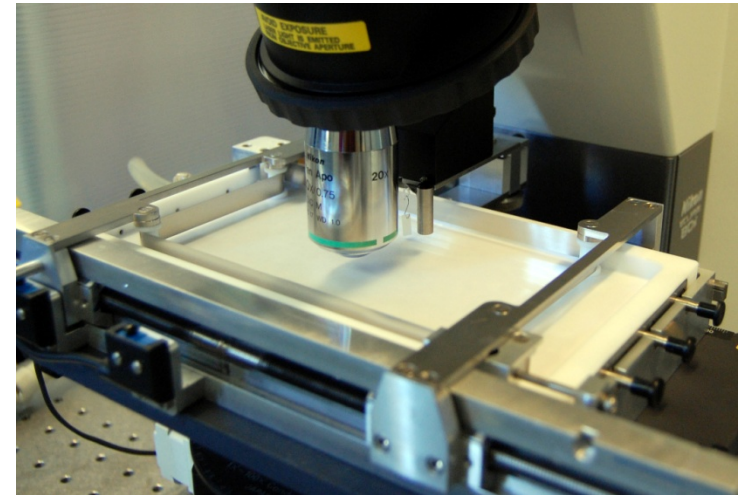
Lung Surfactant



Albumin

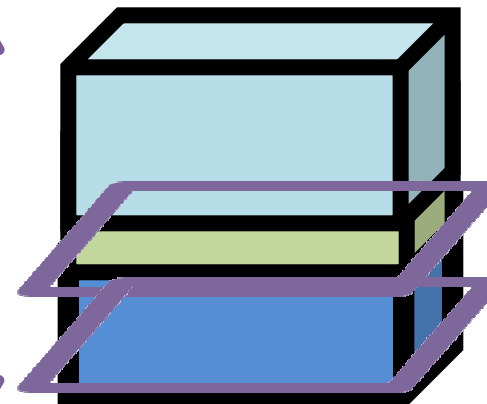


PEG



- **Optical Sectioning Capability**
 - Image Slices Taken at Various Depths

Z (μm)



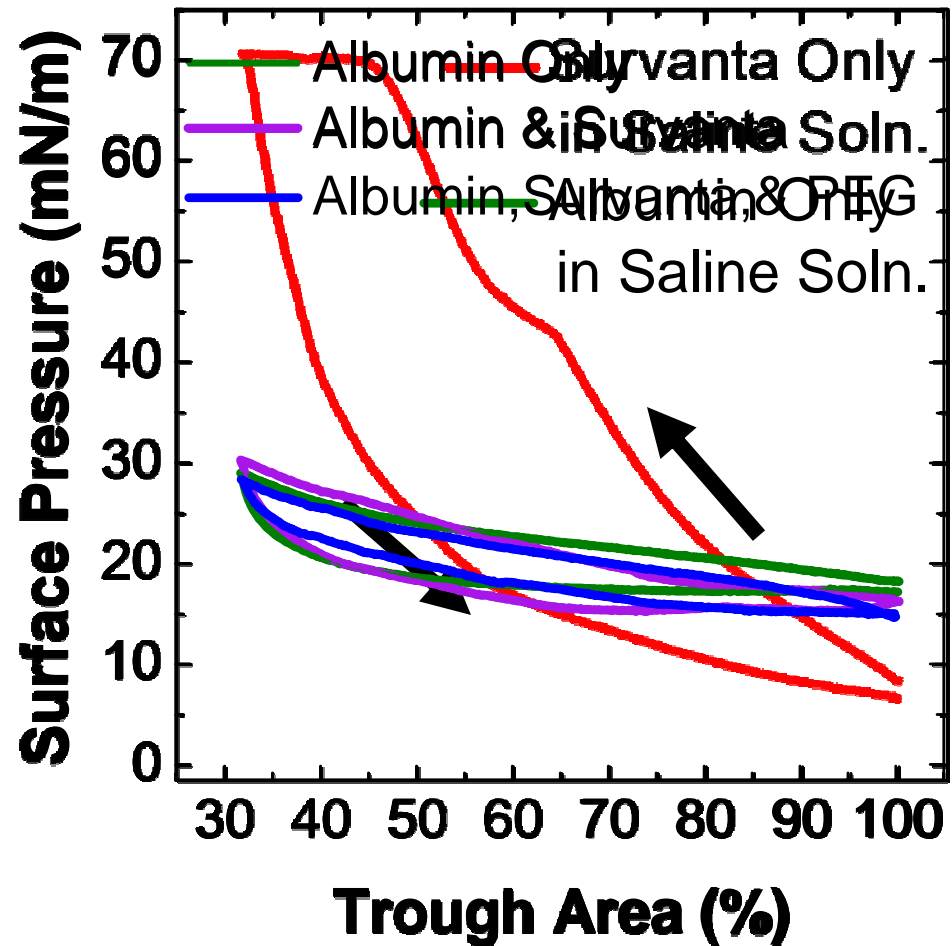
Air

Interface

Subphase
(Liquid)

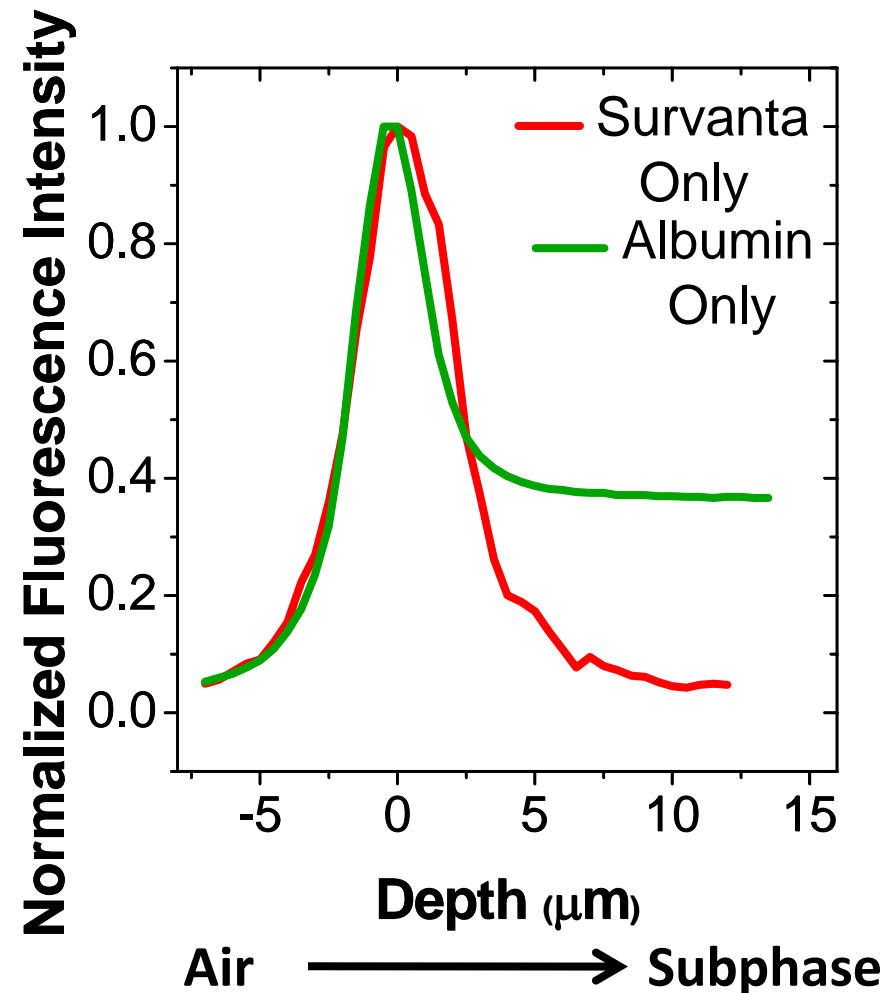
Surface Pressure vs. Area

- **Unique Shapes**
 - Tells Type of Molecule at Interface
- **Surface Pressure**
 - High Surface Pressure = Low Surface Tension
 - Can Evaluate Effectiveness of Surfactant at Interface
- **Our Models**
 - The Healthy Lung
 - Albumin
 - Lung Surfactant Inhibition
 - PEG Reversal of Inhibition

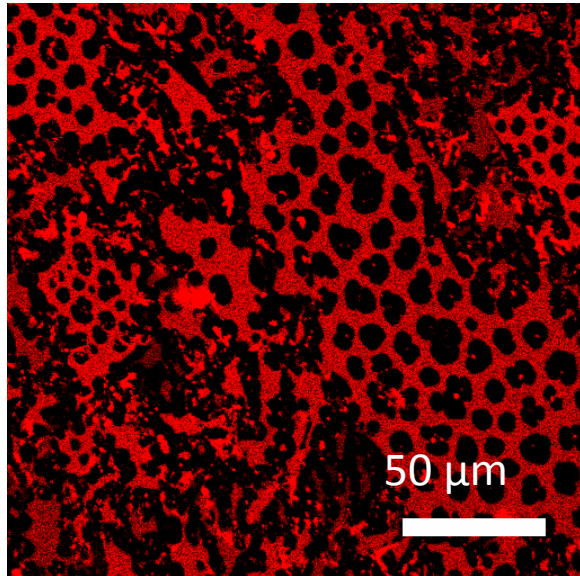


Intensity Profiles

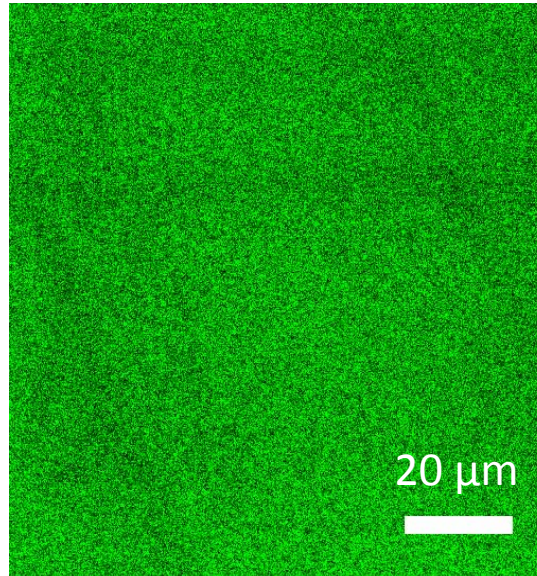
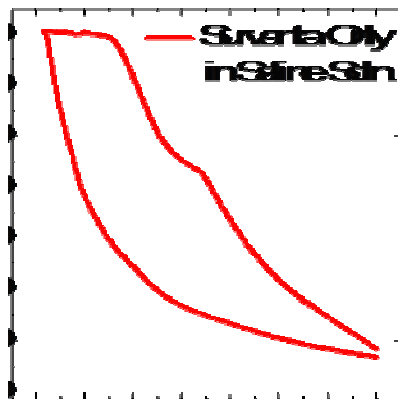
- **Fluorescence Intensity**
 - Peak Occurs at Interface
 - Indicates Molecule Location (in terms of depth)
- **Our Models**
 - The Healthy Lung
 - Albumin



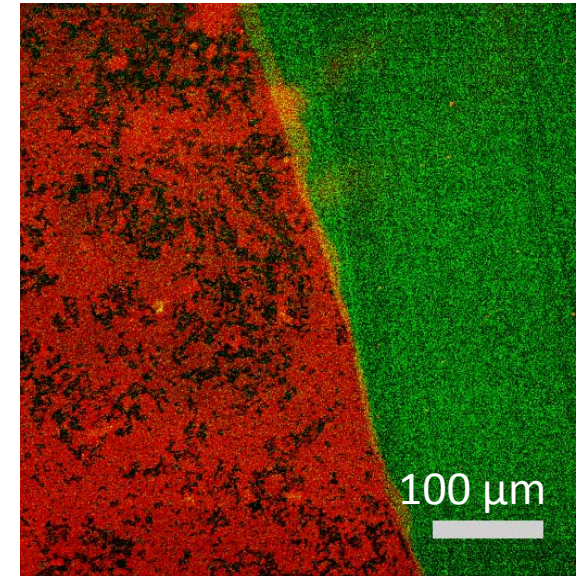
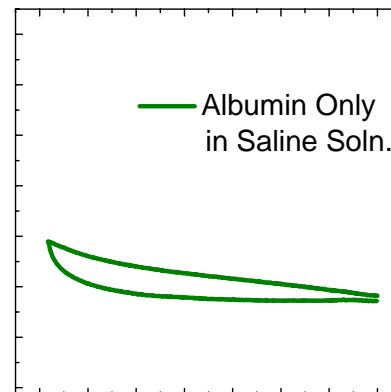
Confocal Images



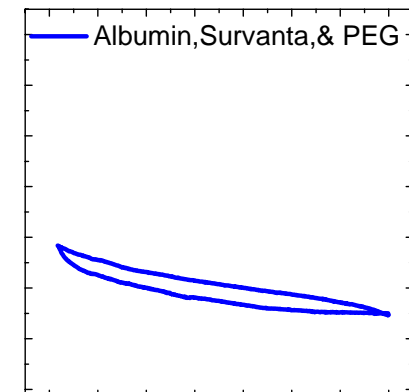
Survanta Only



Albumin Only



Survanta/Albumin with PEG



Project Overview & Future Goals

- **What I Learned This Summer**
 - Importance of Lung Surfactant
 - ARDS/Inhibition Process
 - Langmuir Trough/Microscopy Techniques
- **Continuing Research**
 - Reversal Process Was Unsuccessful
 - New Sample of Survanta
 - Use Three Lasers
 - We Have Only Used Two





CALIFORNIA NANOSYSTEMS INSTITUTE

Thank You to:



University of California, Santa Barbara
CHEMICAL ENGINEERING

Ian Shieh, Mentor

Dr. Joseph Zasadzinski, Faculty Advisor



Dr. Jens-Uwe Kuhn, Program Coordinator

“Dr. Nick” Arnold, Faculty Coordinator



For Funding Our Project

Polyethylene glycol (PEG)

- **PEG Mechanism**

- Excluded Volumes Surround Surfactant Aggregates
- PEG Helps Aggregates Stick Together & to the Interface
- Rise In Entropy of System

