

T2000526 Ink and First Contact Damage test

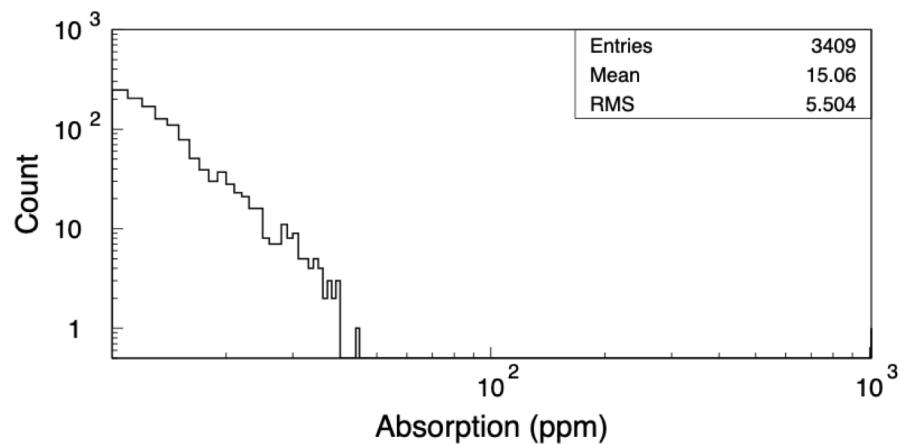
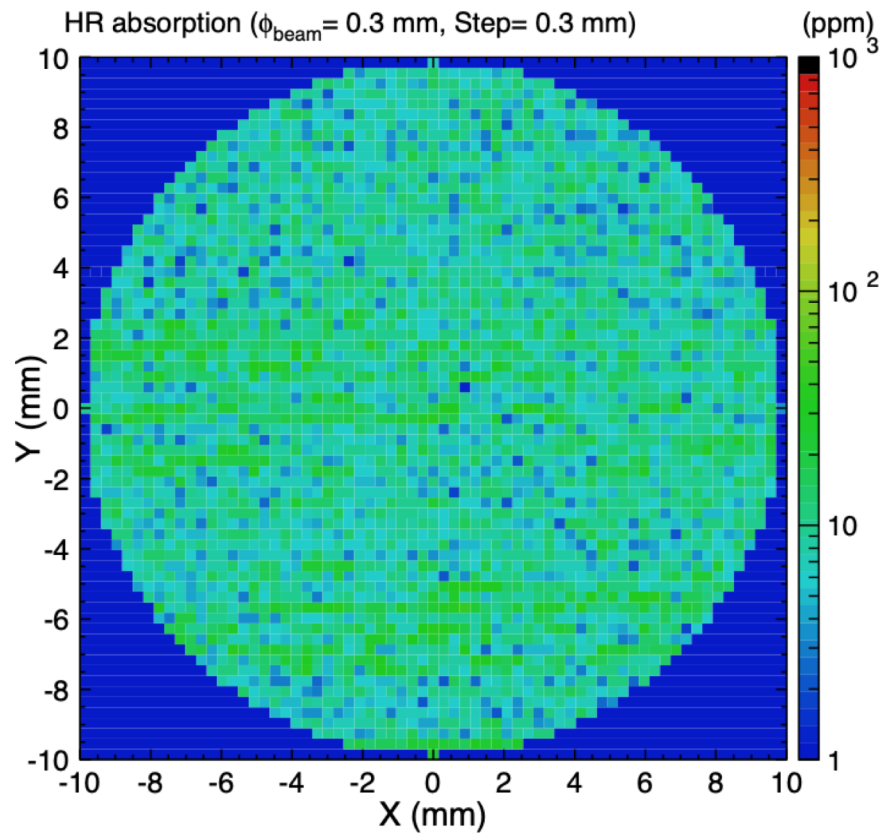
[Sample SN 0919](#)

Zhang, Billingsley

Witness sample 0919 ITM-type HR witness sample, Initial Absorption Scan, no absorbers found

C11068-12 ITM HR witness (sn:0919, \uparrow @-Y)

HR absorption ($\phi_{\text{beam}} = 0.3 \text{ mm}$, Step= 0.3 mm)



Experimental Plan

Witness sample 0919 coating run C11068 HR coating

First line applied near the bottom (label “ink cleaned three times”)

Wait several hours until completely dry

Apply a thin layer of first contact with brush

Wait several hours before removing

Second line applied (label “ink cleaned twice”)

Clean both lines as above

Third line applied (label “ink cleaned once”)

Clean all three lines as above

Fourth line applied (label “ink”)

Very thin patch of first contact applied at the bottom

Wait several hours

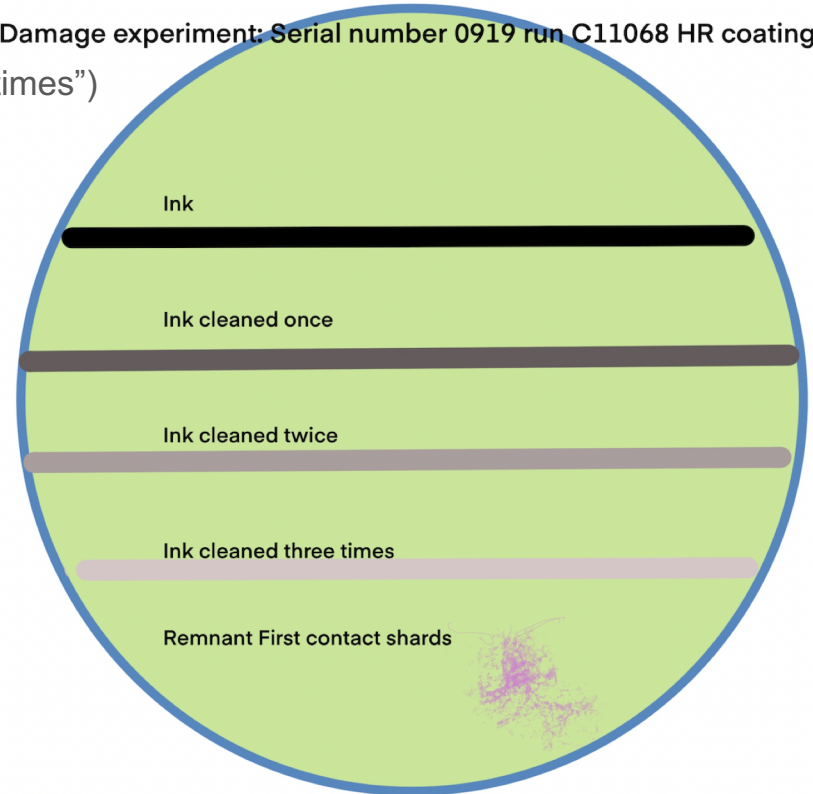
Pull leaving traces

Irradiate in RTS $2\text{W}/\text{mm}^2$ - Inspect

Irradiate in RTS $20\text{W}/\text{mm}^2$ - Inspect

Irradiate in RTS $200\text{W}/\text{mm}^2$ - Inspect

Damage experiment: Serial number 0919 run C11068 HR coating



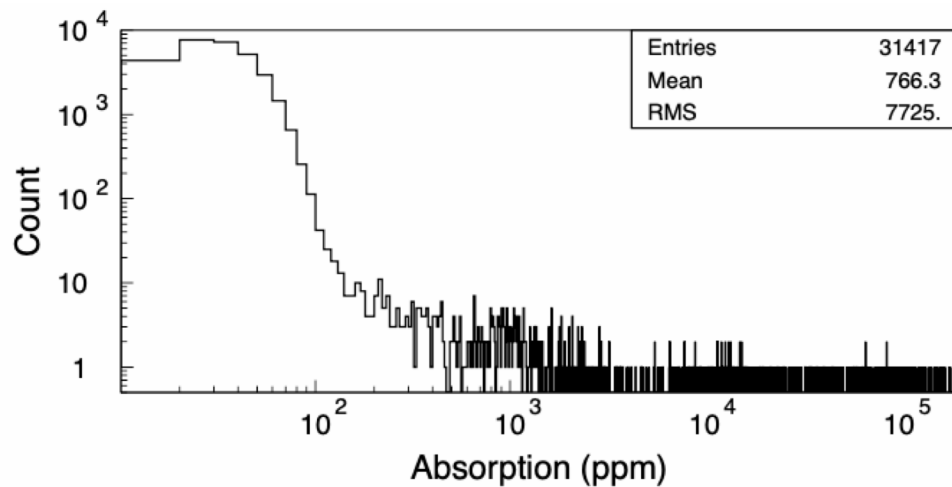
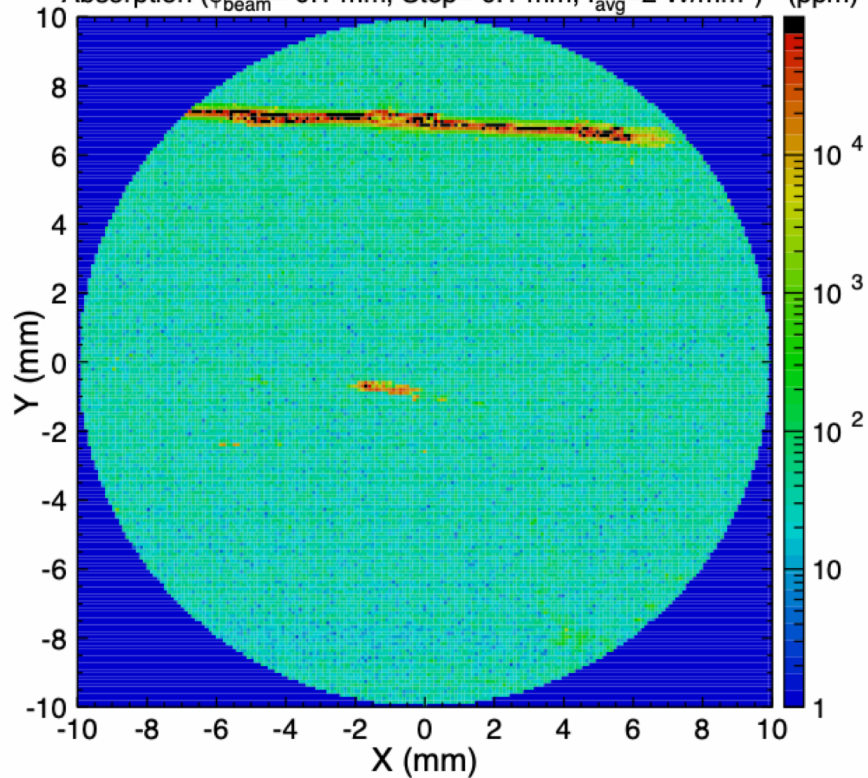
A note on First Contact

- A thin layer does not allow for much solvent to work on the contaminant
 - Once the contaminant is freed from the surface, it is entangled in the polymer
- First contact is optimally adherent soon after drying, ideally being removed within an hour of application for a poured layer - less for a painted layer.
- This experiment seeks to employ the worst of both conditions -
 - a very thin layer
 - an 8 hour drying time

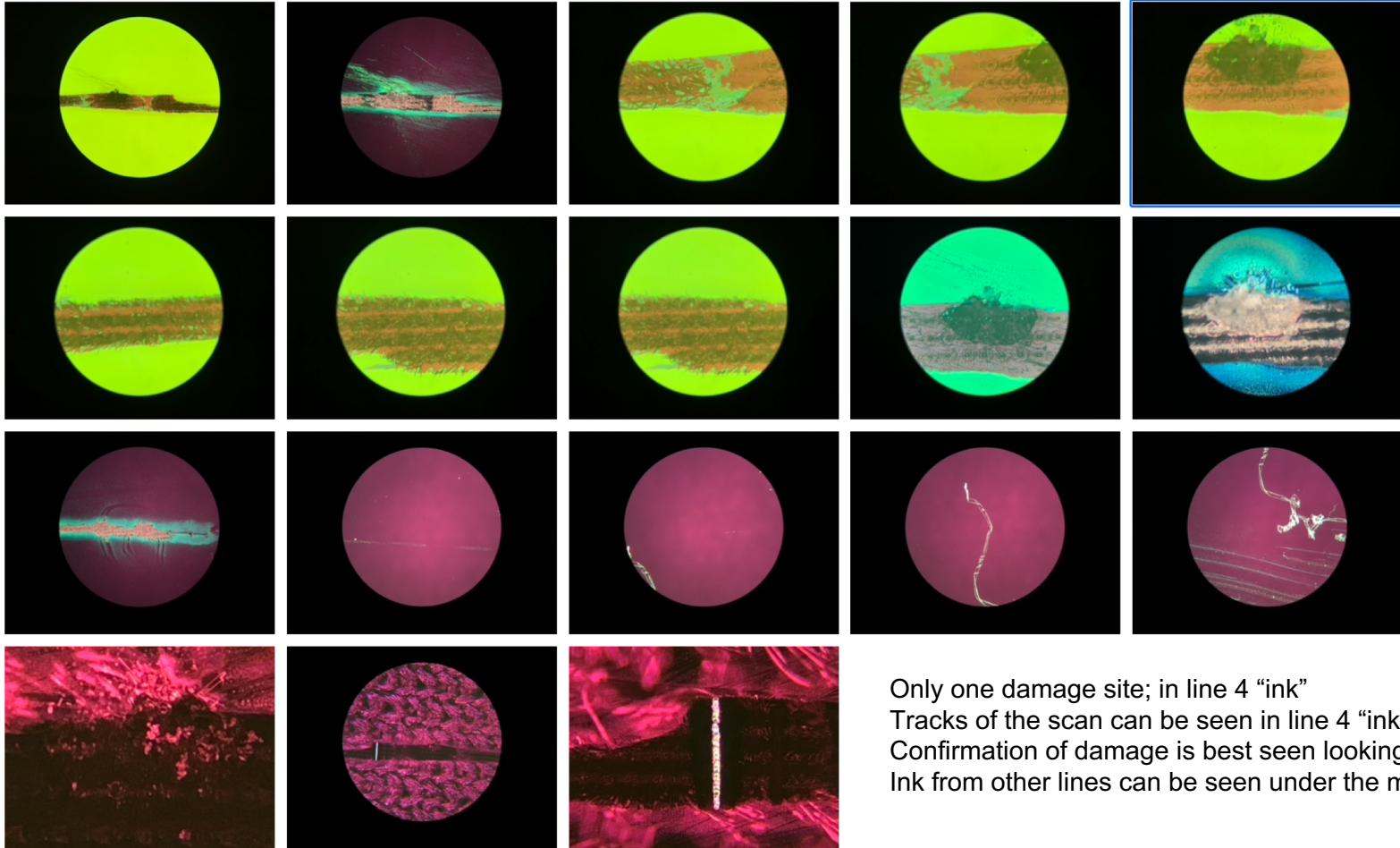
Scan at 2 W/mm²

C11068-12 1" HR Sample (sn:0919, ↑@-Y)

Absorption ($\phi_{\text{beam}} = 0.1 \text{ mm}$, Step= 0.1 mm, $I_{\text{avg}} = 2 \text{ W/mm}^2$) (ppm)

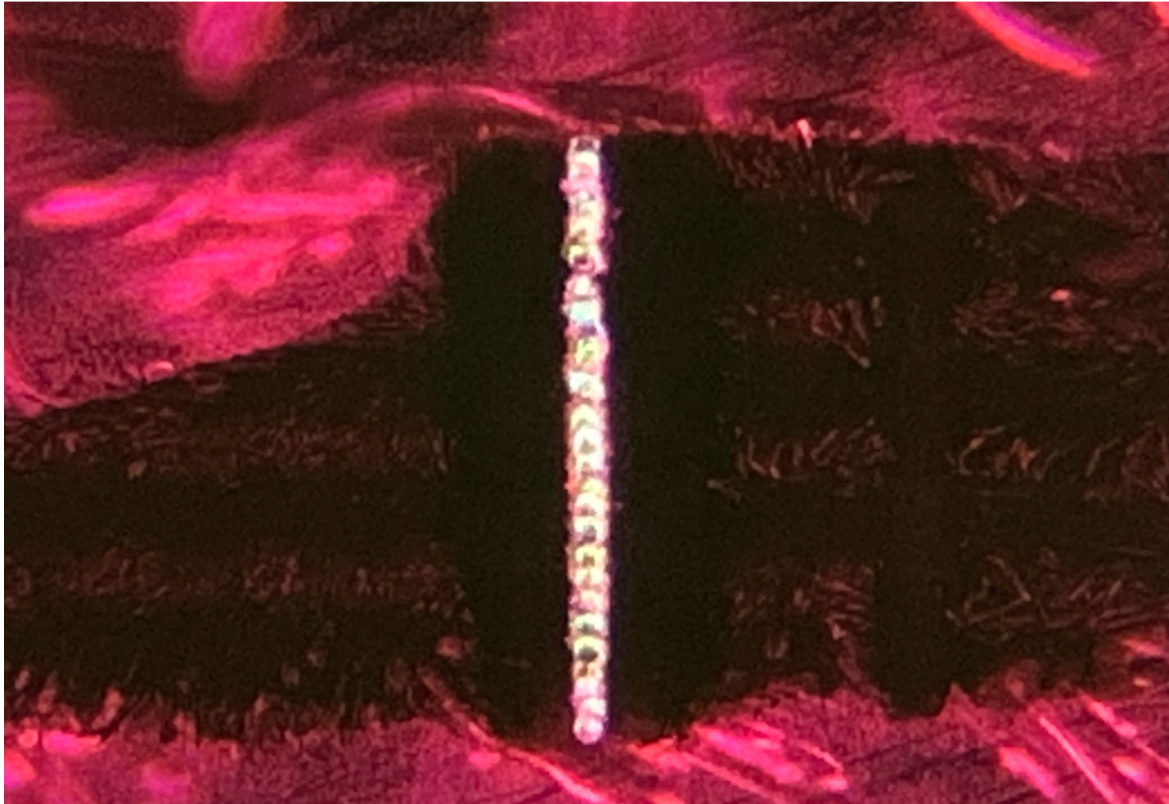


Inspection after 2 W/mm²



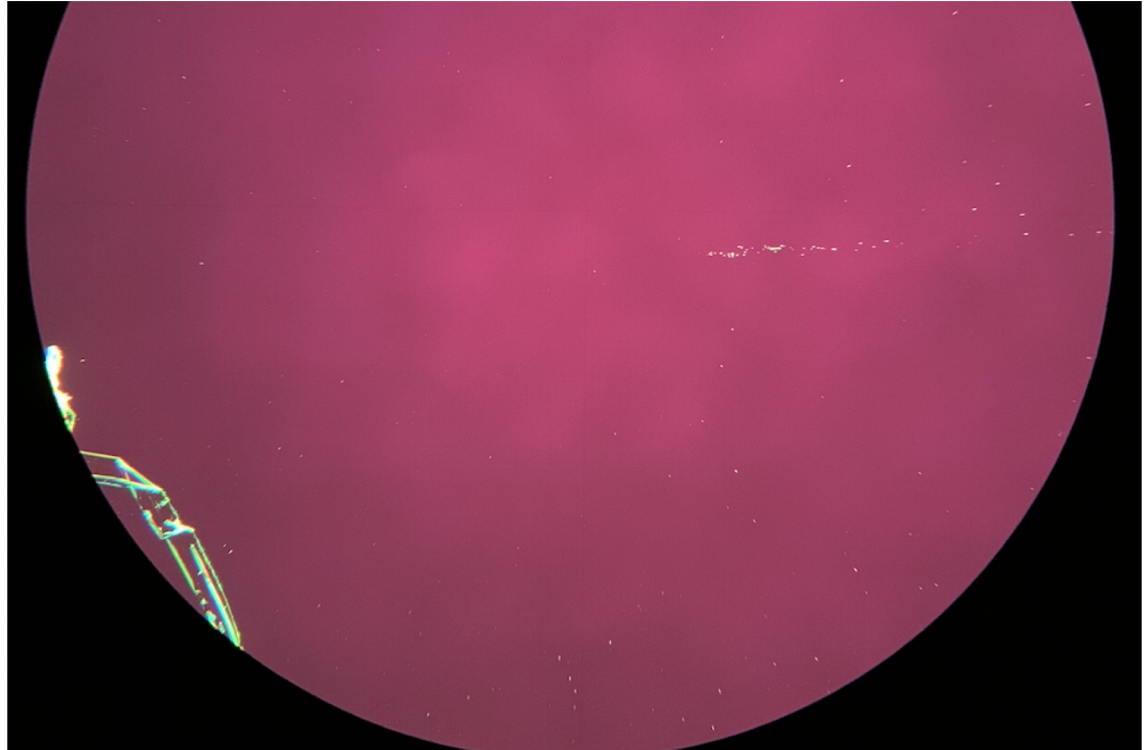
Only one damage site; in line 4 "ink"
Tracks of the scan can be seen in line 4 "ink"
Confirmation of damage is best seen looking through the optic.
Ink from other lines can be seen under the microscope

Damage found at $2\text{W}/\text{mm}^2$ in one location. Easiest to see when viewed through the optic
Possibly at another power level, done during stage movement.



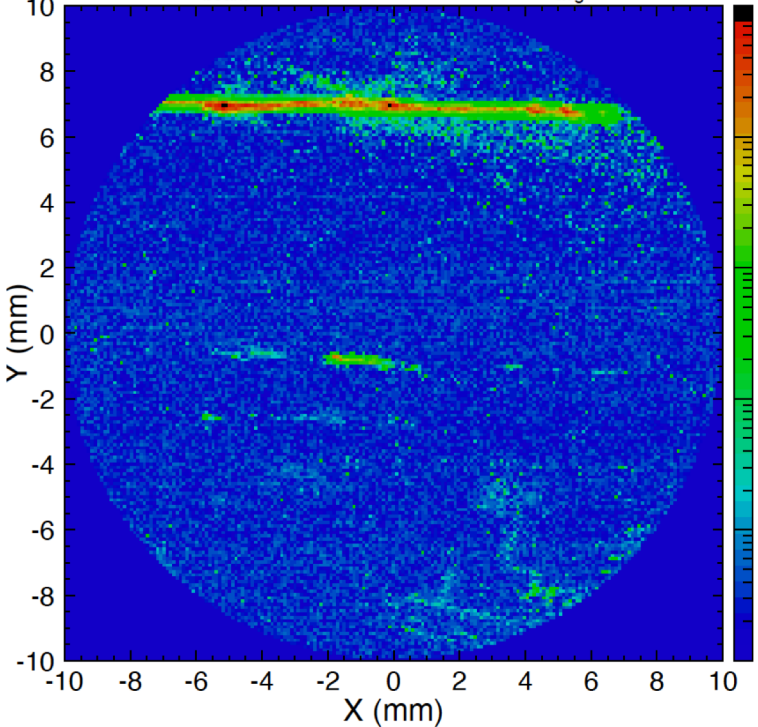
The ghost of line one

A ghost of the first ink line can be seen near some First Contact shards

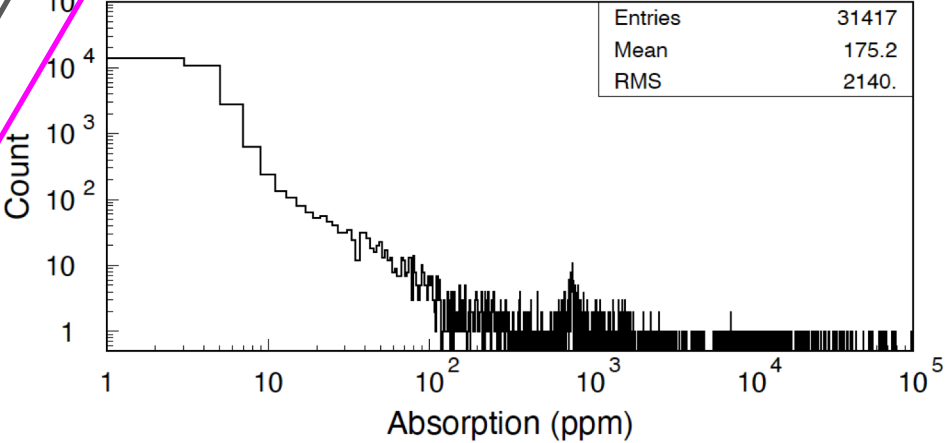


Scan at 20 W/mm²

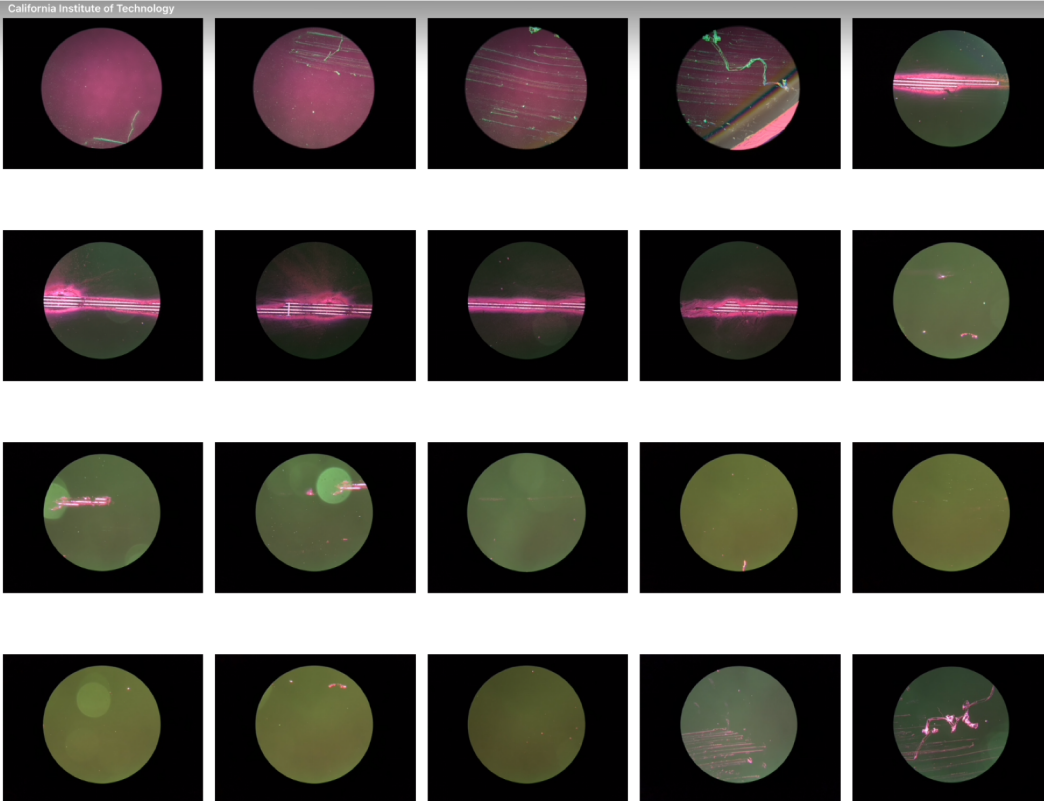
C11068-12 1" HR Sample (sn:0919, ↑@-Y)
Absorption ($\phi_{\text{beam}} = 0.1 \text{ mm}$, Step= 0.1 mm, $I_{\text{avg}} = 20 \text{ W/mm}^2$) (ppm)



The four lines can be seen
The first contact can be seen

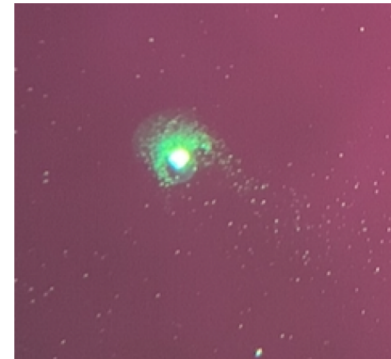


Inspection after 20 W/mm²

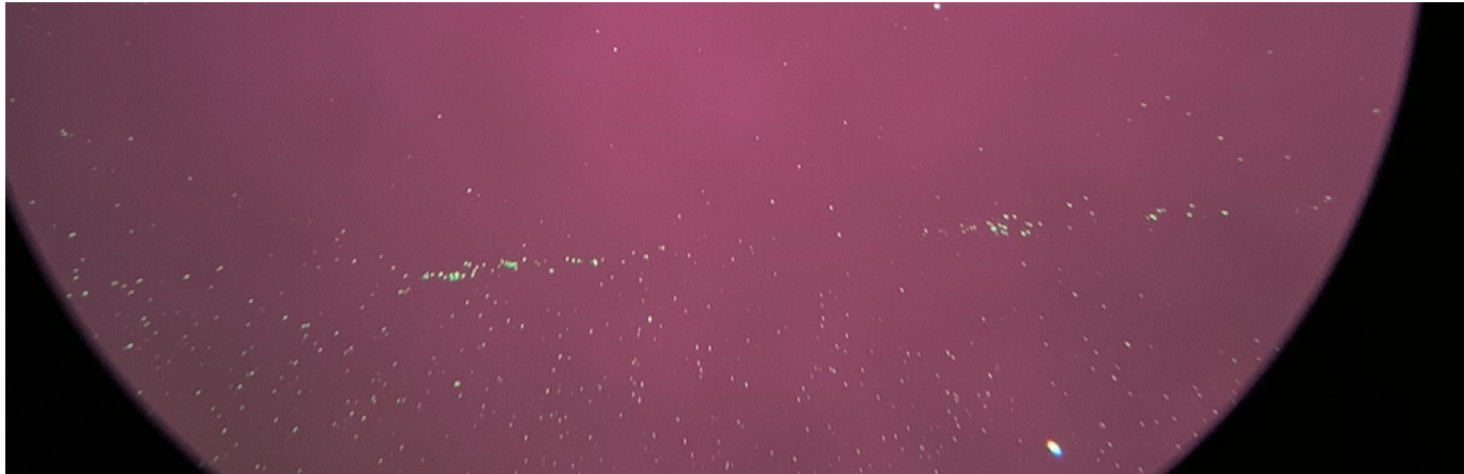


Excessive Damage on line 4- Ink
Damage on lines 2 and 3
No Damage on line 1
No Damage in First Contact

Perhaps one damage site that was not on a line? We usually clean before this type of test, but the sample is getting quite dirty. (below)



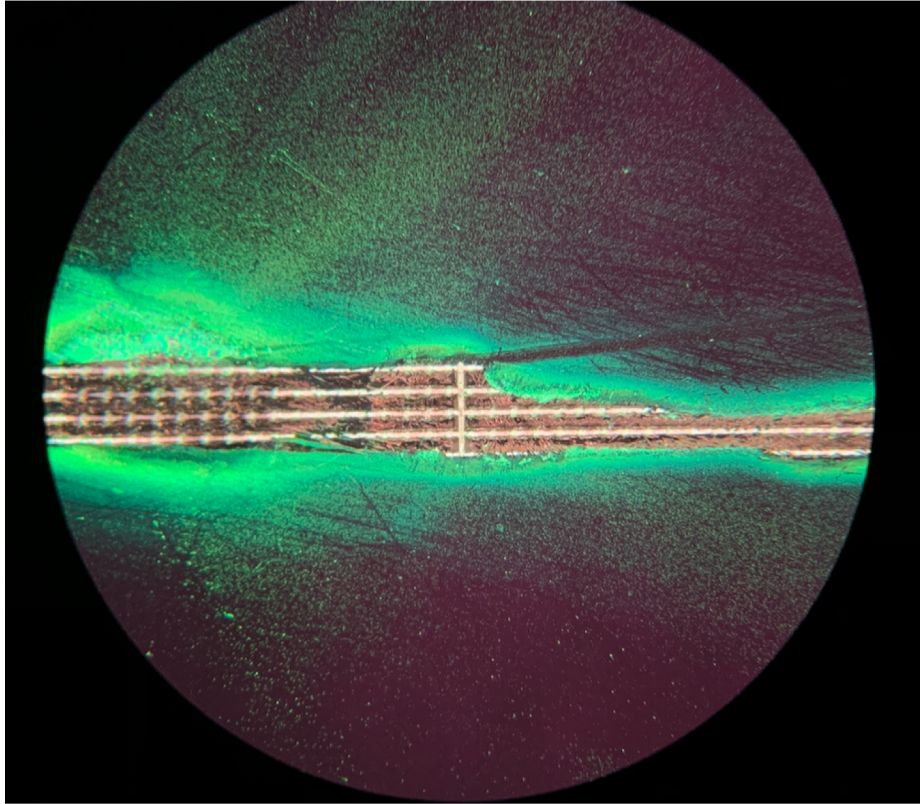
No damage in line 1,



The remaining,
visible part of
line 1 - no
damage

Viewed on the
front of the optic
in dark field.
Cannot be seen
through the optic
(in DF)

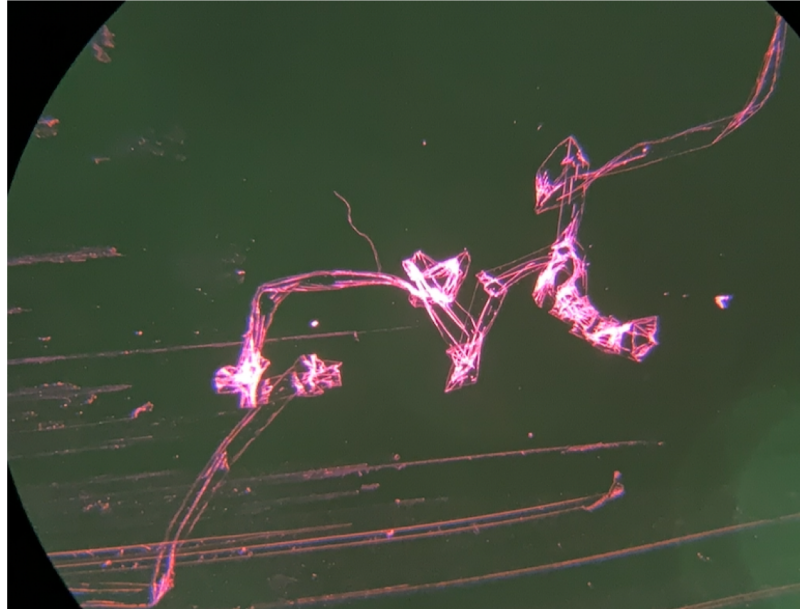
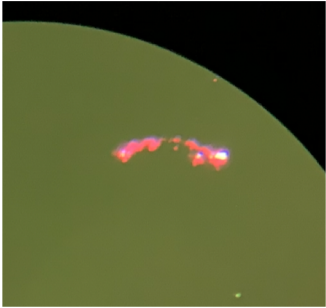
Viewed through the optic in dark field



Viewed through the optic in dark field

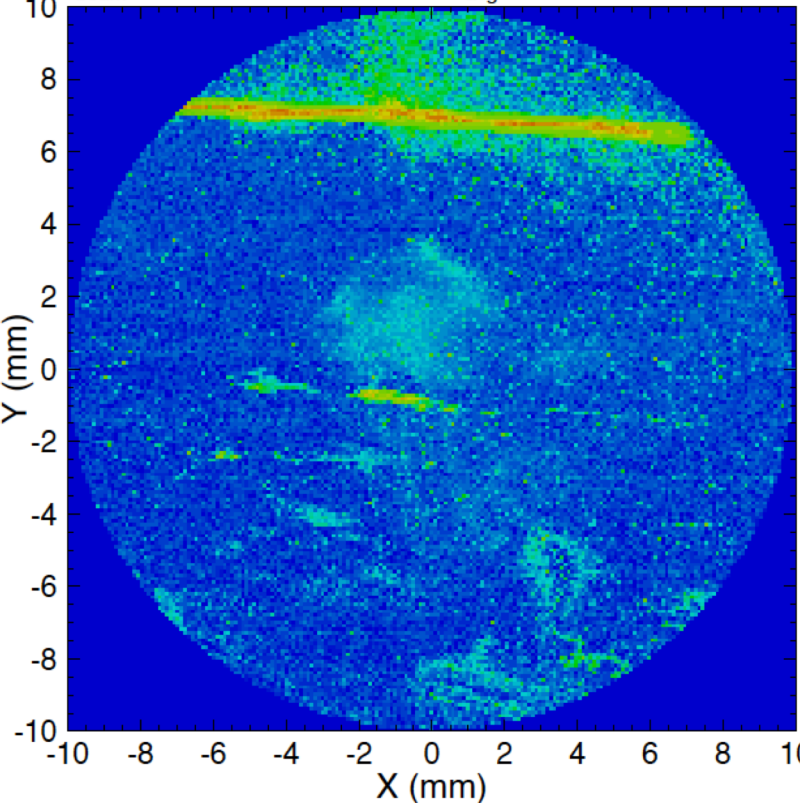
Small damage site in line 2

First contact shard shows no damage

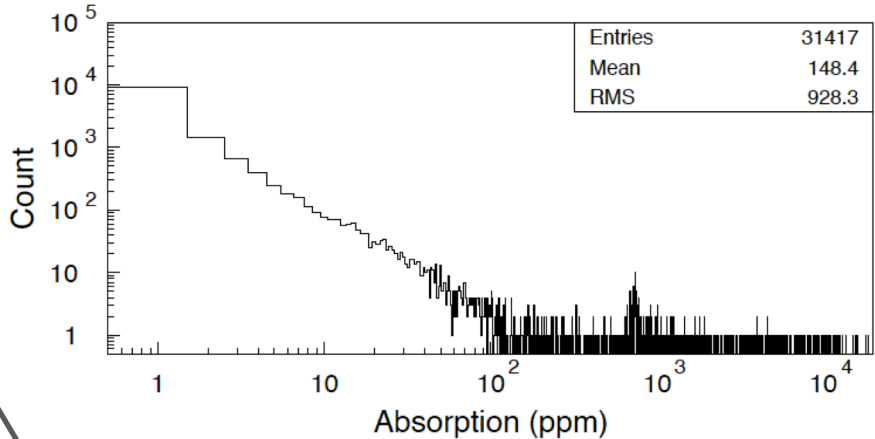


Scan at 200 W/mm²

C11068-12 1" HR Absorption (sn:0919, ↑@-Y)
($\phi_{\text{beam}} = 0.1 \text{ mm}$, Step=0.1 mm, $I_{\text{avg}} = 200 \text{ W/mm}^2$)



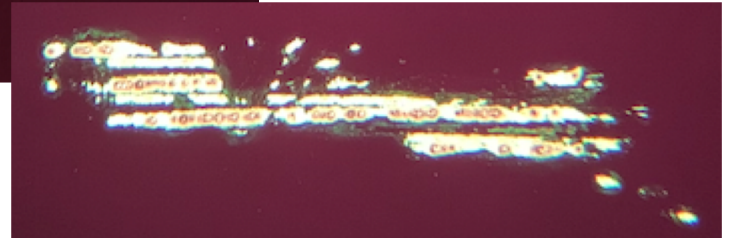
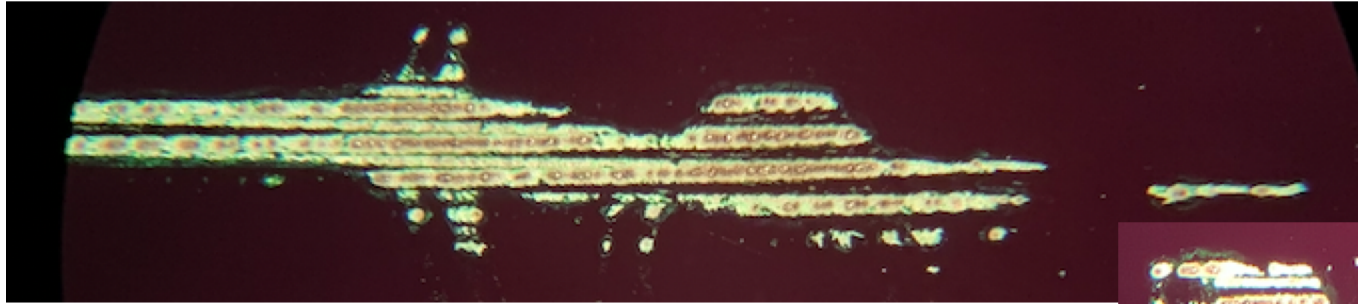
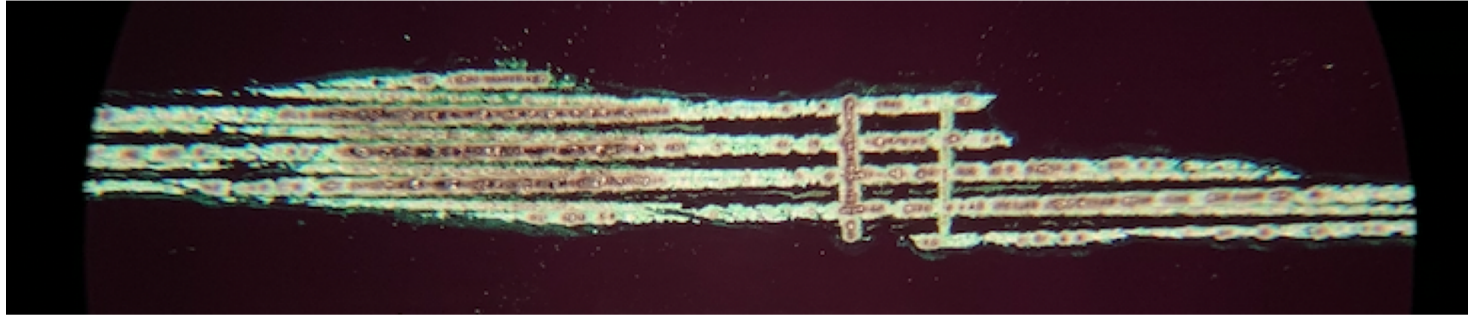
(ppm)



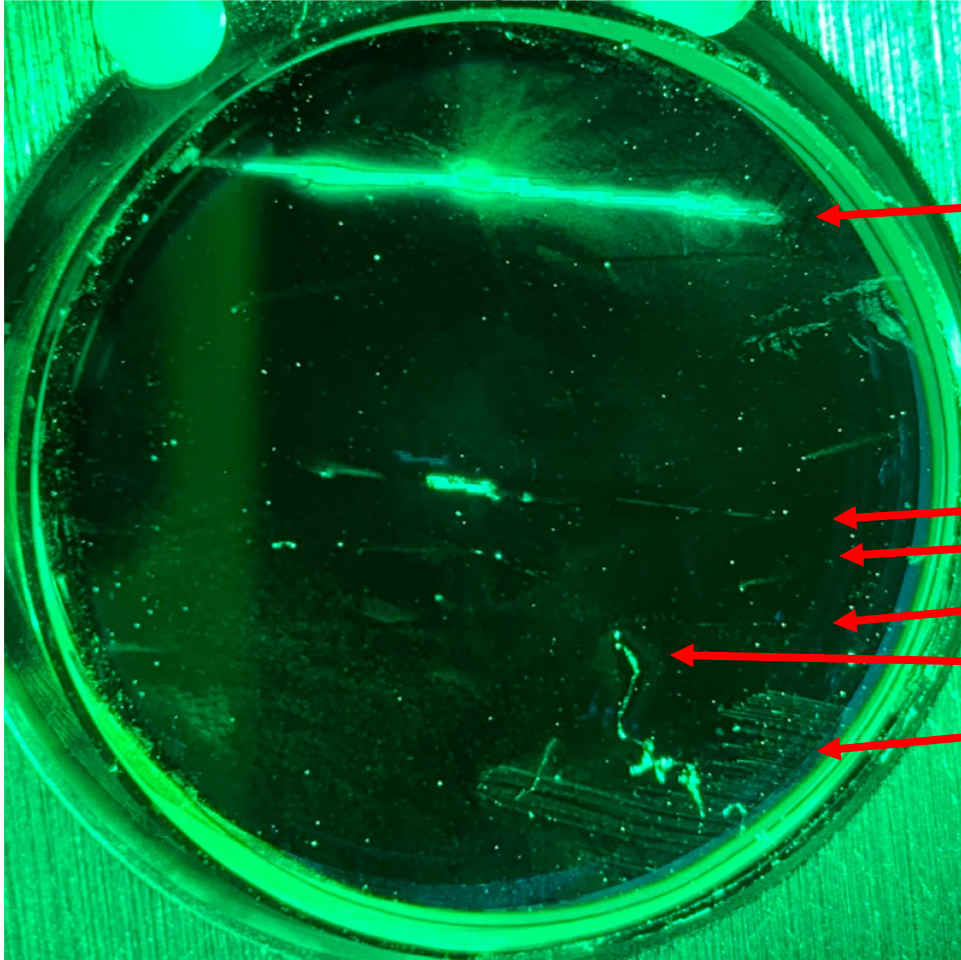
The optic is quite dirty at this point.
The four lines can be seen
The first contact can be seen

10⁻¹

Inspection after 200 W/mm² - Optic now cleaned



How it actually turned out - after all damage runs



Ink (line 4)

1 FC cleaning (line 3)

2 FC cleaning (line 2)

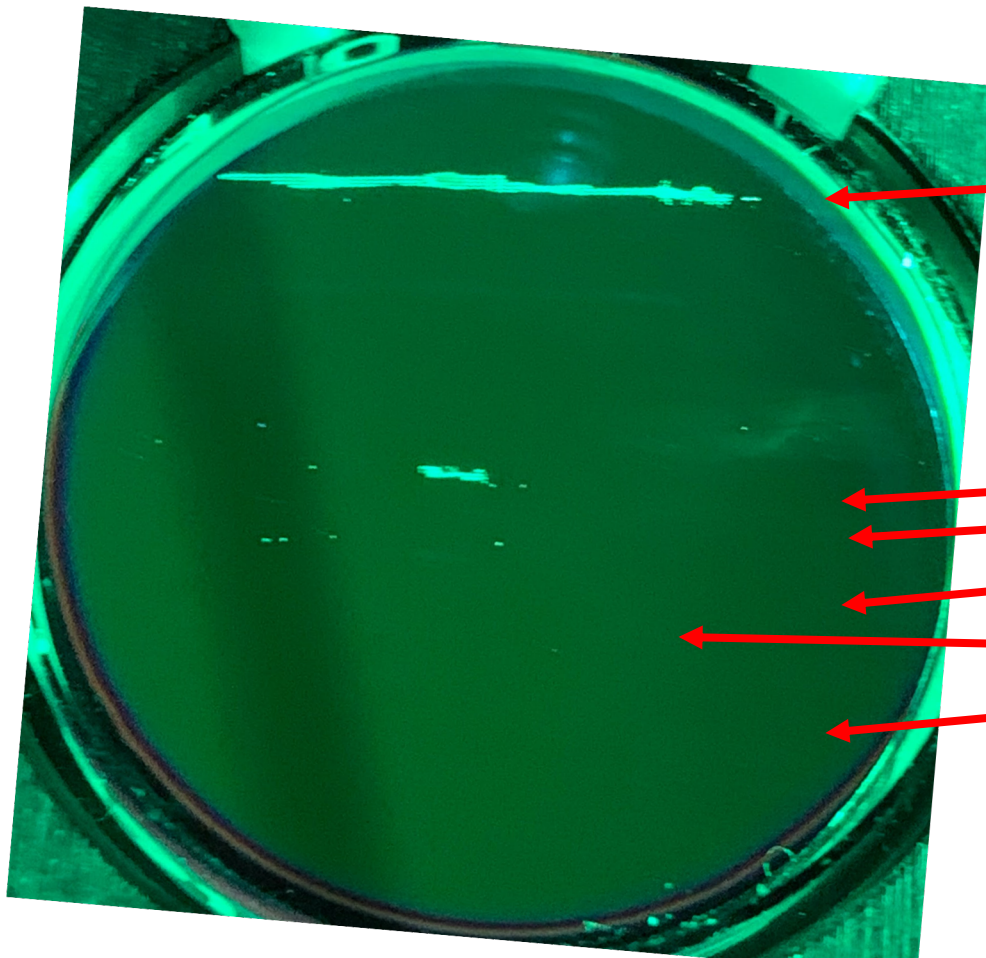
3 FC cleaning (line 1)

First Contact string

First Contact film

All lines are at least partially visible, even with the high background from the mount and the damage

After cleaning



Ink (line 4)

1 FC cleaning (line 3)

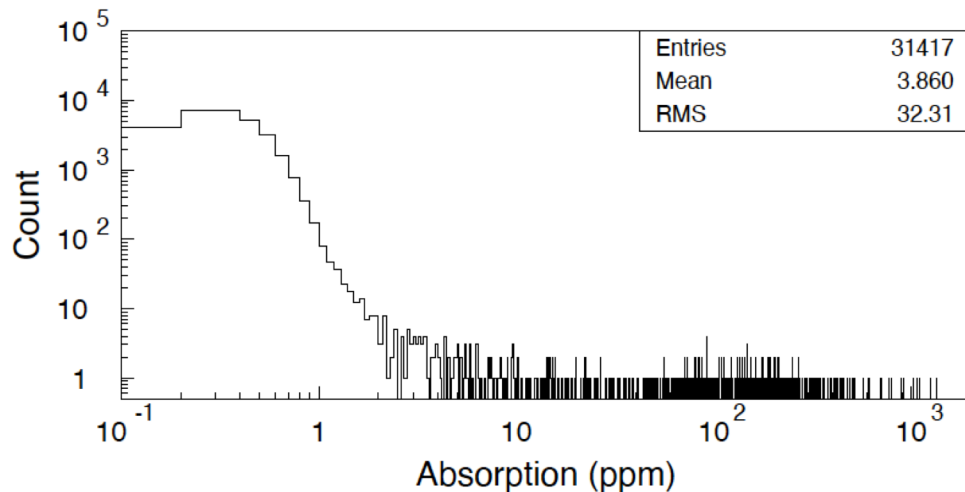
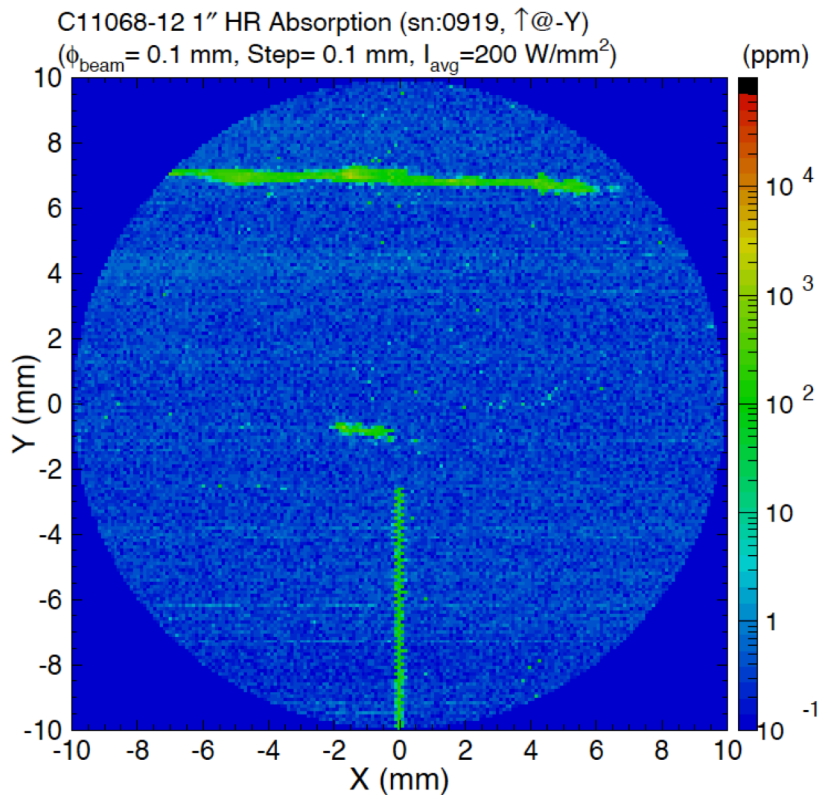
2 FC cleaning (line 2)

3 FC cleaning (line 1)

First Contact string

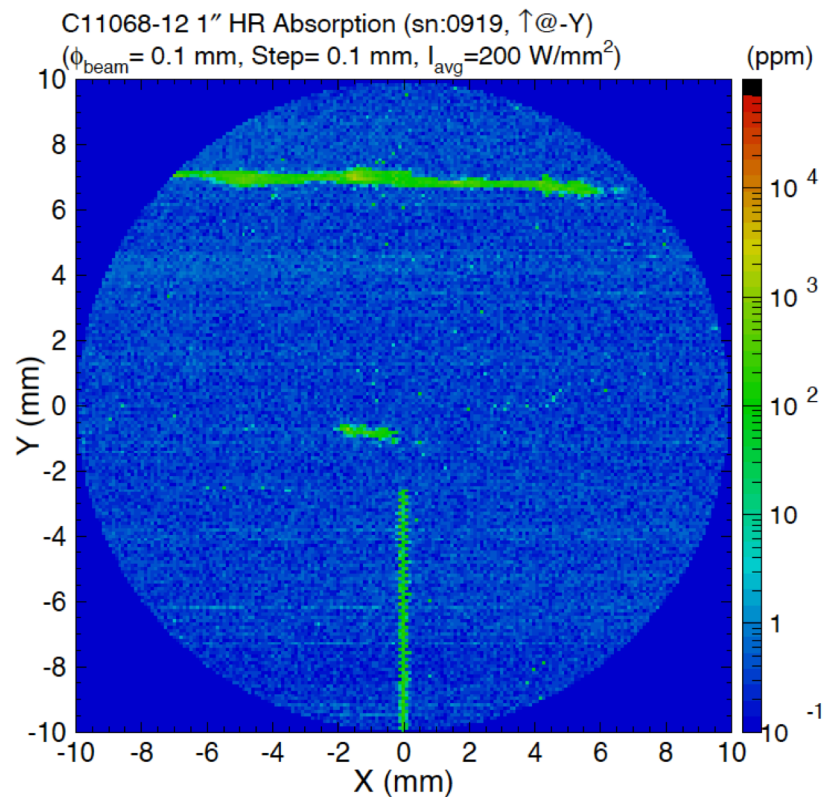
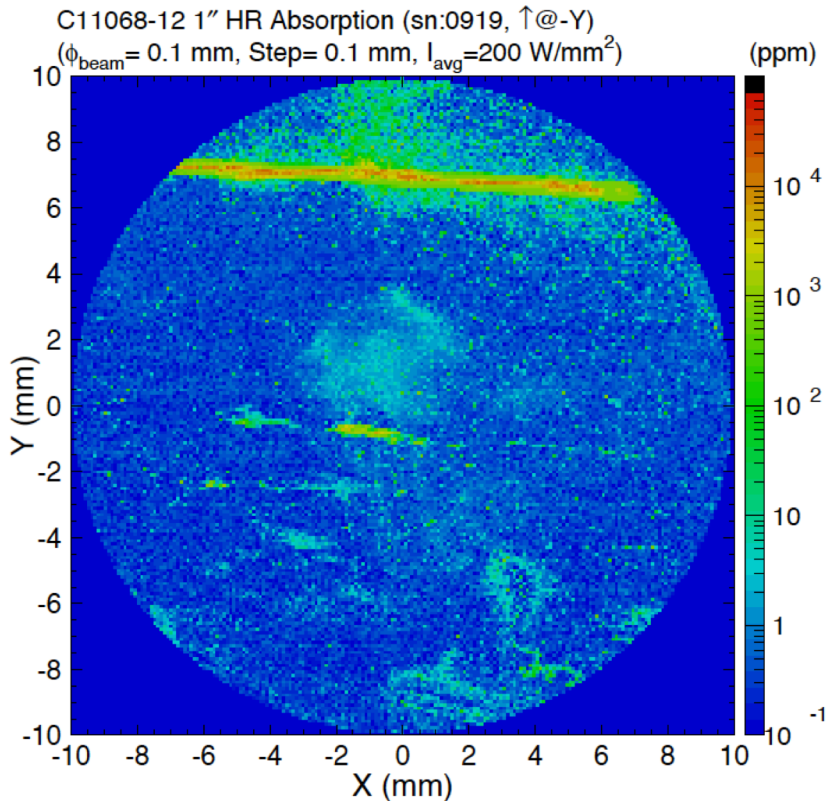
First Contact film

Absorption measurement after cleaning (and unintentional damage)

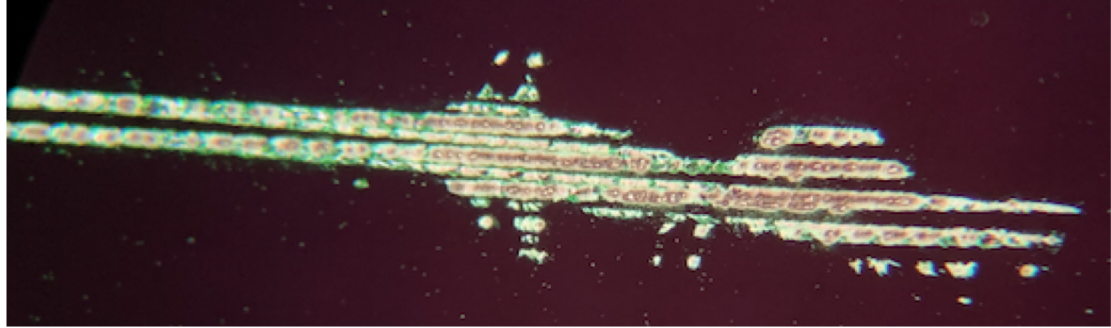


Comparing before/after cleaning

Accidental damage occurred after cleaning at (0,-y) when irradiated with 2000 w/mm^2 Not clear if there is still absorption, or if the signal comes from distortion



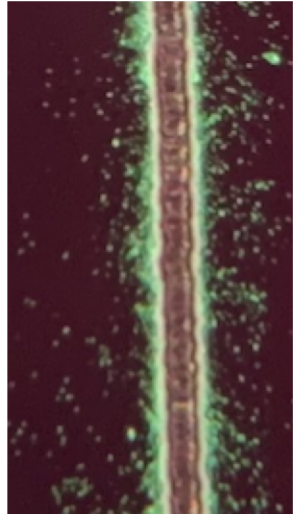
Damage filled with first contact after cleaning



Attempted Cleaning:

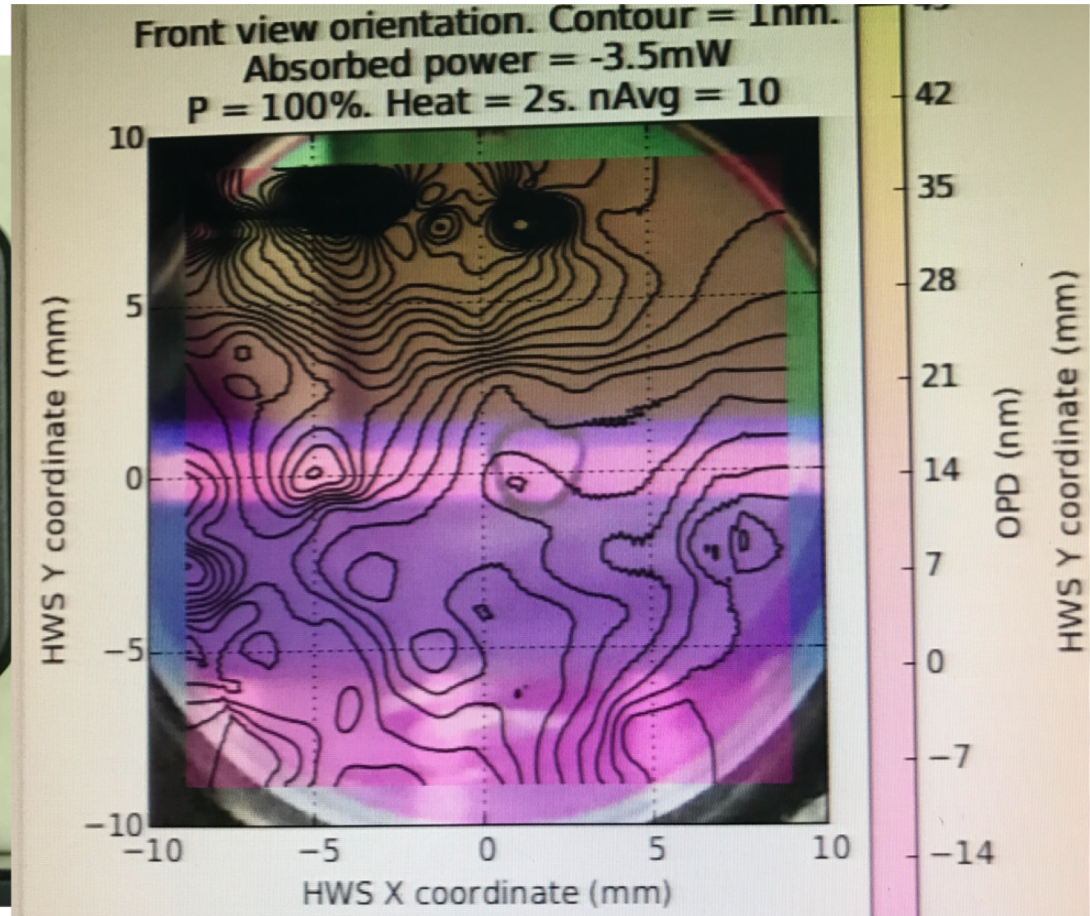
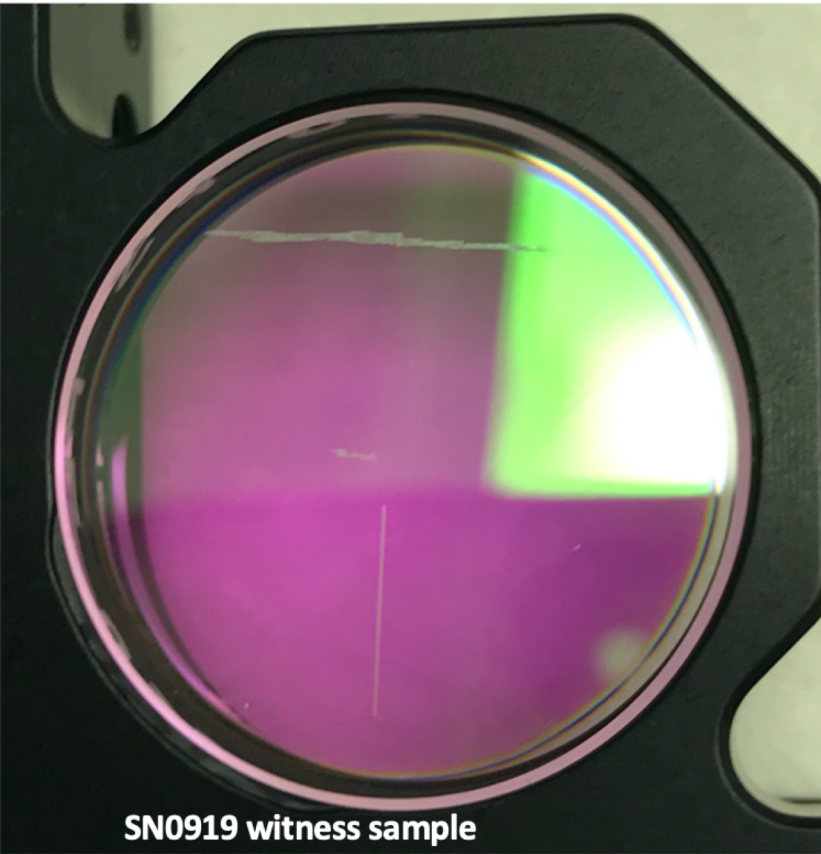
1. Acetone Soak in ultrasonic bath ~ 1 hour
 - a. No noticeable change
2. First Contact thinner in ultrasonic bath ~ 1 hour
 - a. No noticeable change

Images are at different magnifications

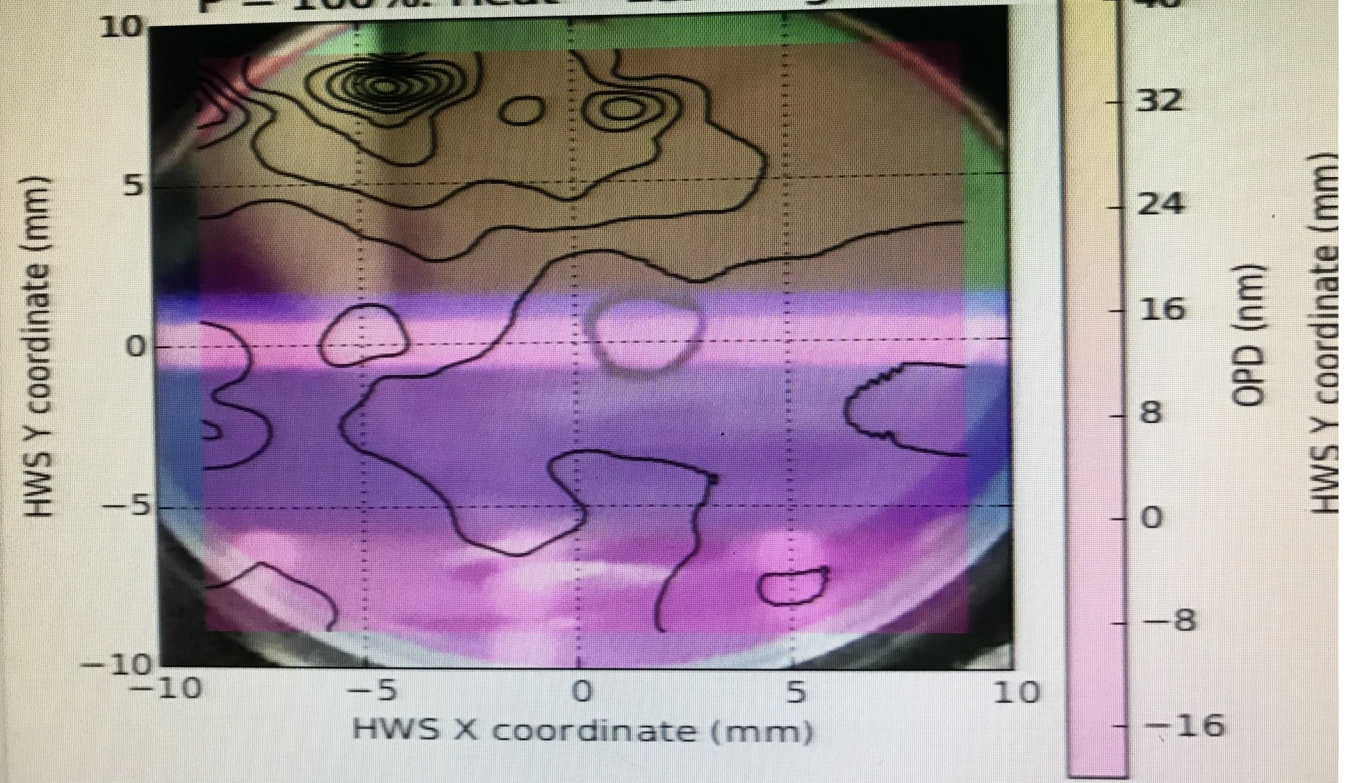


Does HWS see absorption from First Contact?

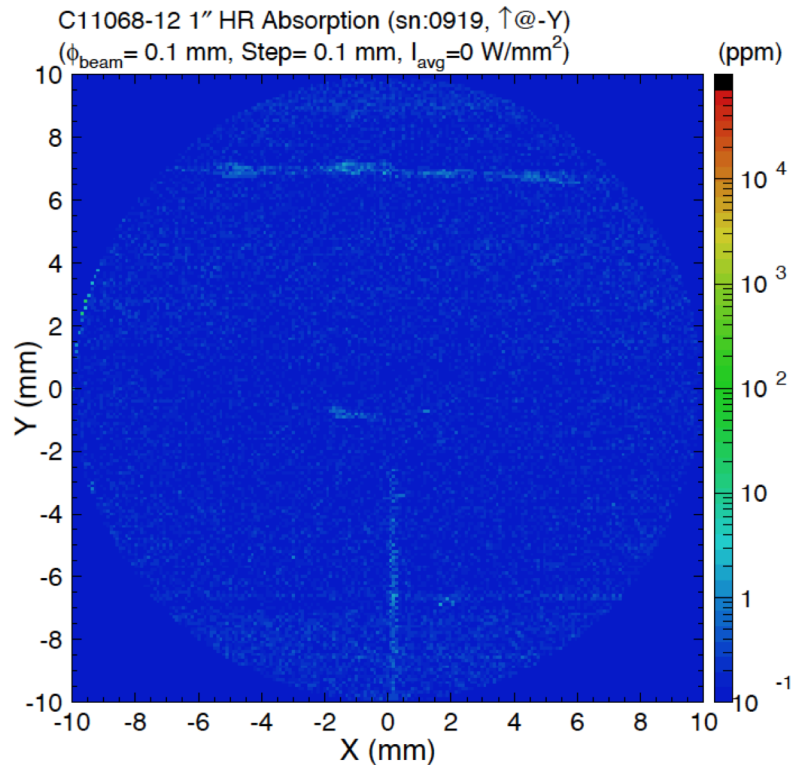
OR from embedded ink?



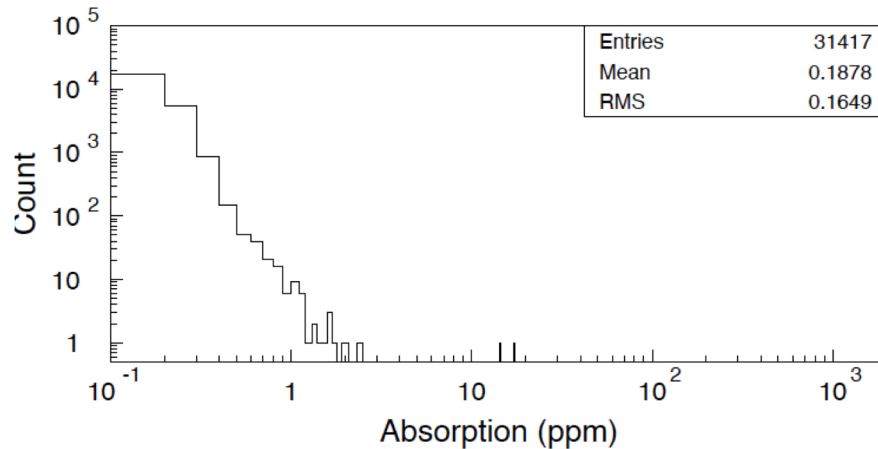
Front view orientation. Contour = 4nm.
Absorbed power = -3.0mW
P = 100%. Heat = 2s. nAvg = 10



Probe (HeNe) beam background, no pump beam

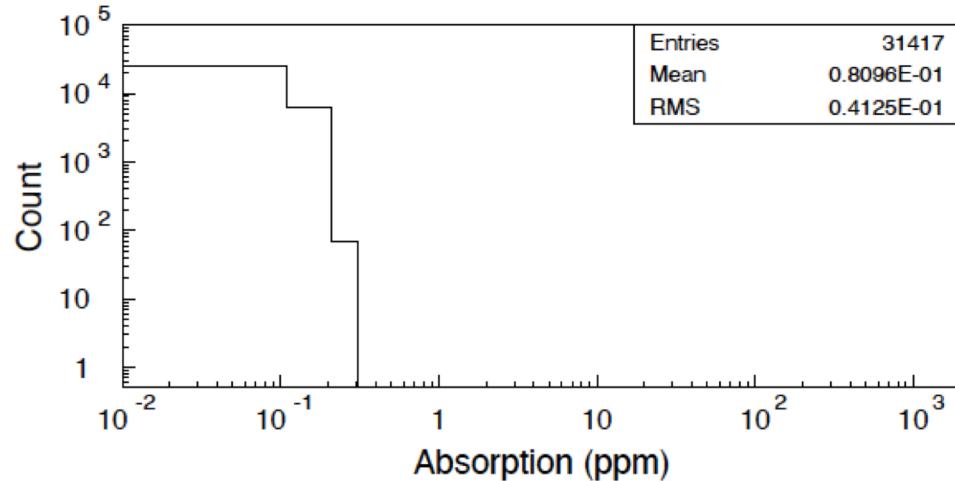
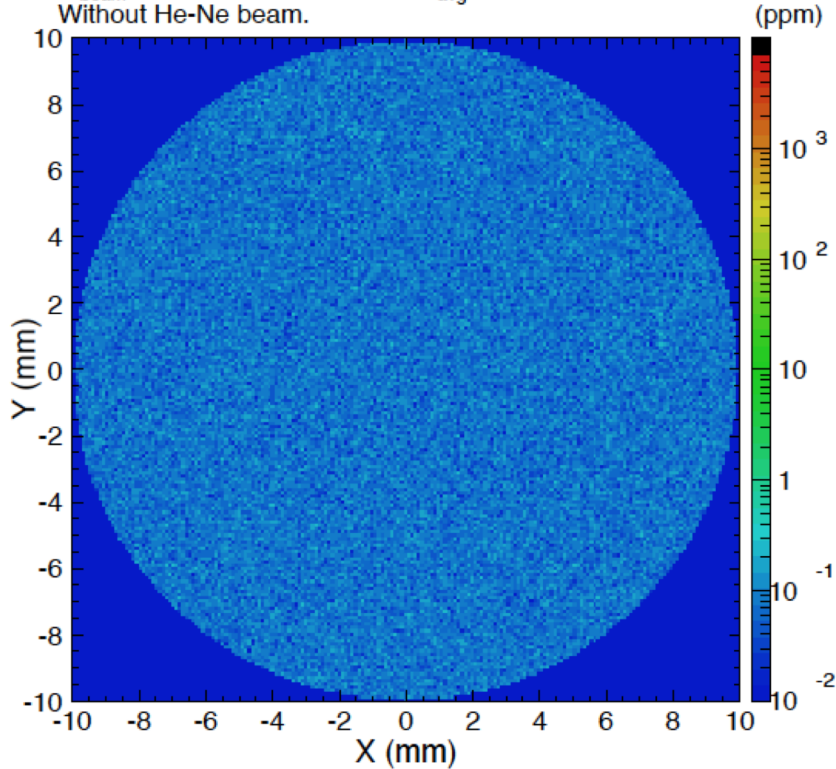


An RTS scan with the IR (pump) beam off.
A slight increase of the background at the damaged points is due to lower He-Ne transmission, making the noise equivalent absorption appear larger.



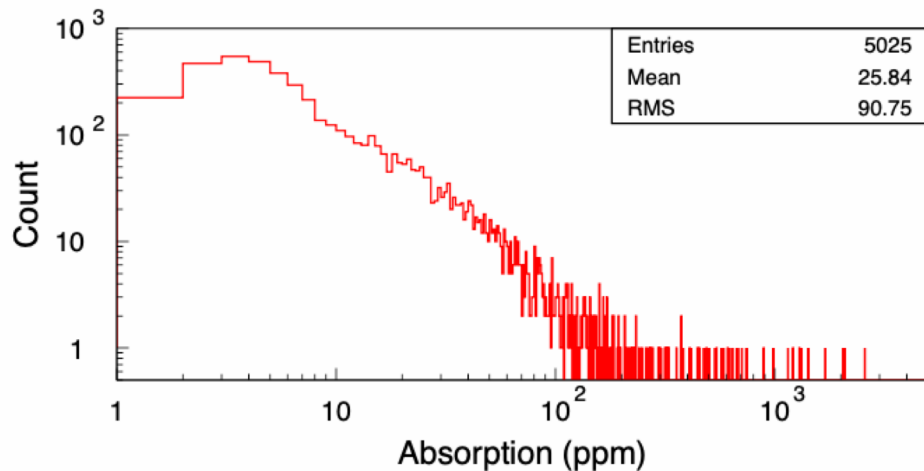
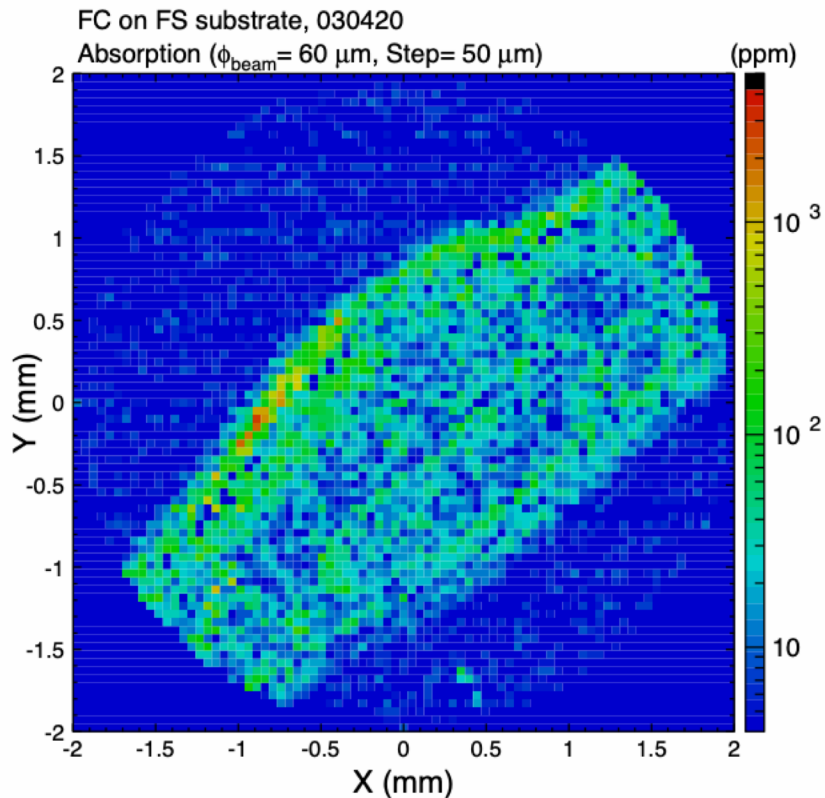
No scatter signal beyond background from Pump beam

C11068-12 1" HR Absorption (sn:0919, ↑@-Y)
($\phi_{\text{beam}} = 0.1 \text{ mm}$, Step= 0.1 mm, $I_{\text{avg}} = 200 \text{ W/mm}^2$)
Without He-Ne beam.



First Contact absorption on an uncoated optic 60W/mm²

No damage identified after FC removal



The ink that we use for optic fiducials

