Experimental facility for outgassing study in vacuum: status and plans

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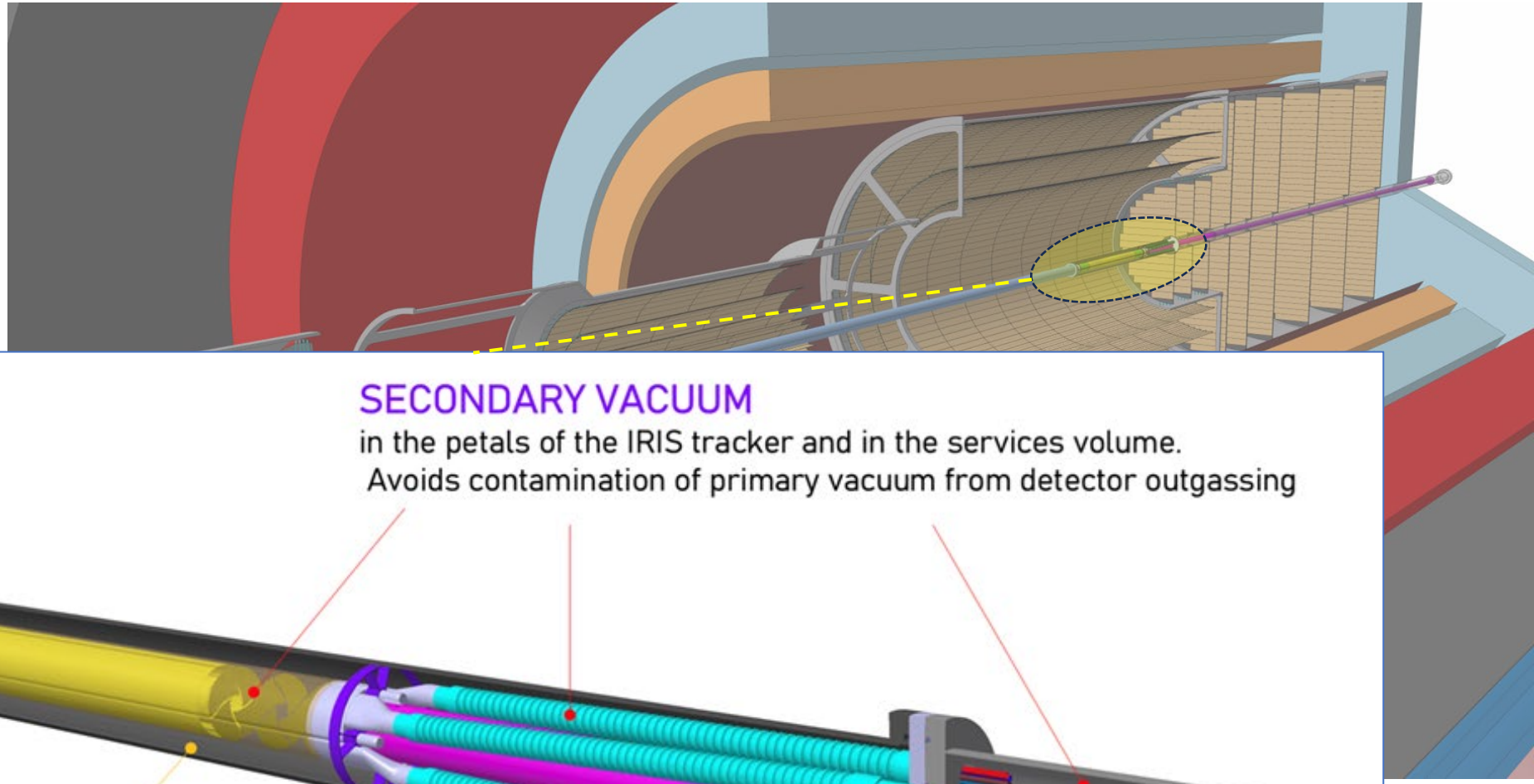
- Preliminary results
  - Present experimental setup
  - Outgassing study
  - Residual gas atmosphere study
  - Total mass loss (TML) study
- Ongoing experimental facilities for outgassing
- Future plan

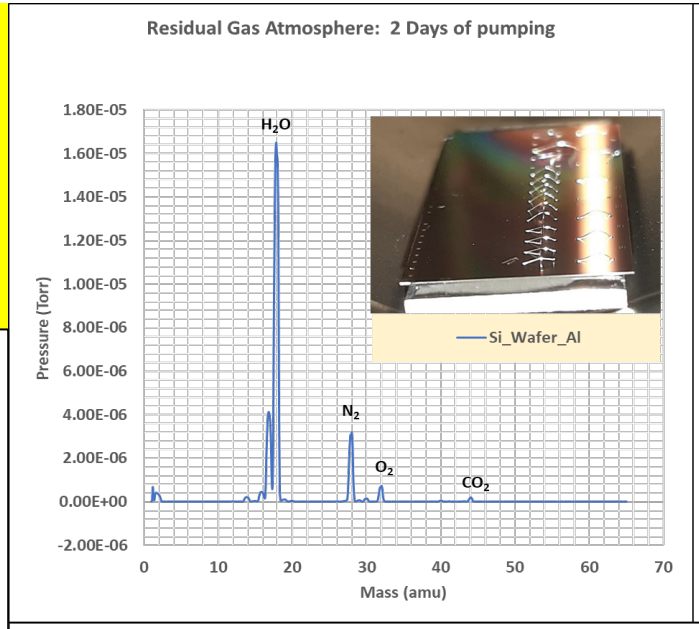
IRIS detector @ ALICE3

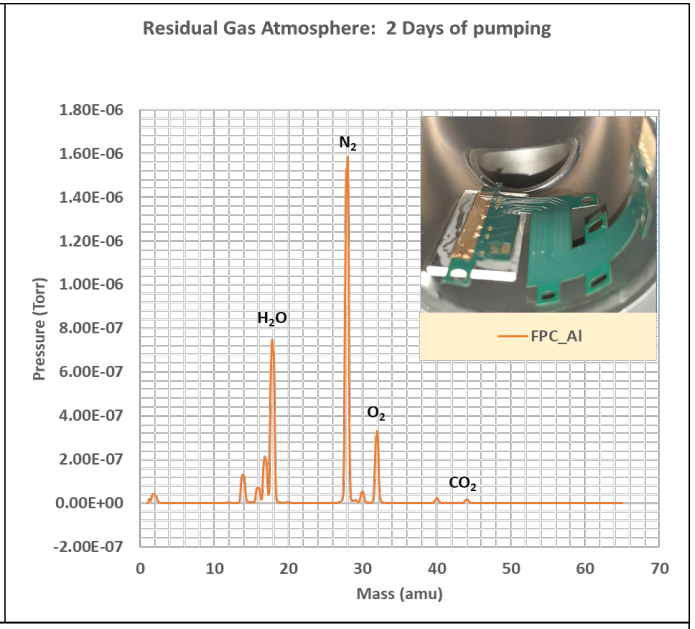


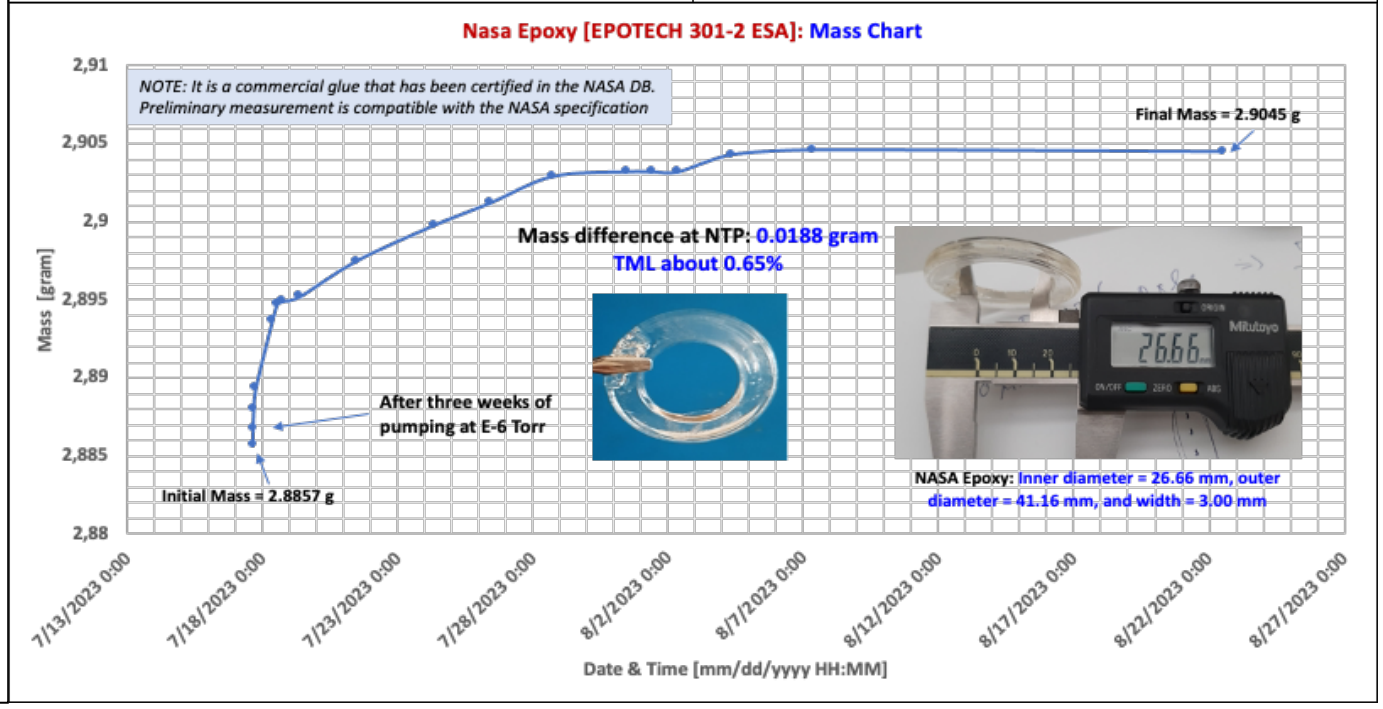
How to perform outgassing measurement?

There are three ways to perform outgassing measurement:

- Comparing the vacuum level with and without sample
- Comparing residual atmosphere of vacuum chamber with and without sample using RGA
- Comparing the weight of sample before and after pumping



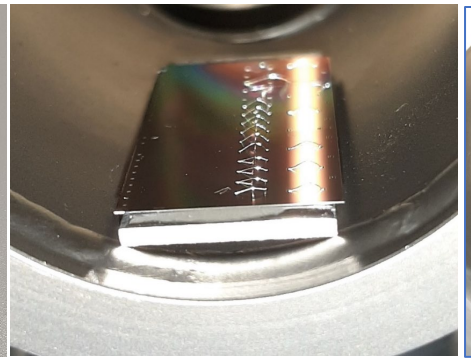


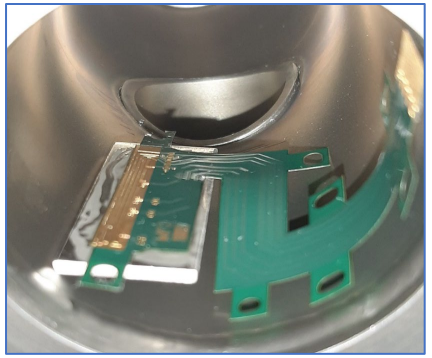


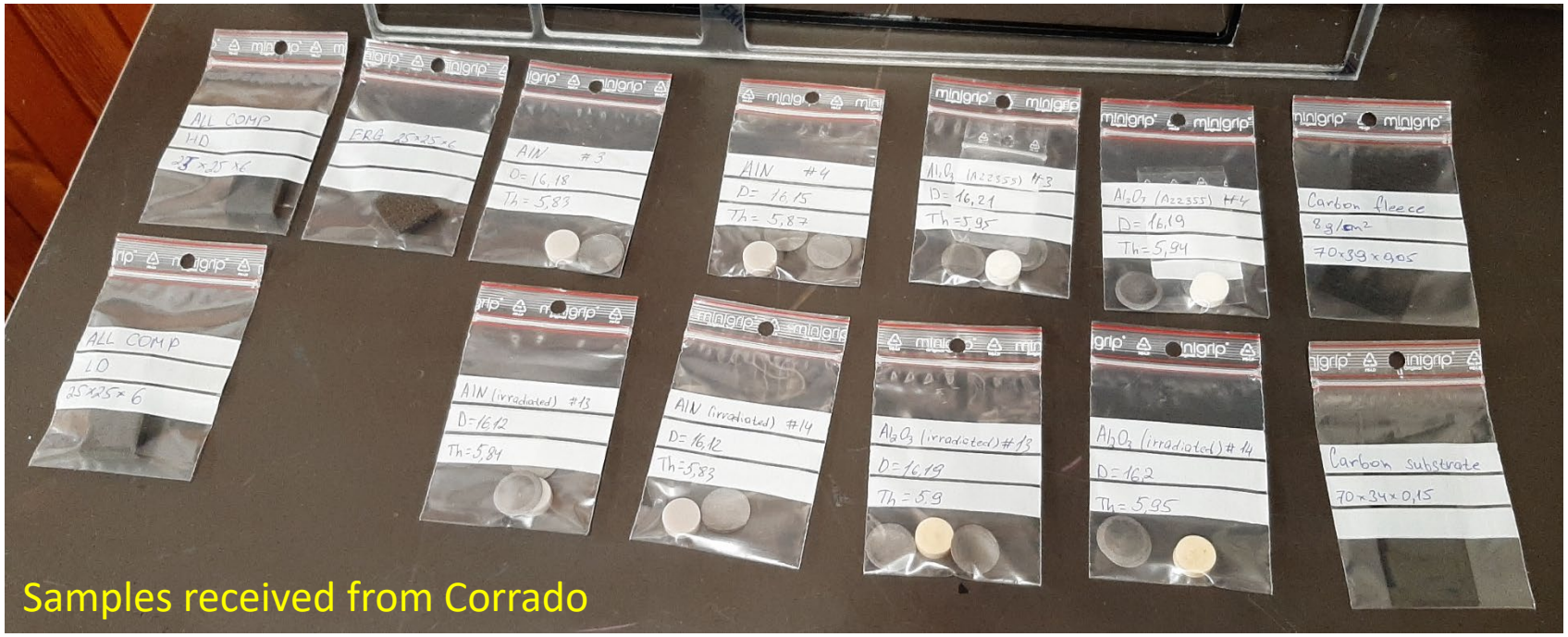
Plans: samples to test in vacuum environment

- Sample received from Corrado Gargiulo
  - 3D printed aluminium nitride (AIN) samples disks
  - Al2O3 samples disk: 3D printed alumina (Al_2O_3) samples disks
  - 3D printed AlSi samples disks
  - Carbon (LAYPUS) Substrate of the cold plate
  - Carbon Fleece of the cold plate
  - Carbon foam All comp high density
  - Carbon foam All comp low density
  - Carbon foam ERG duocel
- Sample received from Felix Reidt
  - Optical Fiber with connector
- Samples tested in Bari
  - NASA Epoxy
  - Si wafer
  - Wire bonded Si wafer
  - FPC


Sample received from Felix







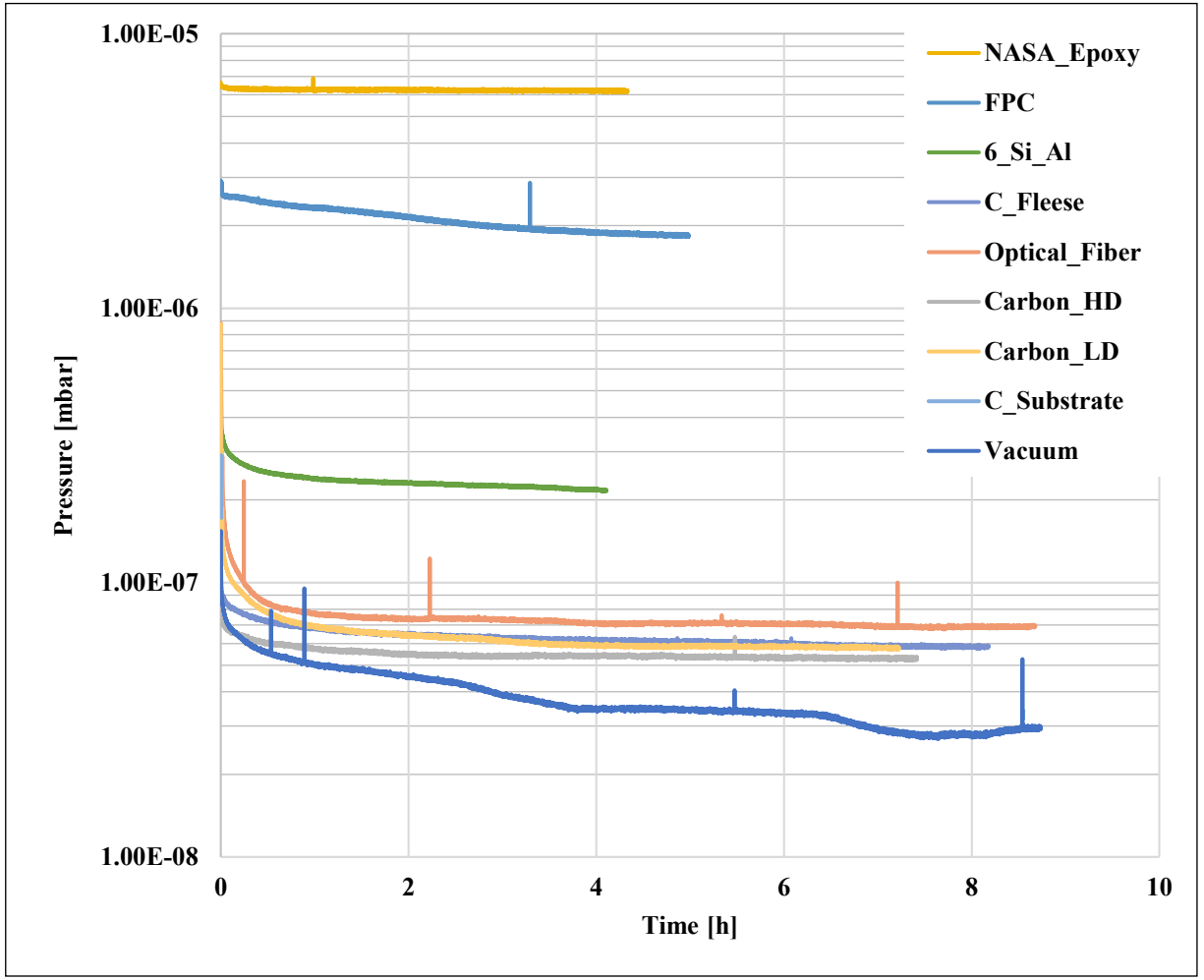
Samples received from Corrado

Preliminary
Experimental Results @10^{-6} mbar

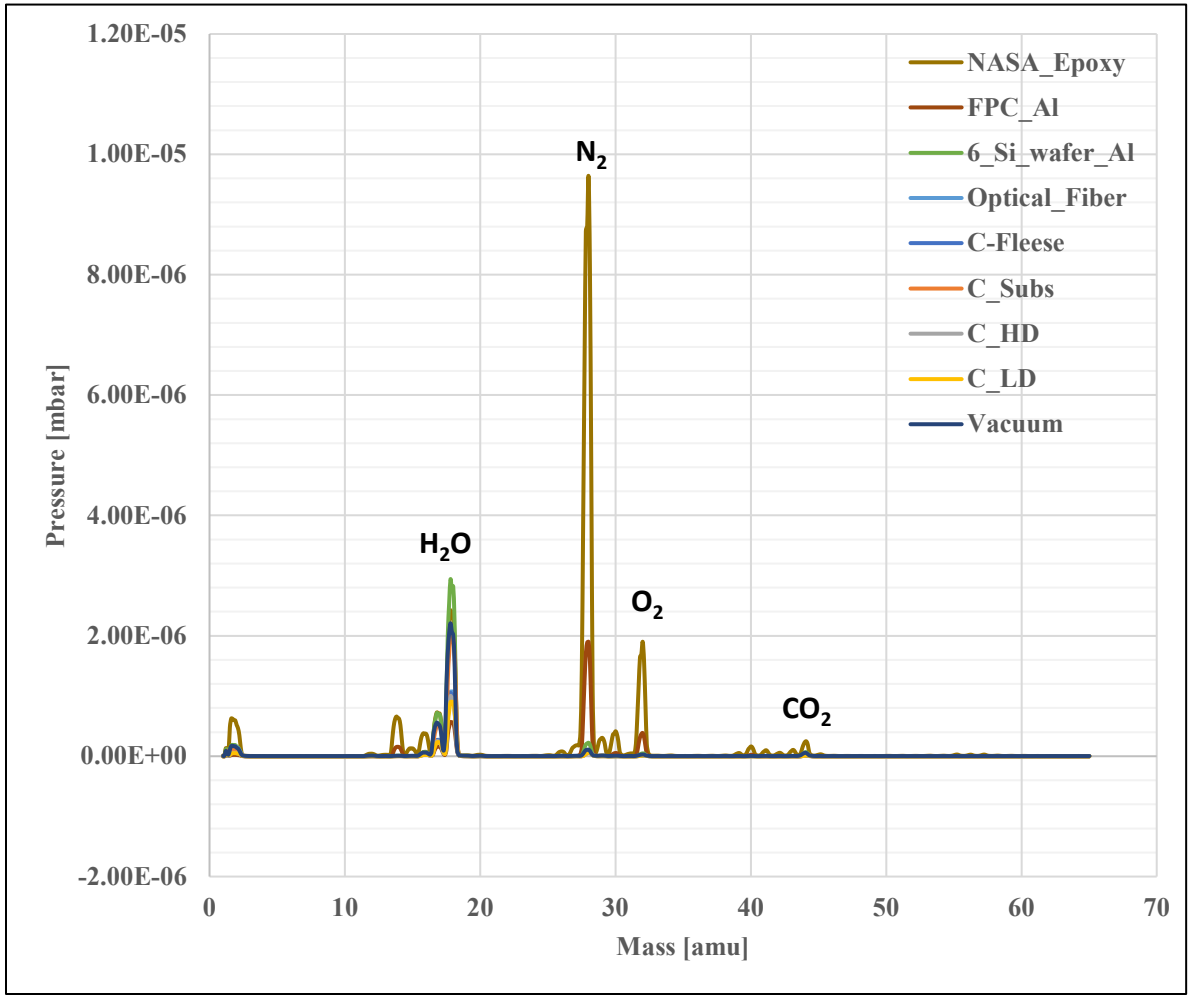
Experimental setup used for outgassing study *(~10 E-6 mbar)*

Preliminary results *(E-6 mbar pressure):* outgassing test

Outgassing under vacuum: (1E-6 mbar)

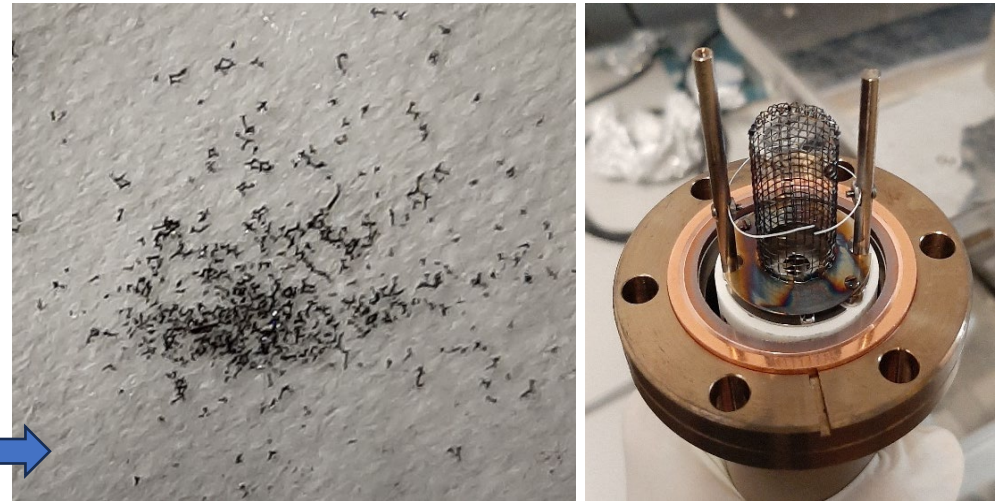


Residual gas compassions: under vacuum (1E-6 mbar)

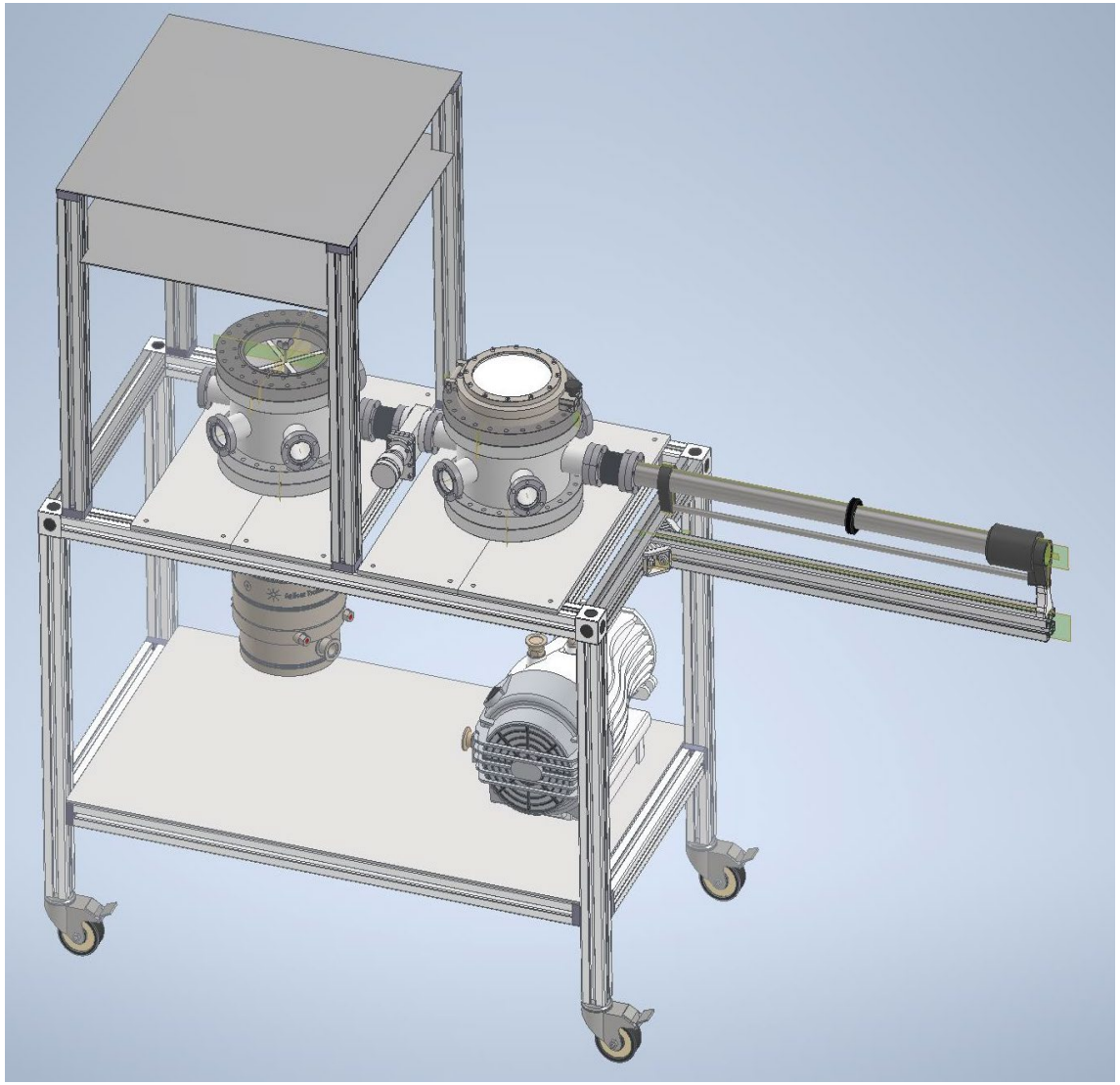


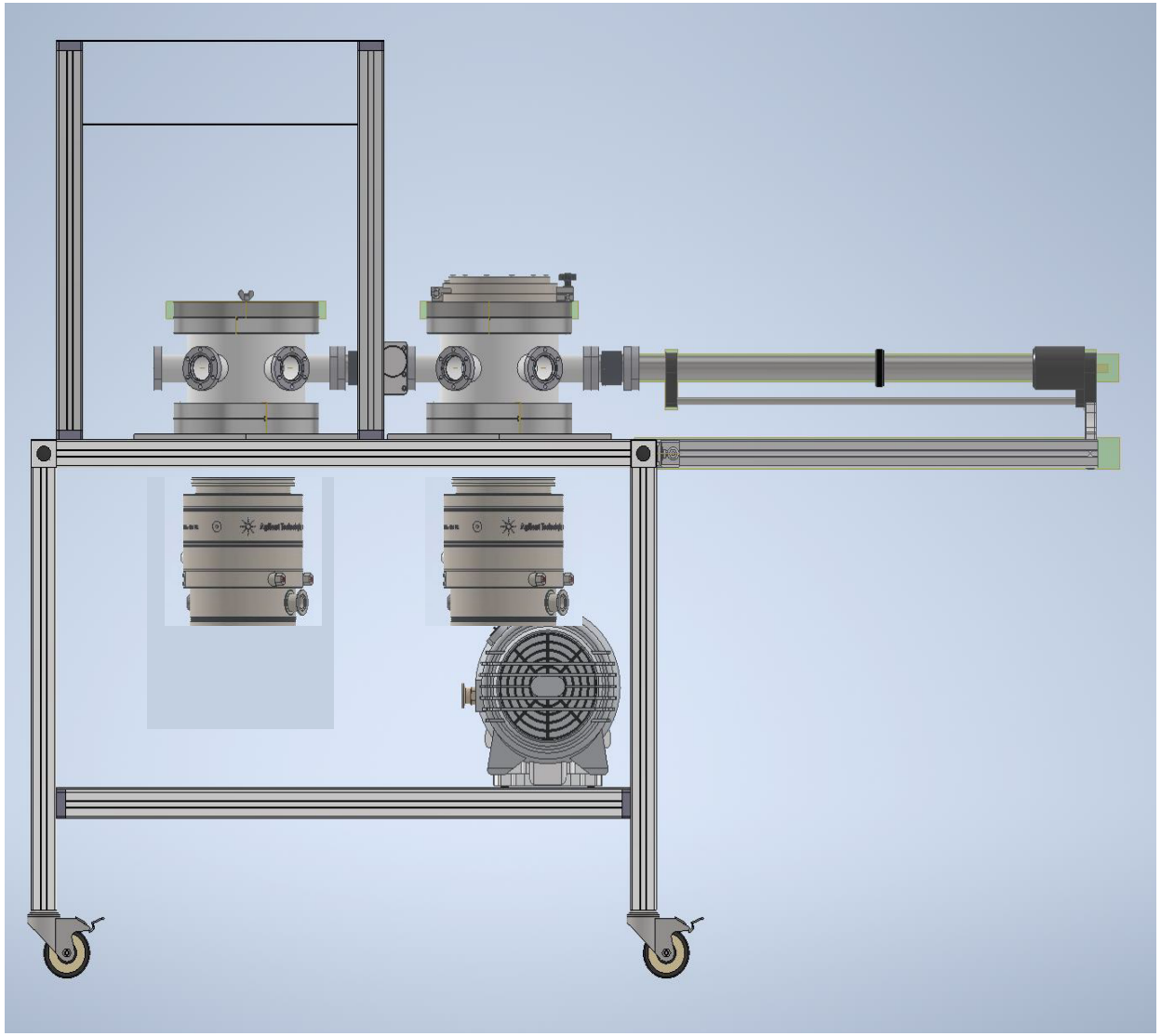
Preliminary results *(@E-6 mbar pressure)*: Total mass loss [TML]:

Samples	TML [%] (Just after vacuum treatment)	TML [%] (Regained after vacuum treatment)
NASA_Epoxy	--	0.651488
FPC_Al	--	0.051177
Si_Wafer_Al	--	0.049188
3_Si_Wafer_Al	0.009726	0.005674
C_Fleese	1.818182	0.462963
C_HD	0.469261	-0.01189
C_LD	0.728988	0.010799
C_Substrate	0.20284	0.142276
Optical_Fiber	0.318701	0.144389
C_ERG	11.84573	12.23214

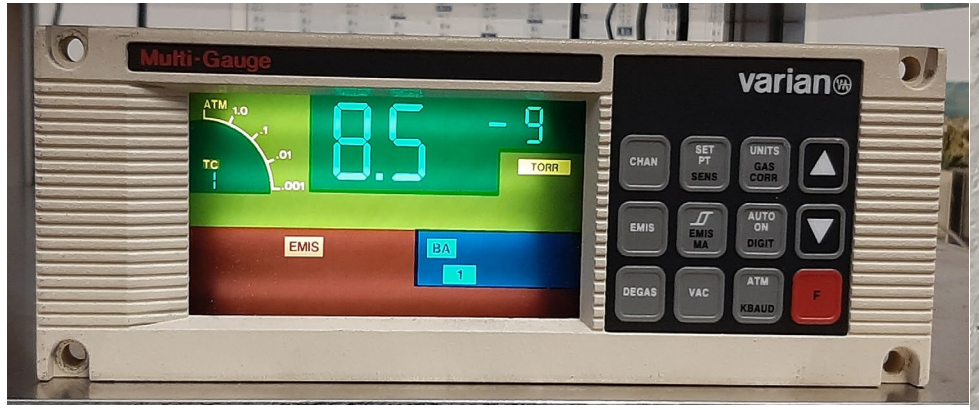


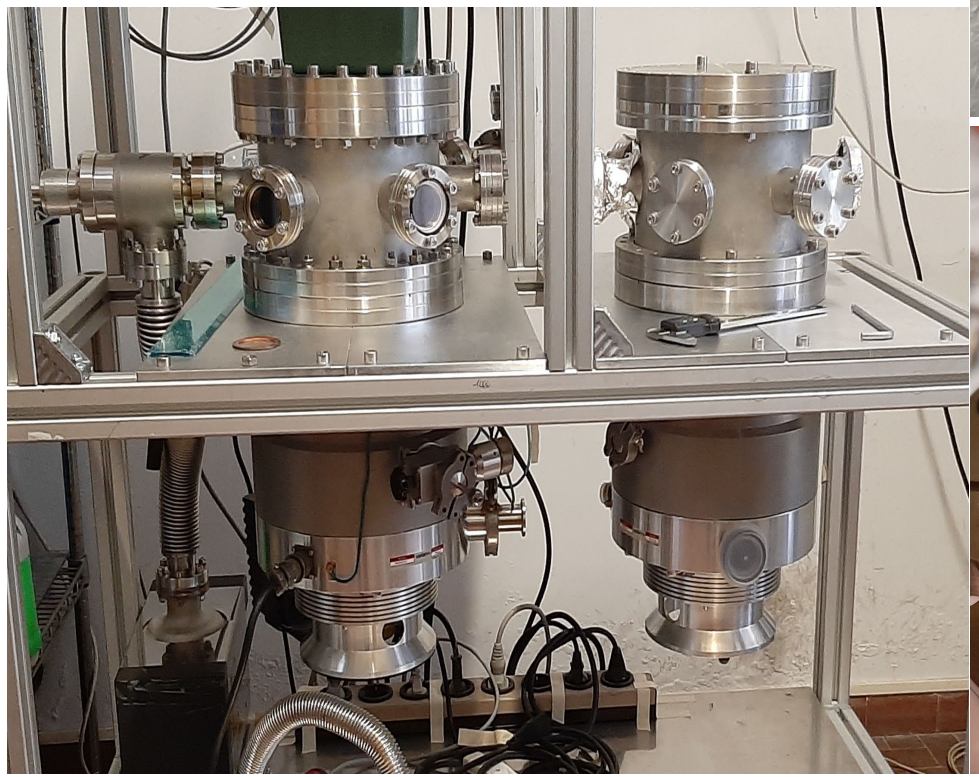
Status: ongoing experimental facilities for outgassing

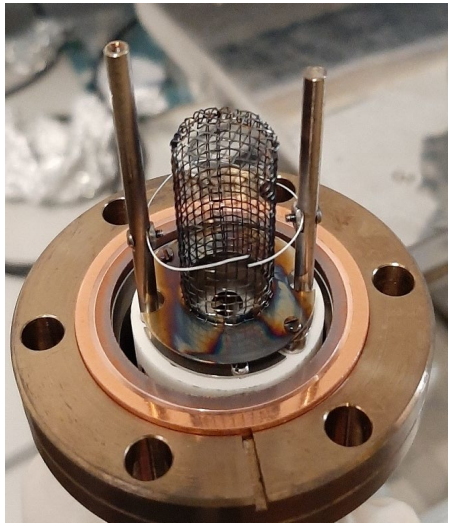


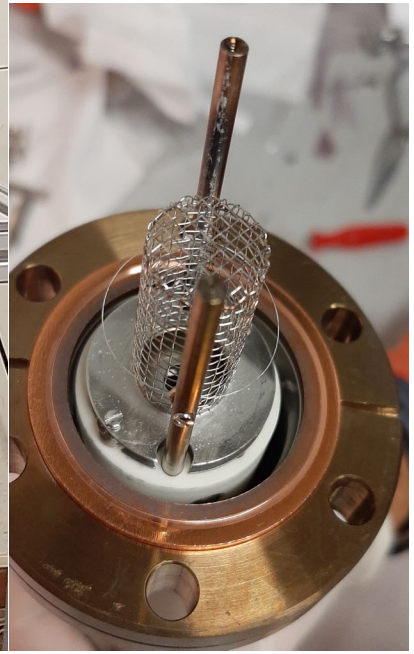


Status: future experimental facilities for outgassing









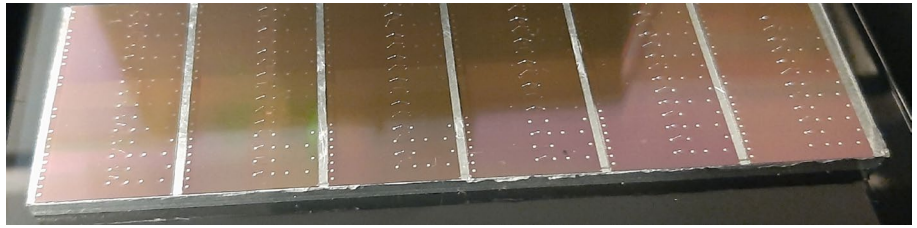
- Test vacuum chambers
  - We have two similar 8-way cross SS chambers
- Vacuum Pumps
  - Two primary vacuum pumps
  - Two TMPs
  - Three Ionic pumps
- Order of vacuum
  - Reached 8.5 e-9 Torr vacuum (without any heat treatment and Ionic pump)
  - Waiting for a CF-40 gate valve to connect both SS chambers
  - Waiting a protection sheet for another TMP
- Residual Gas Analyzer (RGA)
  - Broken filament is replaced
  - By next week, a test will be performed

Future plans

- Need to build a vacuum chamber with a vacuum of the order of ~10^{-10} Torr
  - All gaskets and gate valve must be metallic
  - Heating tape and heating lamp are essential
  - Proper cleaning with ultrasonic bath in distilled water followed by alcohol
  - All types of vacuum pumps (primary, TMP & ION) are available
- Measurements to perform
  - Outgassing study
  - Residual gas atmosphere study
  - Total mass loss (TML) study
  - Wire bonding strength study
  - Gluing strength
- Samples to be test
  - Varieties of samples received from Corrado
  - Glue for IRIS detector
  - Wire bonded Si chips
  - FPC
  - Optical fiber cable

Thank you

List of components : preliminary studied



Samples:

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- Carbon Fleece of the cold plate
- Carbon foam All comp high density
- Carbon foam All comp low density
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- Optical Fiber with connector
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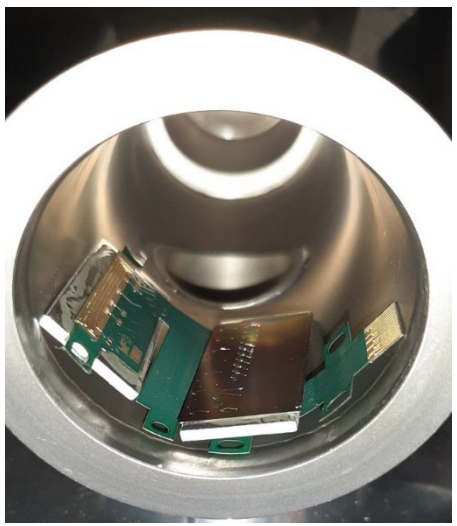
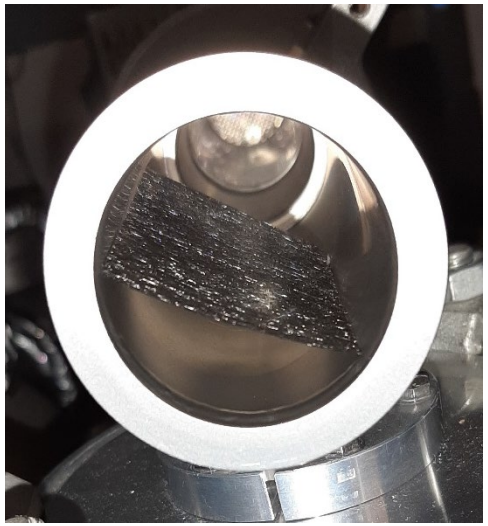
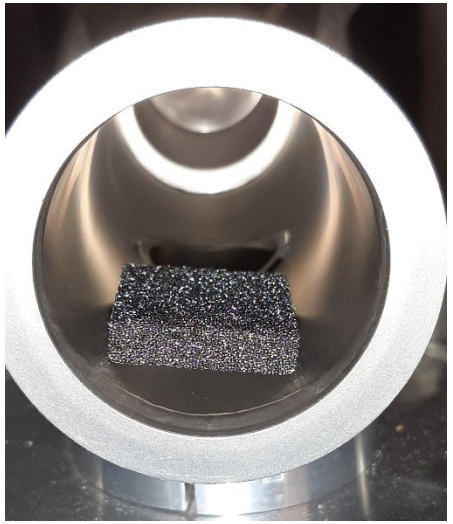
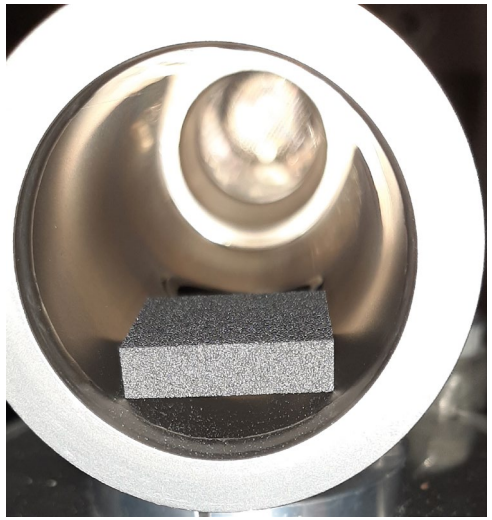
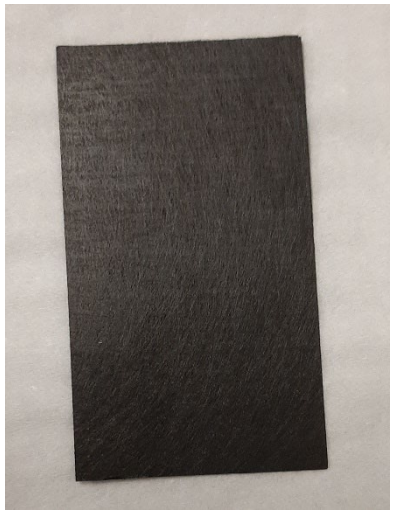
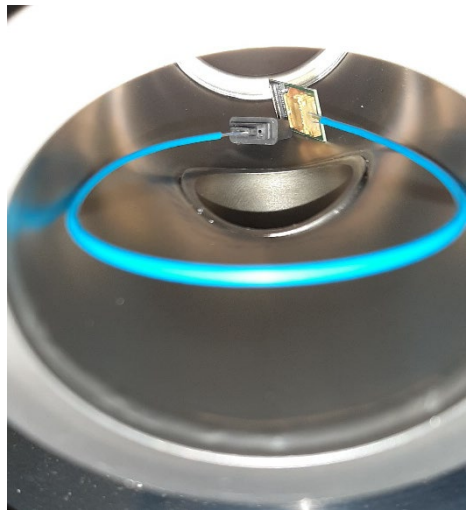


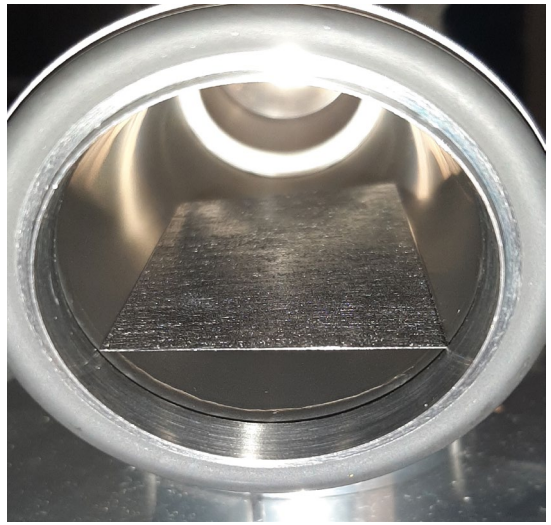












Experimental setup: *vacuum SS chambers with associated equipment to reach 10^{-10} mbar pressure*

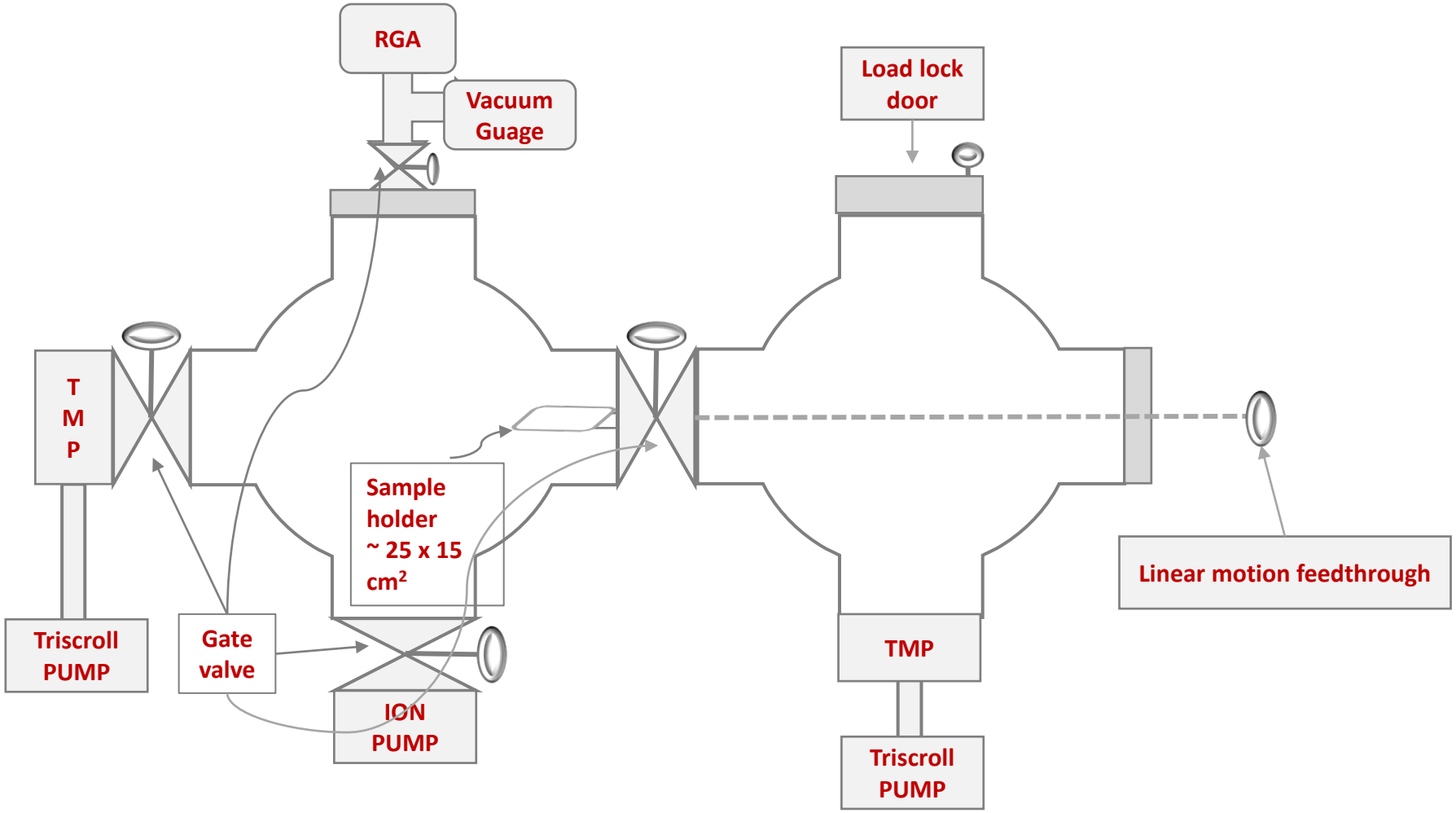


Fig: Schematic diagram of a four-way cross ~20 cm diameter SS spherical chamber are available with all type of pump and RGA

Experimental setup: *vacuum SS chambers with associated equipment to reach 10^{-10} Torr pressure*

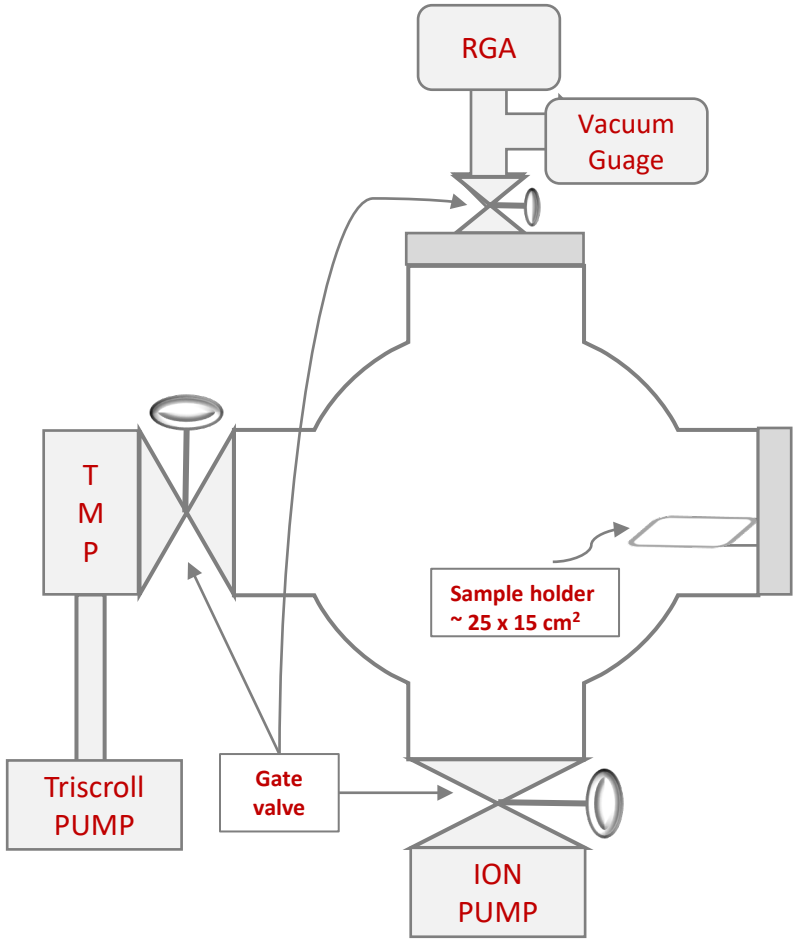


Fig: Schematic diagram of a four-way cross ~20 cm diameter SS spherical chamber are available with all type of pump and RGA

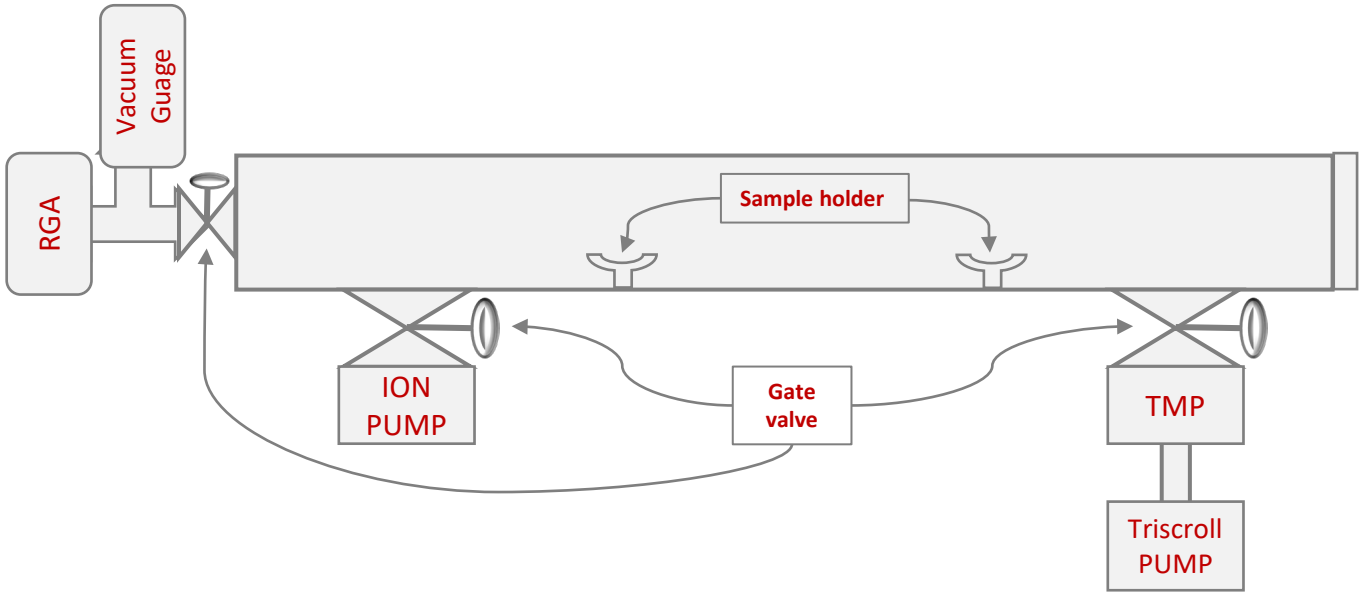
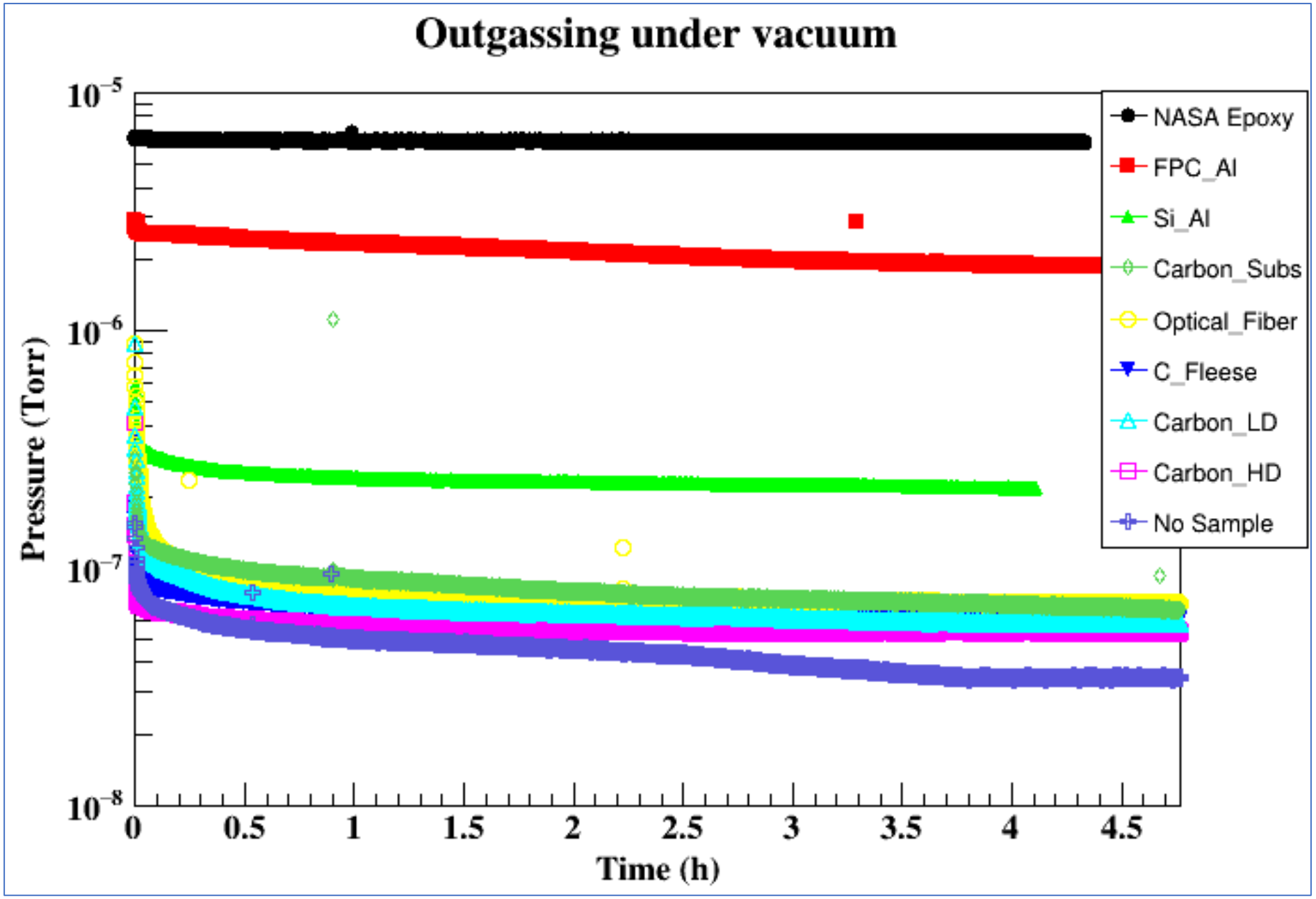
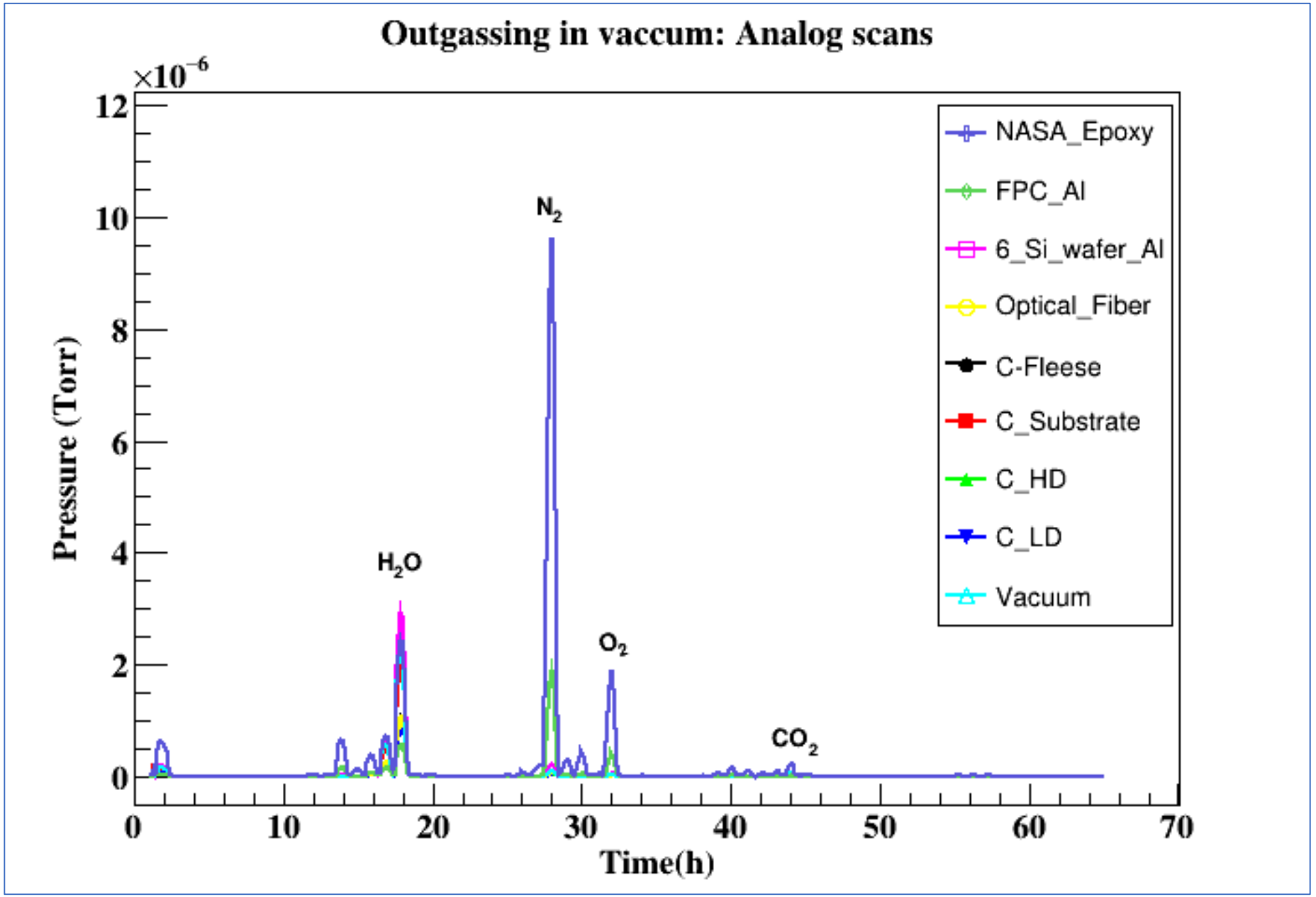
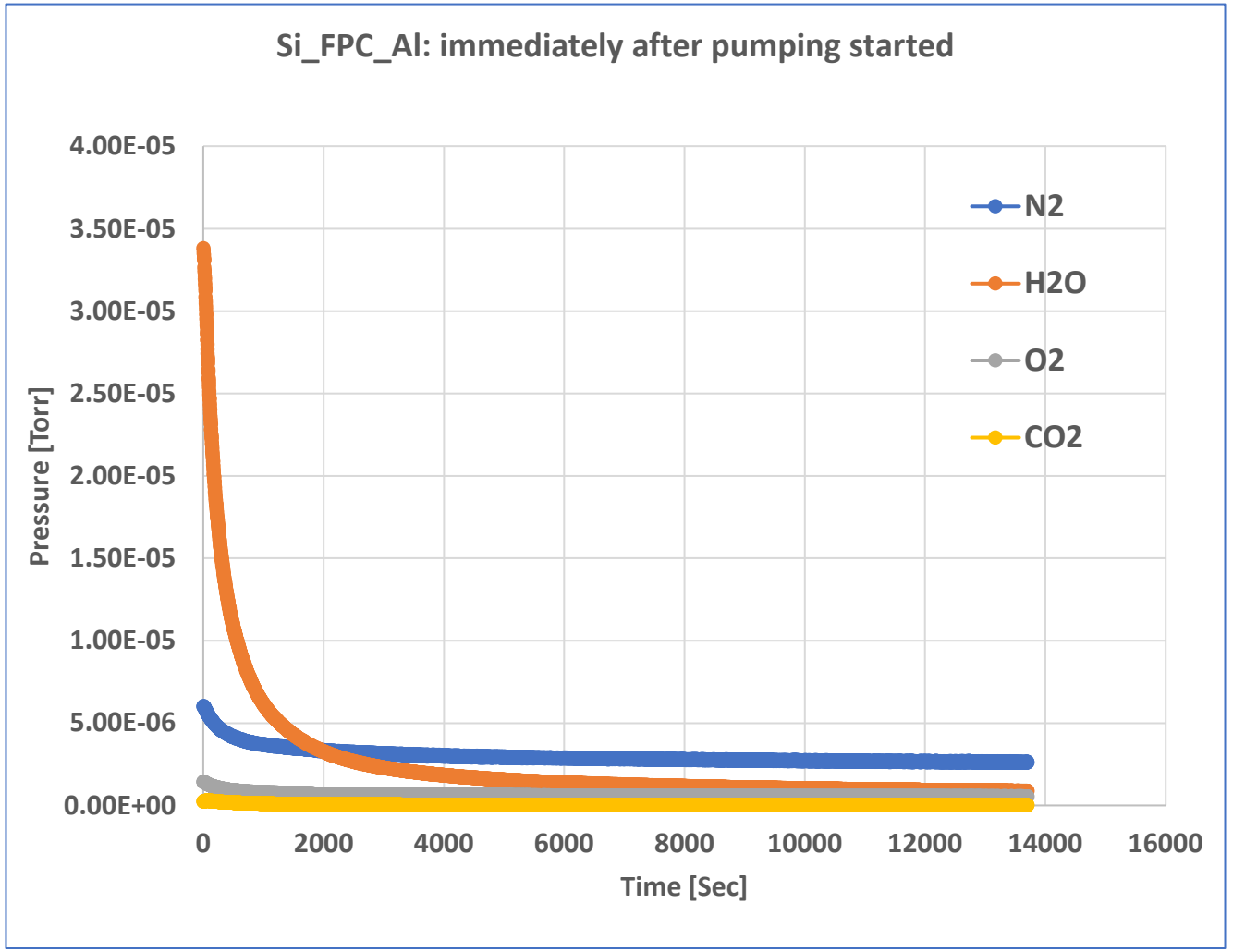


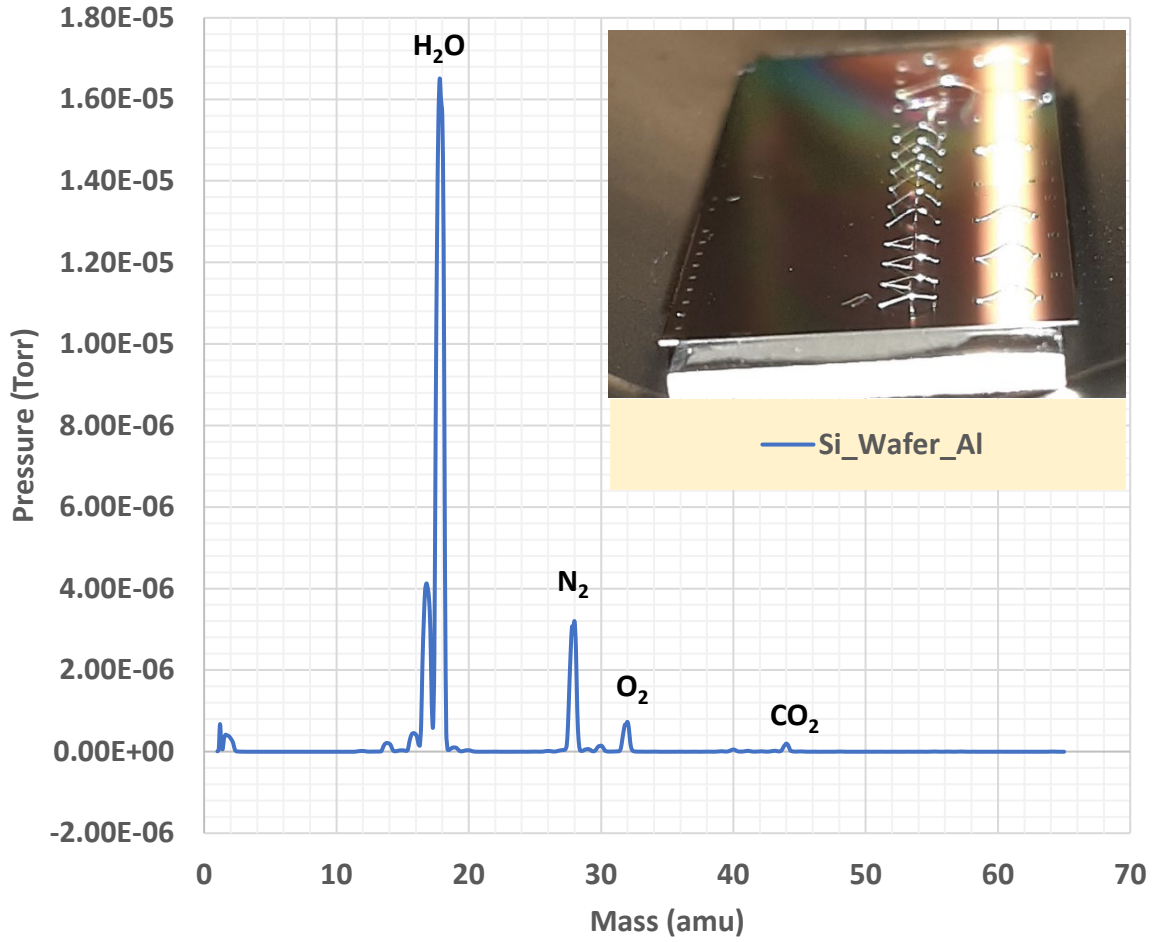
Fig: Schematic diagram of a future SS cylindrical chamber need to build a/c to detector dimension together with required vacuum pumps and RGA

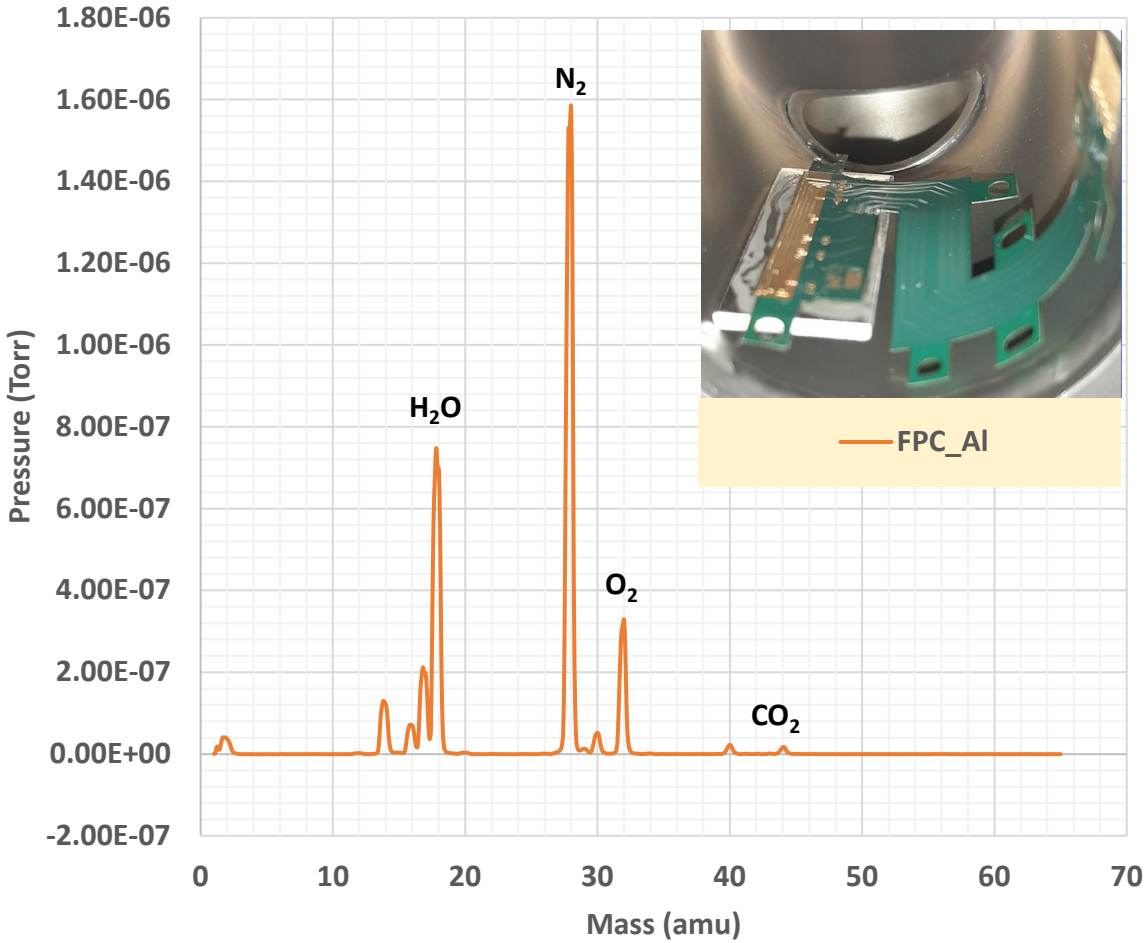

Outgassing under vacuum
Pressure (Torr)
10^{-5}
10^{-6}
10^{-7}
10^{-8}
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Time (h)
NASA Epoxy
FPC_Al
Si_Al
Carbon_Subs
Optical_Fiber
C_Fleese
Carbon_LD
Carbon_HD
No Sample


Outgassing in vaccum: Analog scans
×10⁻⁶
Pressure (Torr)
Time(h)
N2
H2O
O2
CO2
NASA_Epoxy
FPC_Al
6_Si_wafer_Al
Optical_Fiber
C-Fleese
C_Substrate
C_HD
C_LD
Vacuum

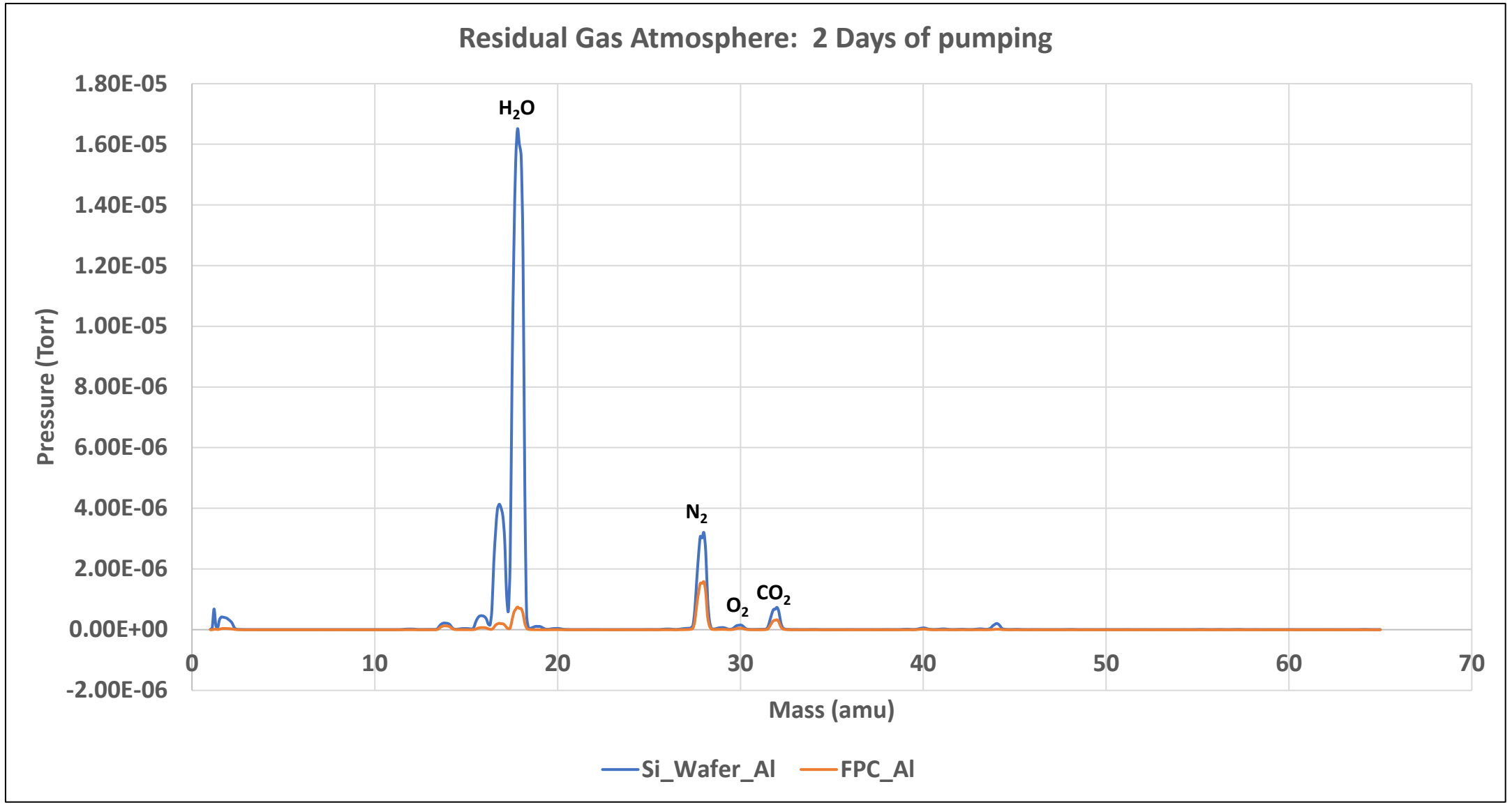

Si_FPC_Al: immediately after pumping started
4.00E-05
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Pressure [Torr]
0
2000
4000
6000
8000
10000
12000
14000
16000
Time [Sec]
N2
H2O
O2
CO2

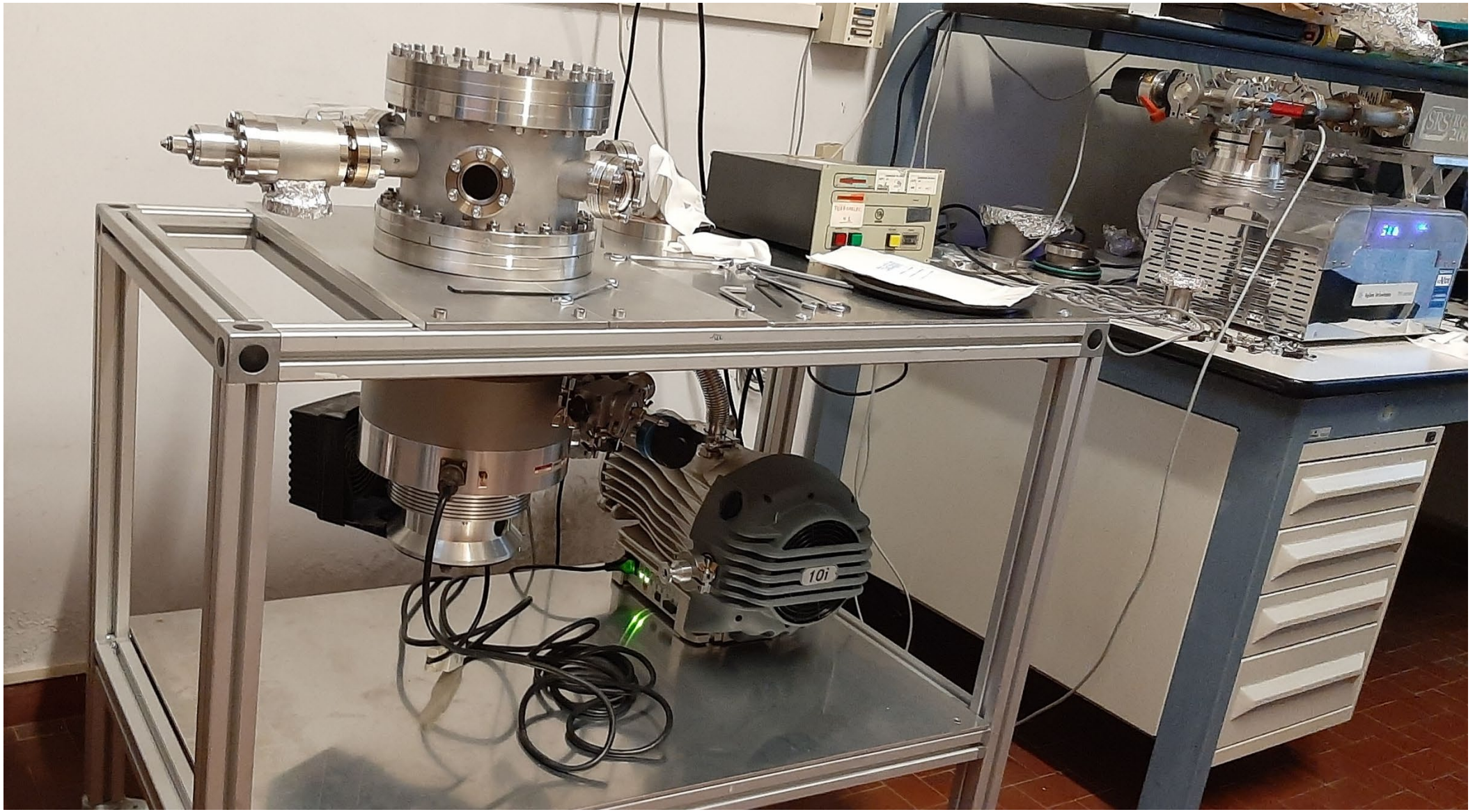
Si wafer and FPC: Residual gas atmosphere study





Si wafer and FPC: Residual gas atmosphere study

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