How to: Contact Angle

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Shaw Group Meeting
141124
Sample/Fluid Preparation

• Prepare surface
  – Mechanically and chemically polish
  – Electrochemically roughen
  – Put in SAM at least 24 hrs before (optional)

• Prepare Fluid
  – If using fluid which isn’t of water, make sure to have FRESH fluid in sealed vial
    • Any water in solvents may affect contact angle
Instrument Preparation

• Turn on light
  – Found that having the light a little dimmer allows for easier readings later

• Take cap off camera

• Turn on automated fluid dispenser
  – 20 uL at the slowest speed
Fluid Preparation

• Load tip into fluid dispenser
  – Want the 3 spaces facing the back side of the dispenser
  – Push up until it clicks in

• Press red reset button

• Load fluid
  – Hold vial up so the tip is dipped into fluid
  – Press green up arrow
Tip and Sample Adjustments

Tightening knob to adjust level of dispenser

Tightening knob to adjust height of tip

Fine knob adjustment for height of tip

Tightening knob to adjust height of sample

Fine knob adjustment for height of sample
Software Preparation

• On the desktop, Click camera icon
  – Choose monochromatic option
• Once opened press Play button in top left
• May want to decrease ratio to 1:2 so entire picture can be seen
Focus Adjustments

• Make sure the two lens adjustments are turned all the way to the left to ensure farthest sample
  – This allows the whole sample to be in the shot

• Adjust any other focus using the rolling knob
Taking Contact Angle Video

• Press reel in the top bar
• Box (left) will pop up
  – Need to create file before recording
• Box (right) allows you to record and stop
• Dispense liquid using orange down arrow on dispenser
• Press stop and then close to end the video
• Need to then PrtSc separate images
  – Save as JPEG
Background Contact Angle Analysis

\[ \gamma^{sv} = \gamma^{sl} + \gamma^{lv} \cos \theta \]

- \( \theta \): Contact Angle
- \( \gamma^{sl} \): Solid/liquid interfacial free energy
- \( \gamma^{sv} \): Solid surface free energy
- \( \gamma^{lv} \): Liquid surface free energy
Background Contact Angle Analysis

\[ \theta_{Hysteresis} = \theta_{Advancing} - \theta_{Receding} \]

• Need to be careful because the capillary dispenser may cause deformation of the geometry
Contact Angle Analysis: ImageJ

Angling Button

Angle readout

Set line for solid/liquid interface and line tangent to vapor/solid interface
Contact Angle Analysis

• Need to get images of advancing, static, and receding contact angles
• Need to measure both left and right of each image
  – This allows for more data points
Contact Angle Analysis

• Once all data is collected
  – Combined left and right measures with each different droplet

\[ \text{Avg: } \frac{a_1 + a_2 + \ldots + a_n}{n} \]

\[ \text{StDev: } \sqrt{\frac{(a_1 - a)^2 + (a_2 - a)^2 + \ldots + (a_n - a)^2}{n}} \]

\[ \text{Pooled StDev: } \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \ldots + (n_k - 1)s_k^2}{n_1 + n_2 + \ldots + n_k - k}} \]

<table>
<thead>
<tr>
<th>Ag3</th>
<th>Ag4</th>
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<tbody>
<tr>
<td>Average</td>
<td>Ag3 StDev</td>
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<tr>
<td>Advancing</td>
<td>43.48</td>
</tr>
<tr>
<td>Receding</td>
<td>23.85</td>
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<tr>
<td>Static</td>
<td>42.78</td>
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<table>
<thead>
<tr>
<th>Ag-Hexanethiol</th>
<th>Smooth Chlorobenzene</th>
<th>Smooth o-Dichlorobenzene</th>
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<tr>
<td></td>
<td>Advancin</td>
<td>Advancin</td>
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<tr>
<td></td>
<td>g         Receding  Static</td>
<td>g         Receding Static</td>
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<tr>
<td>Pooled Average</td>
<td>43.48  23.85 42.78</td>
<td>51.57 35.02 50.81</td>
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<td>1.43  1.71  1.13</td>
<td>0.36  1.07  0.22</td>
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