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From Page No. _____

Bi - Weekly Report 16/11/22

* Focused on polymerization + transfer of Carboxy Fantrip onto HMDS-treated SiO₂ chips

① Constant pressure polymerization - contraction of barriers during polymerization counteracting the drop in surface pressure

Results

- lack of monolayer transfer, many multilayers / islands
- looked like many crushed iceburgs on the surface of a lake

② Constant Area Polymerizations - barriers were compressed to differing surface pressures ranging from 17 mN/m - 2 mN/m then polymerized NOT holding the pressure constant

Trials

17 mN/m - poor transfer, multilayers + islands

13 mN/m - poor transfers, "

10 mN/m - ~~more~~ larger area films, resulted in formation of double layers

5 mN/m - transfers became even cleaner, larger area / less sign of multilayers

2 mN/m - Cleanest transfer to date / No multi-layers + 1 large sheet

2 mN/m - "

Conclusions

- Polymerization + transfer done at lower pressure results in near perfect films
- Allowing solvent to evaporate from surface for 2 hrs instead of the previous 30 min also results in less island formation + larger sheets.

Future

- Contact angle measurements - neutral / basic droplets
- Liquid post functionalization - bucky ball tether
- Conductive substrates - Gold chips (heat treat, surface treatment to create hydrophobic surface, transfer polymer)

To Page No. _____

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From Page No. _____

ZK 10/11/22 Polymerization + transfer onto SiO₂

- Repeating same procedure from on page ZK3032-33.
- everything was followed to a T and the results were almost identical.

Observations

- One very large monolayer formed across entire chip
 - Fractures starting on one corner + propagating out like rays
 - Only imperfections that differed from ZK3032 was some small splashes on the surface of the chip. This is most likely the result of water droplets containing polymer sticking to the chip when the sample was being removed from the air water surface
- ↳ to improve this it may be useful to have a high speed camera monitor the surface while the chip is dipped + removed from the surface.

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10/11/22

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Date

To Page No. _____

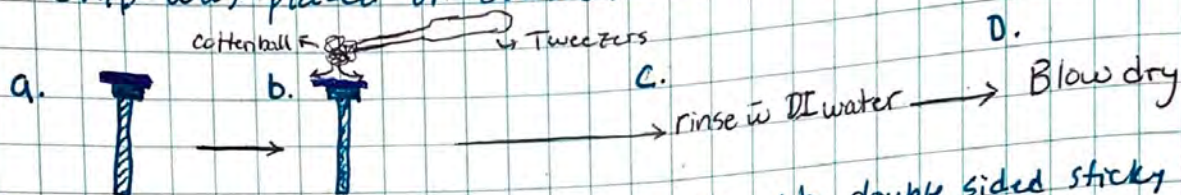
3M 10/9/22

From Page No. _____

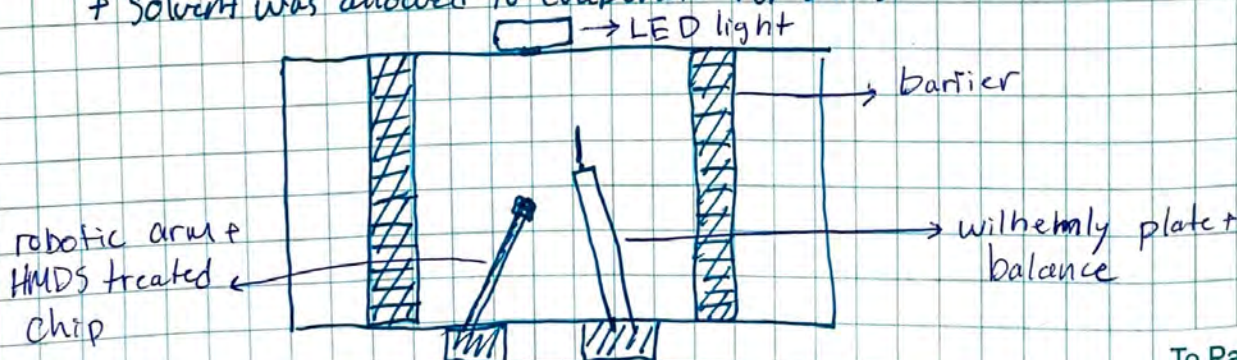
2 m.u./m

Trial #4 * Large are single sheet

- Chip was cleaned w/ Soap/water on a cotton ball / rinsed w/ DI water + blown dry, then UVO treated for 1 hr
- Chip was treated w/ HMDS under vac @ 100°C for 15 min then pumped on for 30 to remove excess HMDS
- Chip was placed on double sided sticky tape on a small post



- The chip is now ready to be used in a transfer
- The LB trough was cleaned w/ Kimwipes
- Water (0.1% w/v H₂O) was poured into trough containing a fresh paper Wilhelmy plate until it bulged over the sides but did not spill over.
- The surface inside the barriers was aspirated until the level of the water was flush with the LB walls in the center.
- More water (0.1% w/v H₂O) was added until bulging over walls again followed by the same aspiration process
- The cleaned mounted chip was attached to the robotic dipper + positioned to the center left slightly behind the Wilhelmy plate + raised ~ 10 mm above water (air surface)
- Monomer solution (40 μM, 0.0922 mg/ml) was deposited on surface + solvent was allowed to evaporate for 2 hrs



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Date _____


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Date _____

Recorded by: _____

To Page No. _____

Cont. From previous page

- barriers were closed @ $4.2 \text{ cm}^2/\text{min}$ until pressure reached 2 mN/m
- LED lights $5V$ (400 nm) was turned on for 30 sec
- pressure dropped from 2 mN/m to 0.4 mN/m
- lights were then turned off
- without opening the container doors, the dipper arm was lowered as fast as possible. (large down arrow on display) until the chip touched the surface of the water (observed by an increase in surface pressure). Note * once there is a sudden increase in surface pressure the  stop button need to be promptly hit to stop chip from breaking through the surface of the water
- This left a dimple or concave area of the water surface around the chip



- The chip is then removed/raised slowly from surface ($3 \text{ mm}/\text{min}$)
- Once the water impression is inverted or convex, aspiration around chip is done until the chip is freed from the surface of the water
- IF a droplet of water remains on chip the aspirator ~~tip~~ can be used to suck off the water droplet *note: without touching the tip to the chip
- The chip was removed from the robotic arm & observed under the optical microscope

Observations

- Chip has a near perfect transfer $> 95\%$ coverage w/o breaks
- No sign of any double layers or islands
- Small Fractures spanning in rays in one corner (only way I could tell the polymer was transferred to the chip)
- Chip had no signs of birefringent spots or lines as seen in all other trials previous to this one

Conclusions

- By far the cleanest transfer. Future transfers will be referring to this procedure in hopes to obtain the same results.

To Page No. _____

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Date

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Book No. _____

TITLE _____

From Page No. _____

ZK 10/6/22

Polymerization / Transfer TrialsConditions held constant for each trial:

- Concentration: 0.0827 mg/ml
- Amount deposited: $40 \mu\text{L}$ onto air water surface
- Deposition pattern: 

- Micropure H_2O w 0.1% NH_4OH (3.3 mL of 30% NH_4OH in 1000 mL H_2O)
- At least 30 min of evaporation allowed before compression
- 400 nm light (5 V LED)
- HMDS treated SiO_2 chip - cleaned right before polymerization + transfer
- horizontal transfer
- Barrier speed: $4.2 \text{ cm}^2/\text{sec}$
- Light on for 10 min

 13 mN/m pressure Trial #1 - bad transfer

- Utilizing MMA to adjust polymerization pressure to be that of the MMA of the polymer

- * For Fantrip, MMA of Monomer: $170 \text{ A}^2/\text{molecule}$
MMA of polymer: $155 \text{ A}^2/\text{molecule}$
- polymerization contracts MMA $15 \text{ A}^2/\text{molecule}$

- * How to ~~control~~ pressure: Compress barriers to $155 \text{ A}^2/\text{molecule}$. Monomer will be squeezed tighter than it would like but should account for the contraction during polymerization in hopes of having the polymer not break apart.

MMA was reported e $172 \text{ A}^2/\text{molecule}$

- Barriers compressed to 13 mN/m . Lights were turned on for 10 min , pressure dropped to 1.9 mN/m .
- Dipper lowered until chip touched water surface
- water was aspirated around chip until water was removed from chip

Observations

- * transfer did not give monolayer, Many double layer + islands

To Page No. _____

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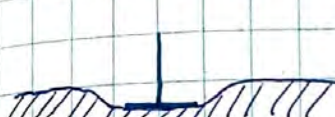
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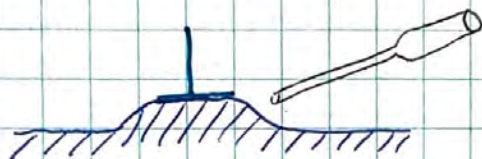
10 mm/m pressure

Trial # 2 - good transfer *Zll* 10/8/22

- Solvent left to sit for 2 hrs instead of 30 min
- pressure was stopped @ 10 mm/m + lights were turned on
- Pressure dropped from 10 mm/m to 6 mm/m in seconds
- light was turned off 30 sec after it was turned on
- Dipper was lowered until dimple was formed around chip but water layer was not broken
- chip was raised slowly (3 mm/min) until dimple was inverted but still attached to chip
- water was aspirated around raised area until chip was freed



Dipper down in H₂O



Dipper raised + aspirated around chip until freed

- * great transfer, mostly one large sheet. Corner showed large sheet may be a double layer over the chip.

5 mm/m pressure Trial # 3

- Solvent was left to evap for 2 hrs
- pressure was stopped @ 5 mm/m + lights were turned on for 30 sec
- pressure dropped from 5 mm/m to 1.6 mm/m
- Dipper was lowered quickly until it created a dimple on the water
- chip was raised @ 3 mm/min until dimple was inverted
- water was aspirated around chip until it was freed from the water
- Aspirated was used to suck off the water remaining on chip w/o touching the chip. This left a very clean surface
- ~~pressure dropped f~~

Observations

- Best transfer yet. No signs of double layers
- Over 95% coverage. Only could tell there was polymer due to cracks forming on a corner + propagating out like a ray
- Small imperfections look like dots on a few parts. Can't tell if that was pre or post polymerization.

To Page No. _____

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TITLE _____
From Page No. _____

3/2 10/4/22

Concentration of Carboxy Fenprop Monomer Soln.

- CHCl₃
- In freezer (100 mL volumetric flask)
- Pathlength 1 mm NOT 1 cm!!
- $A @ 360 \text{ nm} = 0.20318$
- $\epsilon @ 360 \text{ nm} = 2.00 \times 10^4 \text{ cm}^{-1} \text{ M}^{-1}$

$$A = \epsilon BC$$

$$0.20318 = 2.00 \times 10^4 \text{ cm}^{-1} \text{ M}^{-1} \cdot 0.1 \text{ cm} \cdot C$$

$$C = 1.02 \times 10^{-4} \text{ moles/liter}$$

$$\frac{1.02 \times 10^{-4} \text{ moles}}{\text{liter}} \cdot \frac{1 \text{ L}}{1000 \text{ mL}} \cdot \frac{814 \text{ g}}{1 \text{ mole}} \cdot \frac{1000 \text{ mg}}{1 \text{ g}} = \boxed{\frac{0.0827 \text{ mg}}{\text{mL}}}$$

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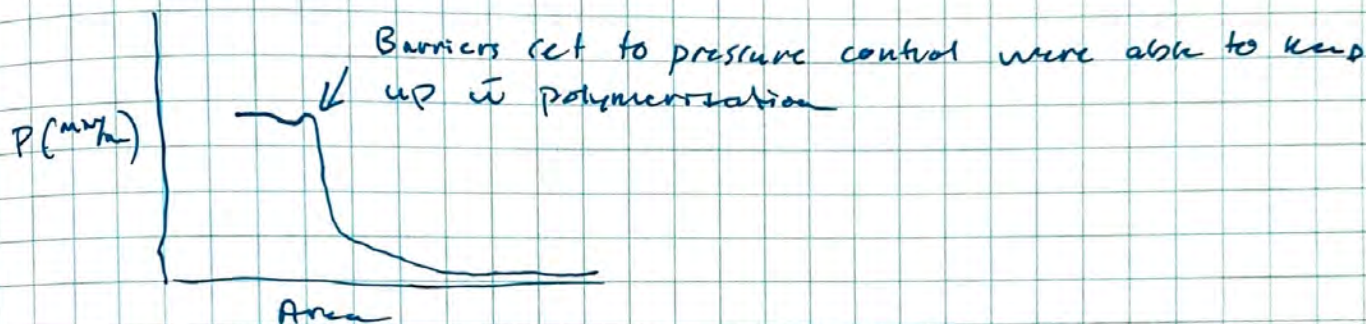
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From Page No. _____

7/29/22

Carboxy Fanstrip Polymerization With Pressure Control - bad transfer

- 40 ml of Carboxy soln. was shot onto air/water surface & allowed to evaporate for 20 min
- barriers were compressed @ 4.2 cm²/sec until pressure hit 10 mPa then barriers were set to hold that pressure (gain set to 1)
- speed of barriers were increased to 10 cm²/s
- 400nm 5V light (LED) was turned on
- pressure was able to keep up w/ the contraction reducing the surface pressure of the trough



- lights + pressure control was kept on for ~5 min, barriers compressed 10 A² from start of polymerization to the end
- lights were kept on for an additional 5 min + pressure fell to 4 mPa. The lights were then turned off
- Ripper was lowered to surface, stopped upon contact w/ water
- water was aspirated around surface until chips were freed from water surface.

Observations

- Polymerization / transfer did NOT result in a clean monolayer transfer. Many areas were NO polymer was transferred.
- many areas were many small islands were transferred (not sheets).

To Page No. _____

Witnessed & Understood by me,

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Date

Recorded by:

From Page No. _____

9/29/22

Carboxy Fantrip Polymerization @ 17 mW/cm + transfer - bad transfer

- Trough was cleaned & set up as usual.
- 70 μ l of Fantrip solution was added onto surface
- 45 min was allowed for solvent to evaporate
- Barriers were closed @ 4.2 cm²/sec until pressure climbed to 17 mW/cm
- Barriers were shut off & lights (400nm) were turned on for 10 min
- Pressure dropped to 8 mW/cm & lights were turned off
- Dipper was lowered until SiO₂-hard chips kissed the surface
- Water around area was aspirated until chips were not touching water anymore

Observations

- transfer of polymer to chips yielded monolayers, bilayers, & areas w/ no polymer
- Many large island areas resulted from this transfer

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To Page No. _____

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QIS Update

10/10/22

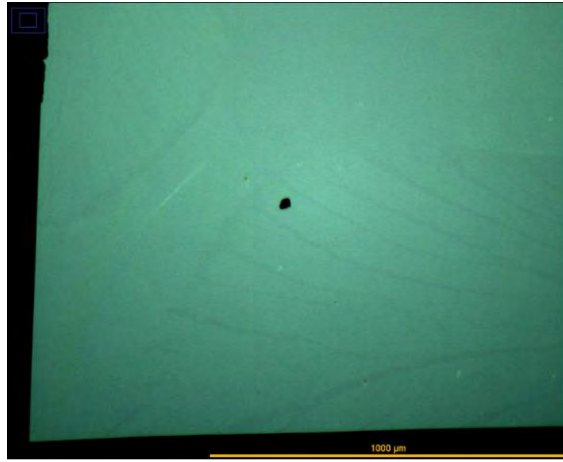
Langmuir- Schaefer Transfer Studies

Pressure control

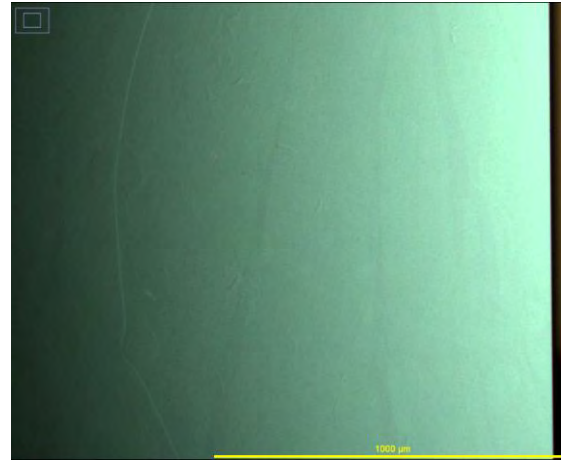
13 mN/m



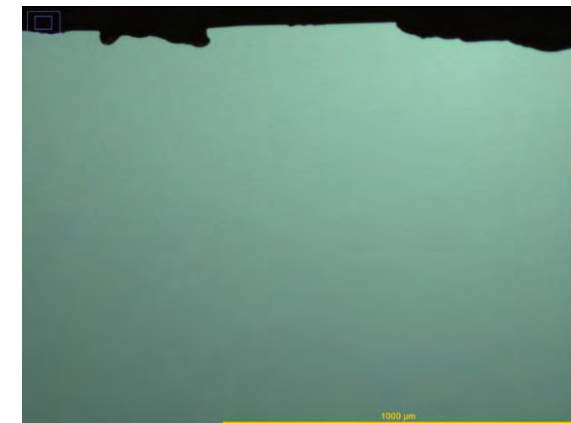
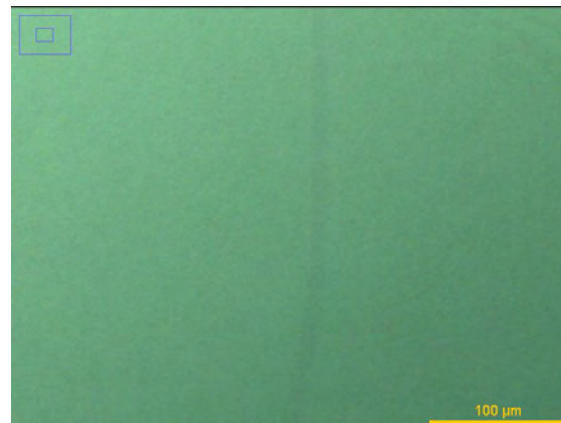
10mN/m



5 mN/m



2 mN/m



2 mN/m

