**Kratos Procedures for GLAs**

From Google Doc

02/03/2019

**Venting Kratos**

Make sure filament and high voltage have been off for ~30 minutes

Ensure valve between STC and LEED chambers is shut

Make sure UPS, sputter gun, heating stages have also been off for 30 minutes (any heated components)

Open SAC-STC valve (flap valve)

Open manual line between load lock and STC

Turn CCG’s off

Press “Stop HV” on ion pump (bottom left box on rack)

Turn off STC Turbo

Close STC turbo backing valve (V3)

Turn off load lock pumping station

Open N2 vent (V5) to assist slowing of STC turbo (usually wait ~10 min after turning off STC turbo before doing this)

Wait for load lock arm to open (will open when pressure is equilibrated, be sure that clips are unclipped)

Access STC through window on top (6” copper gasket) but it is necessary to also remove flange on sputter gun (2 ¾” copper gasket)

**Putting Kratos under vacuum and baking**

Check Affinity and restart if necessary.

Restart the Kratos computer if necessary.

Remove samples that may degas from chamber.

Close valve between load lock and STC, bring load lock under vacuum normally. Line between load lock and STC should also be closed at this point.

Ensure N2 vent (V5) is closed.

Turn on the scroll pump that  backs the STC Turbo and wait 10-20 minutes.

Open turbo backing valve (V3)  to scroll pump.

When the backing pressure (pirani gauge) falls below 1E-1 Torr, start STC turbo, wait for it to spin up (30 min), and turn on CCG’s.

Before bake, all control boxes can be on EXCEPT the stage control unit - make sure this is off

Ensure that the protected mains switch is also off

Remove all parts that cannot withstand high temperatures (cables, RGAs, camera, CCG on STC, etc.) - don’t forget cable on bottom of the back side of the stage

Put blanket over main instrument chambers, leave high voltage post in back, CCG on SAC, and turbo pump on STC outside of blanket

Put heating tape around load lock, cover in foil, and open valve to suitcase loading port

Ensure flap valve is open, automatic baking sequence should open ion gauge differential pumping valve (V2)

Leave SAC CCG on to start bake (otherwise will get SW\_VAC in wrong state error)

Apply thermal tape to load lock arm and stage manipulator, cover in foil, use variac to heat (stage manipulator to 90 deg, and UPS differential pumping to load lock line to 125 deg, use thermocouples to measure temp)

Press “Start HV” on ion pump (bottom left box on rack)

Using EELS bake rack, turn on Mains, set time to desired hours on back panel, press start, monitor temp

On Kratos Bake, set time to match EELS bake time. Allow several hours to cool to around 60 deg  before degassing filaments

VCU Engineer’s tool: Parameters: if necessary, can change limit of flow rate drops higher than 10 (try 10,000?)

Messages window: VME slave messages: type 220 to see flow rate status (note: magnet controller and protected mains must be ON)

**Baking UPS lines**

Perform the following steps after bringing the STC turbo up and before starting the bake to degas the UPS helium lines

Ensure gas bottle is connected and connections are tight

Open fine pumping valve V12 (LL to He lamp valve to the right side of load lock looking toward EELS)

Close turbo backing valve V3

With valves V6 (leak valve), V11 (swagelock valve near He cylinder), V12, and V13 (UPS-to-scroll differential pumping valve whose base needs to be held while turning) closed, manually open the UPS roughing valve V9 (He-to-scroll valve, next to scroll pump) to rough pump the gas lines

Wait 5-10 minutes (we do not have a pirani gauge between the scroll and the He cylinder)

Open V7 (Swagelock valve underneath V13, not marked with red tape), then wait 5 minutes.

Close V9

From the Vision manager, re-open turbo backing valve V3

Open gas line fine pumping valve V8 (Swagelock valve with red tape) and allow the gas line to fine pump for about 20 minutes or until the STC/lock pressure is seen to be better than 10E-7 torr under these conditions

Open the leak valve fully

The baking can now be turned on for both the UPS system and for the whole instrument

**Degassing filaments on Kratos**

After bake, let cool to temperature reading around 60 C on the annealing stage temperature controller

Take off blanket, plug everything in, don't move any of the mechanical components until completely cool

Turn on all panel boxes and protected mains

Double check that the manual line between load lock and STC is closed

If the bake included the UPS lines, be sure to close V7, V8, and the leak valve, and re-open V11 (and He cylinder if it was closed)

TSP - Make sure flap valve is open. VCU Engineer’s tool: Parameters: Set HVSACLimitoff limit to 1 E -5 and set HVSACLimiton limit to 1 E -6 in VCU engineer's tool in software. On touchscreen panel under menu, TSP config, select degas, run it at 40 A (“begin degas”), then again at 45 A, then again at 50 A. Change back pressure limits. For the second time degassing, put in some liquid nitrogen to cool it. Run it just at 50 A, making sure to change pressure limits in the software.

X-ray gun - check degas button, turn on degas, wait for automatic sequence to finish; system may need to be in full manual and x-ray gun off for degas to begin (first time 360 min for initial and final ramp times, second time degassing 20 min for initial and final ramp times)

Ion gun - for each filament under Tuning, check degas button, turn on degas, wait for automatic sequence to finish

Charge neutralizer, start at 1 A current, increase slowly over 15 min to 2 A (0.1 A increments), turn off

RGA - open the MKS RGA software, double click Easy View, click squiggle button (filament), after 10 min or so, click <1> to change it to <2> and wait for another 10 min or so, then click filament button again

Repeat degassing for all filaments a second time, this time the charge neutralizer can just be left at 2 A

**Realigning Kratos camera after bake**

Wait for the system to cool

Aperture and iris - open tabs in control manual, click initialize, then confirm, then calibrate, then confirm and wait.

For stage, (don't have sample on stage) click calibrate and then confirm, wait.

NOTE: After a vent and bake, when turning X-ray gun on, bring voltage up slowly, starting at 6 kV and increasing in 1 kV increments until 15 kV reached

Align camera - pump in puck with gold patterns on it, find the coarse gold grid, zoom in with camera

Focus on Au 4f like normal

In XPS imaging - lens: Field of view 1, aperture: low res imaging, set energy to 84 eV, Al (mono) source, click "on"

If the resolution is not good enough after tweaking the z-axis, try medium or high res imaging.

When a line appears, move to the fine Au grid, or go to the alphabet grid and find the capital delta in the center

Determine what letter is in the circle on the alphabet grid, align the camera with the letter, and turn off imaging

### How to fix random Kratos problems

If the STC SAC pressures are not updating on the computer or VCU, and the flap valve is not opening…

Try restarting the VCU:  unscrew panel on back of tower

Turn off  turbo pump in STC

Ensure the turbo backing valve is closed [V3]

Turn off Ion pump

Ensure all other valves are closed

On VCU unit behind panel, flip power switch.

Note: when VCU is powered off, the turbo pump will turn off, so must make sure STC is isolated.

The VME/Slave messages window with message level 220 will only display meaningful information if the magnet control box (top right on tower) and protected mains are both on.

Water flow problems can sometimes be corrected by running a wire through the aperture in the manifold on the side of the instrument (top left hose). If this doesn’t work, try switching the inlet and outlet water at the manifold for 2 h with the X-ray running (turn the gun on and off several times). If this still doesn’t help, replace the flow meter on the circuit in question. If this also doesn’t help, yell at Kratos.

**Baking problems - water flow errors**

If the system baking is frequently disrupted by “cooling water flow errors,” make sure the flow rate is consistently >1 L/min. To do this, open the VME/Slave messages window and enter 220 in the code section and press “ON.” The first three numbers are water flows, and the first number is the magnet/mono crystals/turbo pumps circuit, which should probably be >1.8 L/min, but the limit is >1.0 L/min. The second number is the mono x-ray (Al/Ag) cooling flow and the third is the non-mono x-ray (Al/Mg) cooling flow; these should be 0 unless one of the guns is on.

If the flow looks good, try running a wire through the aperture and checking the flow again.
If this didn’t help, the flow meter may need to be replaced. The flow meters are the black plastic things with the orange rings on them. From left to right they are the magnet/mono crystals/turbo pumps circuit, the mono x-ray circuit, and the non-mono x-ray circuit.

The last time there were problems with baking the Kratos due to water flow problems, the solution was to replace this flow meter.

Additionally, there is a rumor that the restricting aperture can be unscrewed with an allen key and removed to be cleaned.

**STC/SAC flap valve o-ring replacement**

Use Kratos part number 01-851 only. Make sure not to roll the o-ring into place, since it will likely come out during the system bake. Stretch it to fit around the groove, and try opening/closing the valve several times before baking. If it does come out while baking, stretch it into place and try massaging it around the perimeter to relieve torque in the o-ring. Good luck!

From Dave Surman regarding the o-ring

1.       Use a clean-room wipe (rather than any solvent) to clean both the

sealing face on the SAC chamber and the groove prior to inserting the

O-ring. In addition he suggested that the O-ring itself should be wiped but

caution needs to be exercised so that the surface of the iO-ring is not left

with any kind of sticky surface.

2.       When inserting the O-ring it is often necessary to induce a small

amount of 'negative' twist before the O-ring is rolled into the grove. This

means that when the O-ring is in the groove it has zero twist and will lie

flat. We have observed that in many cases when the O-ring comes out it is

because there is a small residual twist on the O-ring as a result of it

being rolled into the groove.

3.       The most important part is to be sure that there's no residue on

the sealing face as, with time, this can cause the surface to get "sticky"

and it will slowly lift the O-ring out. Also, you need to be absolutely sure

that the surface of the O-ring is clean but that the cleaning wipe doesn't

induce any kind of change in the O-ring surface.

### Aligning the monochromator for the Al and Ag sources

Focus the camera on Au grid.

You should find the correct height that your sample is focused to the analyzer.  Unfocused Al mono xrays will not help so much in doing a height-to-analyzer focus.  Use the dual anode [will be Mg if tilted so that top half of window hits puck] to focus to the analyzer.

Insert the Dual Anode ~ 1cm from puck.  should see shadow in tv. Top half of window above the puck.

Image the Au grid and locate center.  Sputter clean if image not clear. [recommend hi res imaging with 27sec integration time field of view 1 for large image, field of view2 for magnified image]

Move z up and down for focus.  Locate letter in grid and shift camera to center.

\*note, Au grid should have desired focus height, or must focus to other sample of correct z height.

Change to mono source, preparing to tune monocrhometer knobs

Scan BE to see CBE of metal standard peak with dual.

Run Ag 3d spectrum mode 368eV, 500ms dwell, passE 5

Center snapshot at 368.2eV [or whatever the center the dual was at].  If peak is off center, tweak monochrometerin snapshot mode [passE 40] to maximize counts [gets top of peak in center]

If this doesn’t center, then go to the gun and tweak bottom left hex with wrench. then go back to mono knobs.

bottom knob tilts xtal one way, side knob tilts other way.  vertical knob focuses in and out. top left locks everything.

Once max counts, scan repetitively to see CBE on, FWHM to spec.  If CBE off, can also change analyzer work function.

Can also do analyzer and plateu function to get higher counts.

Focusing--

use dual source and alphabet grid

take images at varying z heights to optimize depth of field= z height for the dual anode source.

now we can optimize all the other things with focusing optics to this height.

Tuning the monochrometer and mono anode source

start with bottom omno micrometer knob and look at peak at best dual z height.

o1s peak on the stub works fine.

do snapshot mode and watch peak increase [you should set the snapshot window to a fixed intensity, and see peak grow, then reset intensity axis if necessary.]

now use wrench and tilt mono gun. see if increase.  get it to increase.

Do the same working with all of the micrometer knobs on the monochrometer.

getting detector plateau

note starting analyser voltage

start at 2600V,  take an O1s scan ~7eV wide, 0.1eV step.

determine intensity/counts of peak, and plot against voltage.

unlike channeltron, channel plates [which are made of many channeltrons] have gain variation across the channeltrons, and voltage may not give homogeneous intensity

we can use a flat field correction to fix this.  see procedure chris moffitt sends.

field of view 1 is ~1mmx1mm, but using teh mono, our spot is < that. ~0.5mmx1mm, so you get low intensity top bottom.

field of view4 is only diagnosis mode seeing 5mm box great for lining up ion gun spot

field of view 3 = 150x150 or 200x200 um