Langmuir-Blodgett Films Doped with SMF's

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INTRODUCTION

Ultrathin films have become an important advancement in modern society with many diverse applications, including solar cell parts, computer chips, and anti-reflective coatings on glasses. The Langmuir-Blodgett (LB) technique was employed to deposit ultrathin films on substrates. Intermolecular forces strongly influence the formation of these films, and our studies of the formation and properties of such films help us understand these forces. The method exploits the hydrophilic and hydrophobic properties of an amphiphilic molecule to develop a film at the air-water interface. Pressure vs. area isotherms were taken to characterize the gas-like, liquid-like, and solid-like phases and to determine the zero-pressure molecular area for optimal film deposition. A substrate is dipped into the water to deposit a single molecule layer film. Multiple layered films are deposited by passing the substrate through the air-water interface multiple times. Small molecule fluorophores (SMF's) are small molecules that emit light from an excited state. They are added as dopants to the LB film. Trapping the fluorophore into the LB film reduces the degrees of motion available to the molecule. This is likely to influence the fluorescence time, which is measured by time-resolved fluorescence

OBJECTIVE

- Trap a small molecule fluorophore (SMF) in a thin film of arachidic acid (AA) to hinder the vibrational and rotational modes of motion of the fluorophore
- Observe a change in the UV-Vis spectra to determine a change in electronic structure

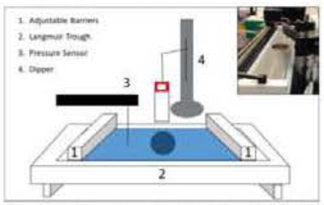


Figure 1: Kibron MicroTroughX and LayerXPro Dipper

LIMITATIONS

- Due to the abundance of vibrations on the second floor that disrupted the cleaning and deposition process, the experimental setup had to be moved to another lab on the first floor
- The files from the data that was collected during the first half of the fall semester could not be saved due to only having a trial version of the software

METHOD

- The Langmuir-Blodgett method was used to deposit amphiphilic molecules of arachidic acid (AA) onto a substrate. A Kibron MicroTrough XL compressed a solution of AA, AA doped with rhodamine 6G (R6G), and AA doped with stilbene into packed films on the surface of the subphase.
- The doped solutions were made using a 1:10, 1:100, and 1:1000 ratio of the dopants to the arachidic acid solution. Chloroform was used as a solvent.
- The subphase, a Milli-Q water and zinc sulfate solution, was added to the trough after it was cleaned and each AA solution was applied to the surface of the subphase at a pressure of 0 mN/m.
- Barriers on the surface of the trough compressed the solution into a packed film on the surface of the water.
- Glass slides were prepared using either a sodium hydroxide solution to make the slide hydrophilic or by rubbing a slide with ferric stearate to make it hydrophobic.
- These slides were dipped into the surface of the water at a constant pressure just below the solid-like phase to deposit the film and were then characterized using UV-Vis

RESULTS

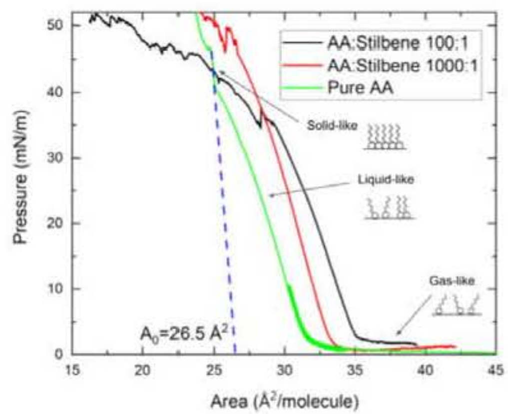


Figure 2: Isotherms of pure arachidic acid and arachidic acid doped with stilbene in 100:1 and 1000:1 ratios. Pure arachidic acid entered the solid phase at a pressure of about 41 mN/m while the 1000:1 stilbene solution entered the solid phase at about 45 mN/m. The 100:1 solution showed no evidence of a solid phase.

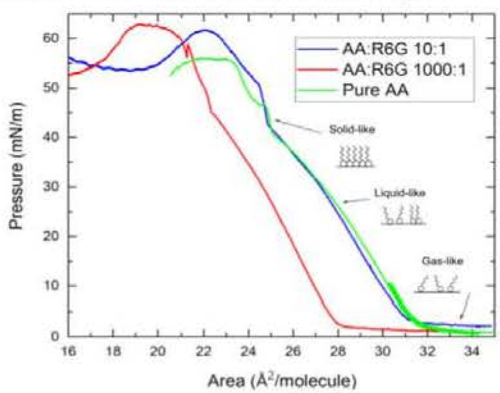
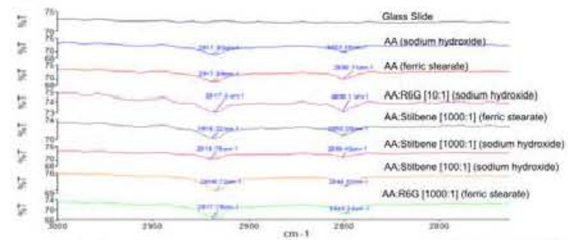


Figure 3: Isotherms of pure arachidic acid and arachidic acid doped with rhodamine 6G in 1:10 and 1:1000 ratios. Pure arachidic acid entered the solid phase at about 41 mN/m. The 10:1 R6G solution entered the solid phase at about 43 mN/m while the 1000:1 solution entered at about 46 mN/m.



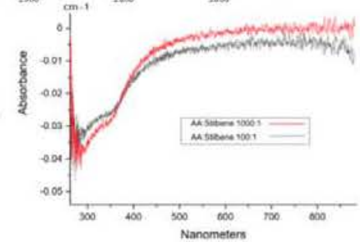


Figure 3 (above): FTIR of the LB films deposited onto glass slides. The way the film is prepared is in parentheses. The two peaks around 2917 cm-1 and 2850 cm-1 confirms the deposition of AA onto a slide. **Figure 4 (right):** The UV-Vis data of the stilbene slides prepared with ferric stearate shows negative absorbance.

CONCLUSIONS

When compared to pure AA, the isotherm of AA with the dopants of stilbene and R6G show that the dopants are being trapped into the LB film during compression at varying ratios. FTIR of the slides show that AA was deposited onto a glass slide. UV-Vis data of the AA:Stilbene films indicate that film is re-emitting light from the absorbed light in the 350 nm range. Further data is required to resolve the negative absorbance. The UV-Vis spectra of AA:R6G showed nothing of significance. Further spectroscopic techniques will be utilized to assist in confirming R6G is depositing onto the film and not dissolving into the aqueous solution. Fluorescence measurements did not yield a signal due to very few LB layers deposited onto the slide. Future work will be dedicated to increasing the layers of AA deposited onto the slide in hope of stronger signals. The use of quartz slides instead of glass would allow for more FTIR data on the dopants.

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