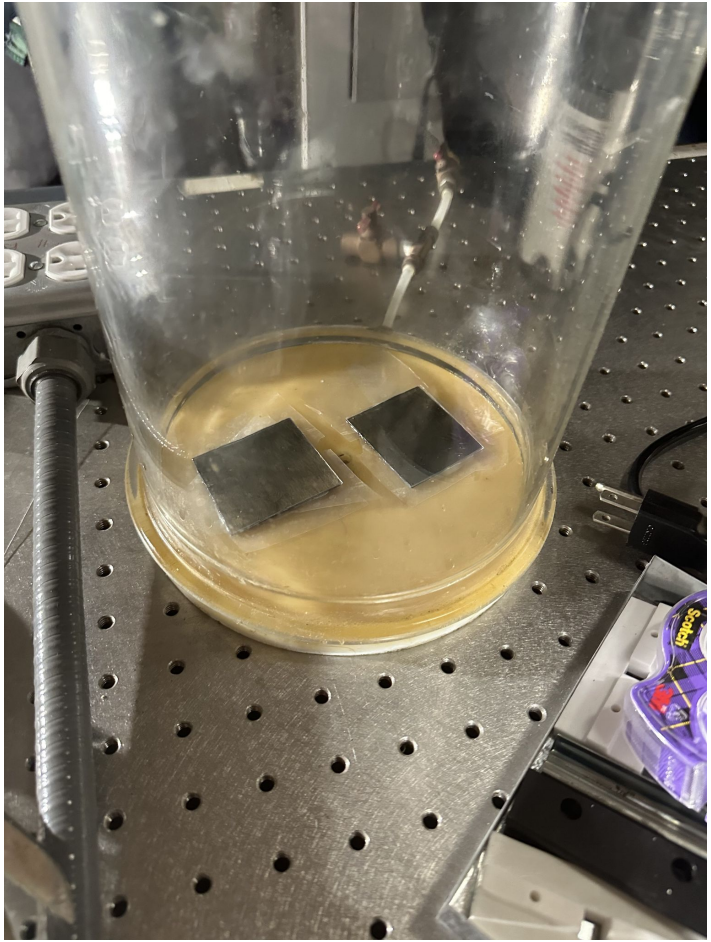
Evaporation #6 Set up

- 2 × 30 ml lexan-carbon fiber samples
- 1 × Lexan sample (30 mil) 2″× 4 ″
- 1 × 30 mil Lexan sample Thickness Test

The initial plan for evaporation #6 involved overflowing the lexan-carbon fiber samples with epoxy and placing them into the Bell jar with a extra roughing pump we found to create a vacuum. This did not pan out as the seal that was formed was quite poor and there was lifting of the thin sheets we placed under the sample. Instead we left the epoxy to cure on its own and saw minimal air bubbles
*Thor Lab stands and blanks have arrived.



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Start Log       Run: 18 Date: 2/28/2024   Time: 11:46:22
Time, 600627 Rate (Å/s), 600627 Thick (kÅ), 600627 Frequency (Hz)
1.047, 0, 0, 5015471.42,
2.031, 0, 0, 5015471.64,
3.031, 0, 0, 5015471.5,
4.031, 0, 0, 5015471.4,
5.031, 0, 0, 5015471.37,
6.078, 0, 0, 5015471.1,
7.094, 0, 0, 5015471.01,
8.078, 0, 0, 5015471.18,
9.063, 0, 0, 5015471.1,
10.047, 0, 0, 5015471.04,
11.063, 0, 0, 5015470.98,
12.109, 0, 0, 5015470.94,
13.094, 0, 0, 5015470.92,
14.109, 0, 0, 5015470.91,
15.094, 0, 0, 5015470.84,
16.109, 0, 0, 5015470.58,
17.156, 0, 0, 5015470.65,
18.141, 0, 0, 5015470.5,
19.125, 0, 0, 5015470.45,
20.109, 0, 0, 5015470.33,
21.125, 0, 0, 5015470.25,
22.125, 0, 0, 5015470.09,
23.188, 0, 0, 5015470.25,
24.172, 0, 0, 5015470.01,
25.172, 0, 0, 5015469.97,
26.172, 0, 0, 5015469.97,
27.234, 0, 0, 5015469.82,
28.219, 0, 0, 5015469.7,
29.203, 0, 0, 5015469.64,
30.219, 0, 0, 5015469.53,
31.281, 0, 0, 5015469.62,
32.25, 0, 0, 5015469.45,
33.234, 0, 0, 5015469.41,
34.25, 0, 0, 5015469.36,
35.25, 0, 0, 5015469.31,
36.25, 0, 0, 5015469.33,
37.25, 0, 0, 5015469.24,
38.297, 0, 0, 5015468.94,
39.281, 0, 0, 5015468.9,
40.297, 0, 0, 5015469.01,
41.297, 0, 0, 5015468.9,
42.344, 0, 0, 5015468.77,
43.328, 0, 0, 5015468.71,
44.344, 0, 0, 5015468.75,
45.344, 0, 0, 5015468.71,
46.406, 0, 0, 5015468.36,
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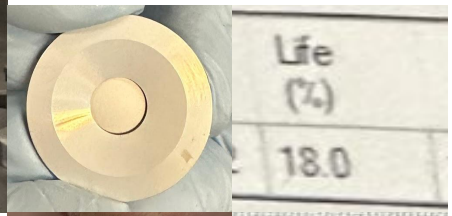
Plan + Obstacles:

The plan for this coating was to use < 1 kAng of Cr while keeping the Al consistent at 35 kAng per crucible. A third crucible was found and we decided to up our possible Al deposition to a total of 105 kAng, up frp, our usual 70 kAng. During this evaporation I hoped to test a “layering” process, such that we open the shutter and allow for ~15 K Ang of deposition close the shutter, let the vapor condense and form a thin film, re open and repeat so that we have multiple layers of Al form the reflective coating rather than one thick layer to see if it would have any impact on reflectivity.

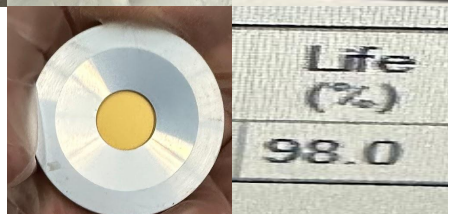
Unfortunately, this evaporation did not go as expected, as we began to coat the Cr we noticed 0.0 Ang/Sec and 0.0 kAng despite being at 40 mA (we would usually see ~10-20 Ang/Sec. We increased it to our peak cruising current of 70mA and yet again saw 0.0 despite the expected ~ 40 Ang/Sec. Notice that the time and frequency were still recorded, after checking to see that there truly was Cr in the crucible and visually seeing a coating form, we concluded that the quartz crystal microbalance was not adequately showing deposition data.

Quartz Crystal:

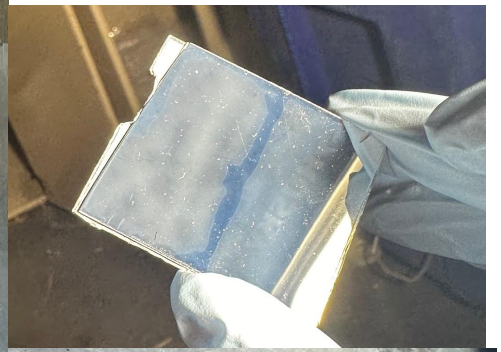
We attempted to coat some Al, in hopes that some data would be picked up but despite 200mA the issue persisted. At this point we ended the evaporation and left the chamber pumped down. I noticed after that the “Life %” of the QCM displayed as “1%”, after checking from older evaporations I found that the Life had been deteriorating steadily. We located a new quartz crystal and replaced the previous one. After checking the software, the Life now reports 98%.

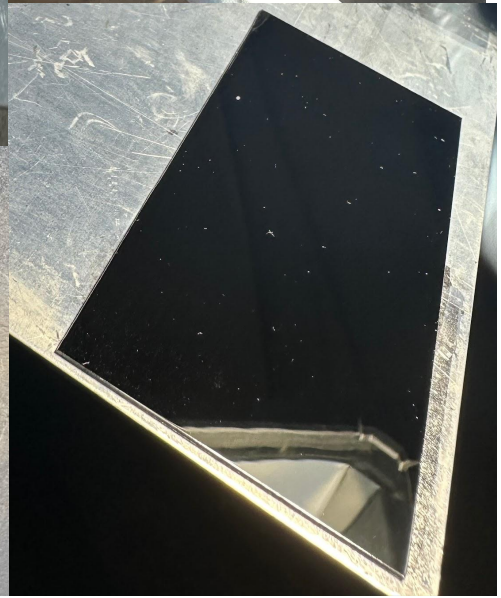


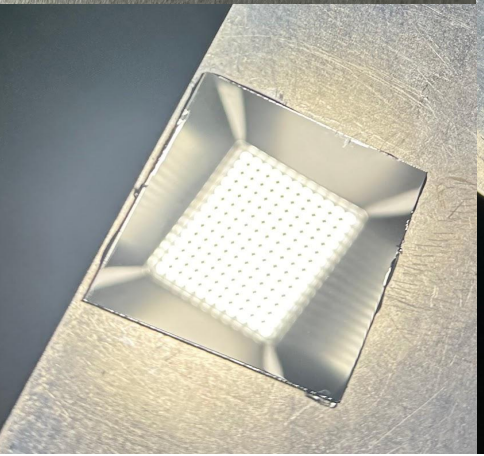
Old Crystal



New Crystal







Coating Results:

The top right image is from Evaporation #5

Visually, the evaporation went well, when the mirrors are held up to light we cannot see through the coating as in evaporation #5, nor is the surface of the film “hazey”. The exact reason for this is still unknown to us, we suspect either the large quantity of chromium is responsible, or since these samples were left in the chamber (under vacuum) overnight that perhaps instantly flushing the system with nitrogen gas could be causing some unwanted haziness, we will attempt to replicate this evaporation next week using the time stamps and currents that are recorded in order to acquire data and test whether leaving samples in the chamber prevents the haziness.

Moving Forward:

- Evaporation #7, repeating the same process of Evaporation #6
- Reflectivity Tests for evaporation 6 and 7 by Kong @ BNL
  (Waiting for their setup to be improved for waviness measurement of old mirrors)
- Understanding multi-layer deposition
- Answering Alexanders' questions regarding pressure and thickness
- Working towards a second report regarding evaporations 3,4,5 and binding mechanisms?

(1) what is a theory behind Cr and Al layer thickness influence on the reflectivity? Chromium is only needed for bonding aluminum to a substrate, correct? Aluminum thickness should just be few times more than a skin layer thickness for a given wavelength, or am I totally wrong here? If surface roughness accumulates over deposition, it seems to be beneficial to decrease both Cr and Al thickness at the same time, which is none of the configurations in a 1^{st} and a 2^{nd} depositions. I now do not recall what the 3^{rd} configuration was, which is not described in this note.

(2) what is a theory behind an expectation that going to 10^-9 torr will improve the coating quality? Are we concerned about a residual gas pressure (why?), or about something like a residual dust contamination per se, or about Cr/Al atom diffusion (and eventual dust attachment)? I mean what is a mechanism by which say abundant nitrogen molecules in the vessel can affect the deposition?