University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

Badger Name: P4 Plasma Cleaner
Model: PDC-001-HP
Location: PAN-Bay 4

Revision: 1
Revisionist: Wanjohi Kimani
Date: 21-Mar-23

Table of contents

1. Scope

2. Tool description

3. Safety

4. Restrictions

5. Tools and Equipment

6. Procedure

- **6.1** Loading substrate
- **6.2** Setting parameter
- **6.3** Unloading substrate

7. Etch rates

University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

1. Scope

1.1. This document provides detailed instructions on how to properly operate the Harrick Plasma Cleaner.

2. Tool Description

2.1. The Harrick Plasma Cleaner is a benchtop unit with adjustable RF power setting that uses oxygen and/or Argon plasma to chemically etch surface organic contaminants with highly reactive free radicals or activate surfaces to alter surface characteristics such as wetting or adhesion. Maximum RF power is 45W. A PlasmaFlo gas mixer allows quantitative control of up to two (2) process gases and monitoring of chamber pressure.

University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure



Figure 1: *The Harrick Plasma Cleaner, located in PAN Bay 4.*

University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

3. Safety

3.1. Assume samples, boats or foils are warm or hot if they have been ran in the plasma cleaner for long. Use caution when unloading from the chamber.

3.2. Adjust gas (O2 or Ar) flow using the flow meters only. Do not adjust the metering valve.

4. Restrictions

4.1. No oils, rubber or cements

5. Tools and Equipment

5.1. Plasma Cleaner (PDC-001-HP)

5.2. Plasmaflo (PDC-FMG)

5.3. Pump (PDC-OPE Economy Dry Oxygen Service Pump)

5.4. Quartz boat

5.5. Aluminum foil

5.6. Timer

6. Procedure

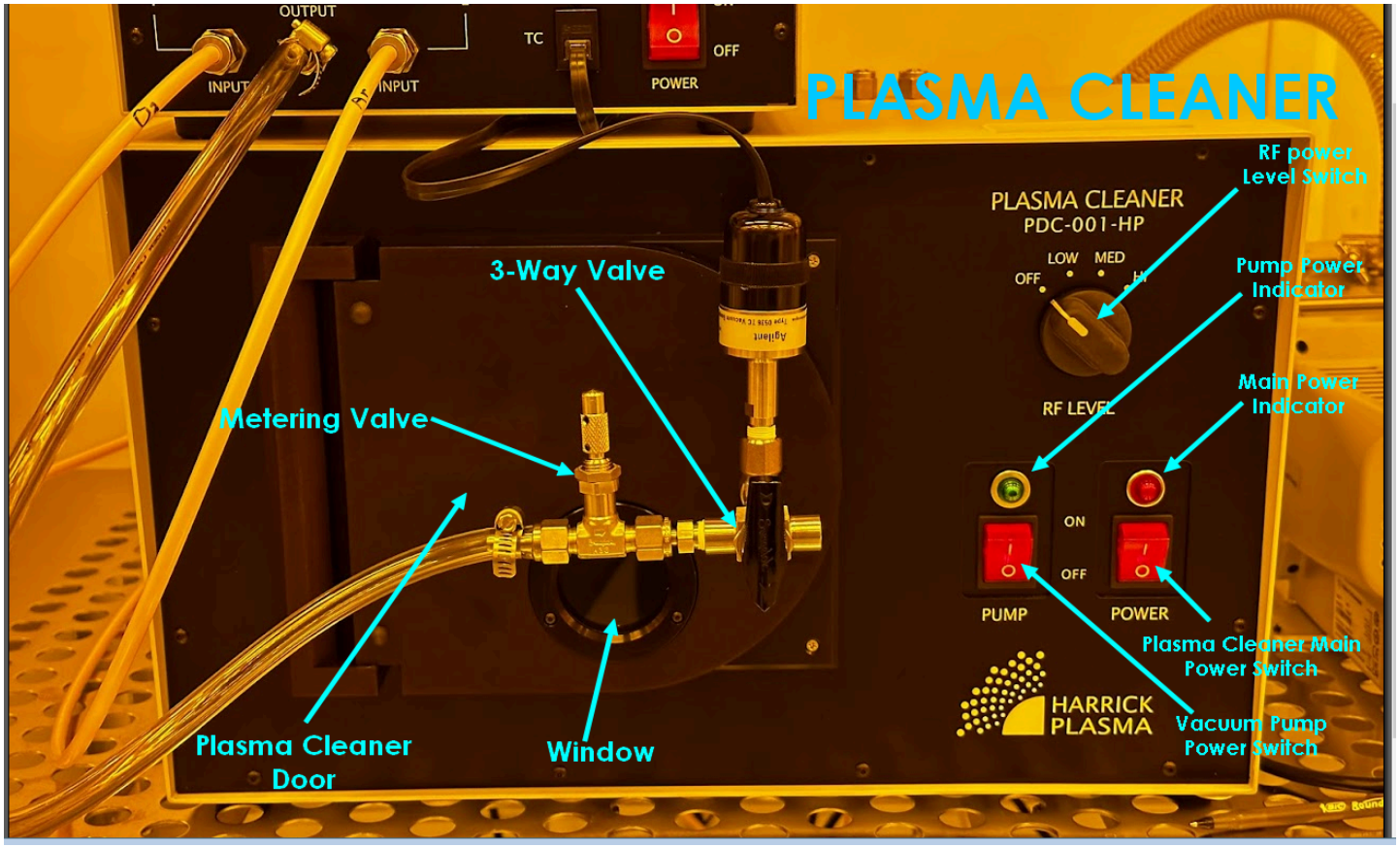
6.1. Loading substrate

6.1.1. The Harrick Plasma cleaner is badger interlocked, which means you have to enable it in badger to use it. However, there is no charge to use it.

University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

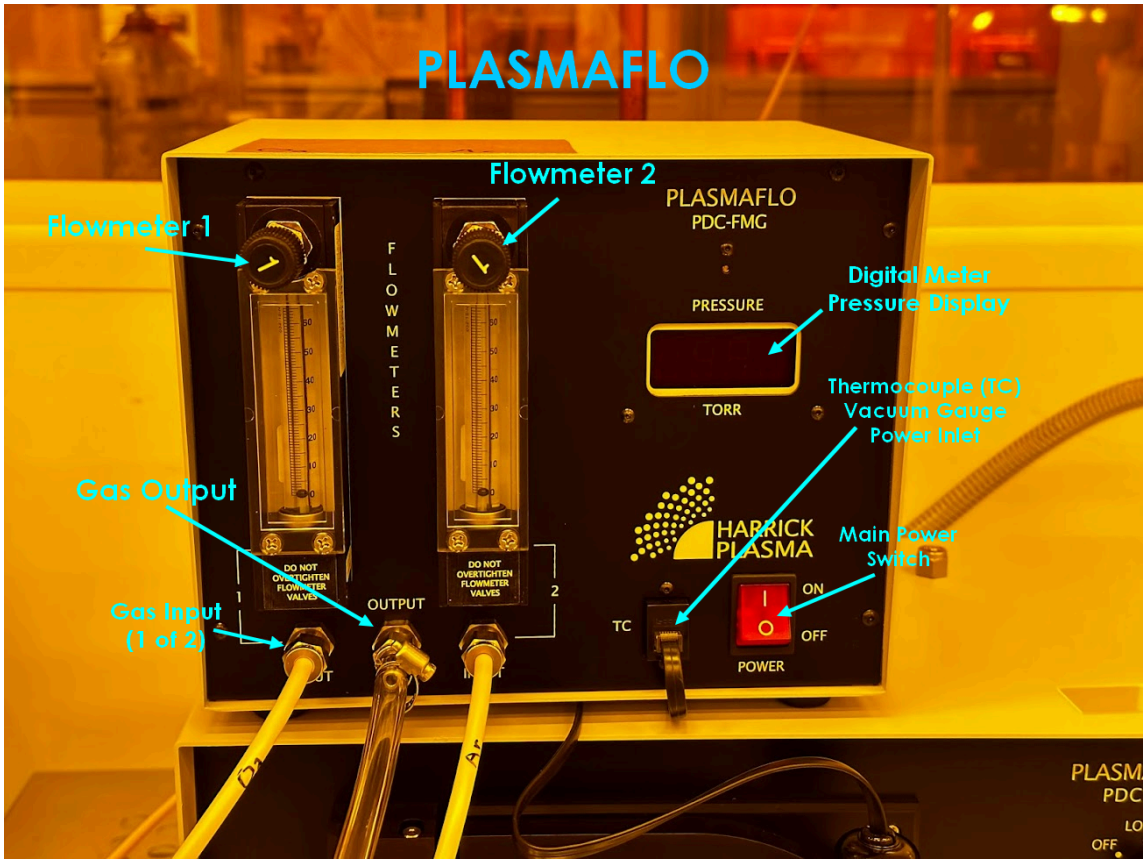
Figure 2: *The control panel of the Harrick Plasma cleaner*



University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

***Figure 3**: Control Panel of the Plasma Flo*



University of Minnesota Nano Center

O2/Ar High Power Expanded Plasma Cleaner- Standard Operating Procedure

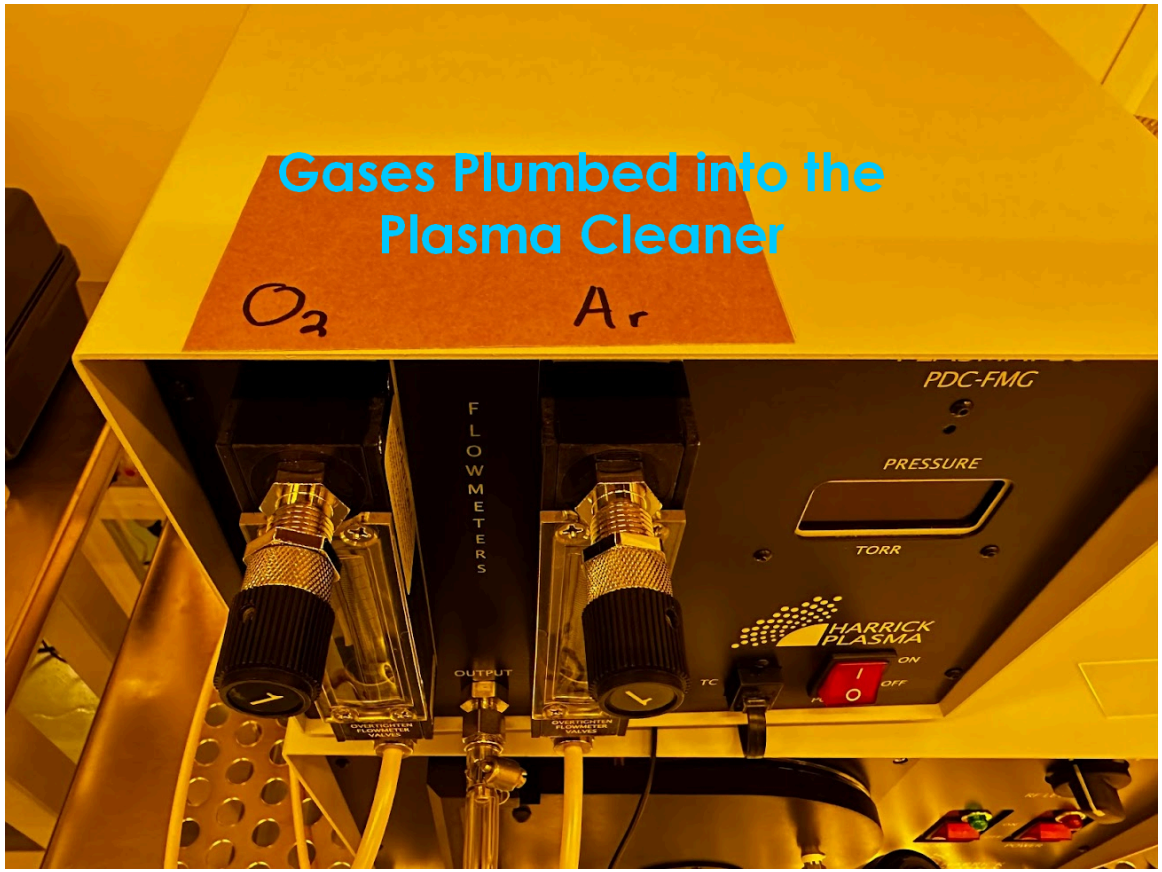
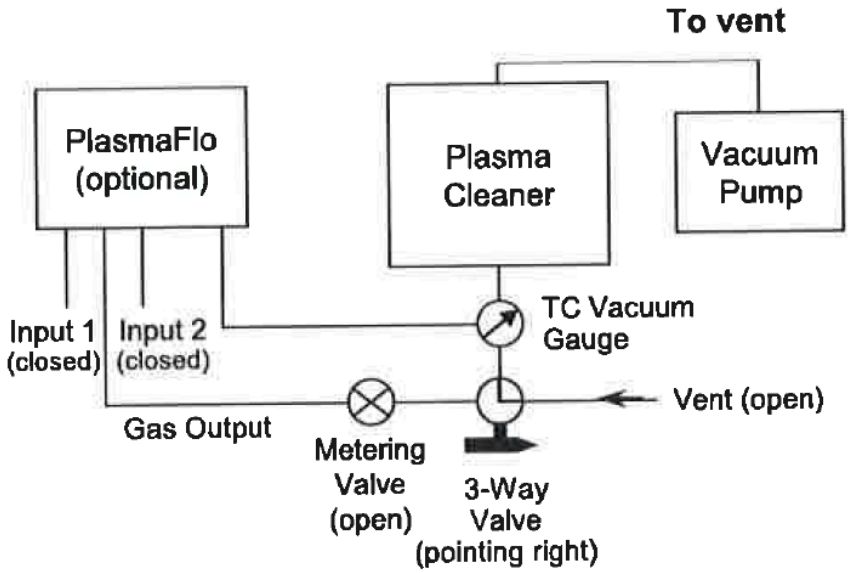


Figure 4: *Oxygen and Argon gas labels*

6.1.2. Bring the chamber up to atmosphere; first ensure that the vacuum pump switch and the power (RF) switch are set to off. Turn the 3-way valve to point to the right (see diagram below).

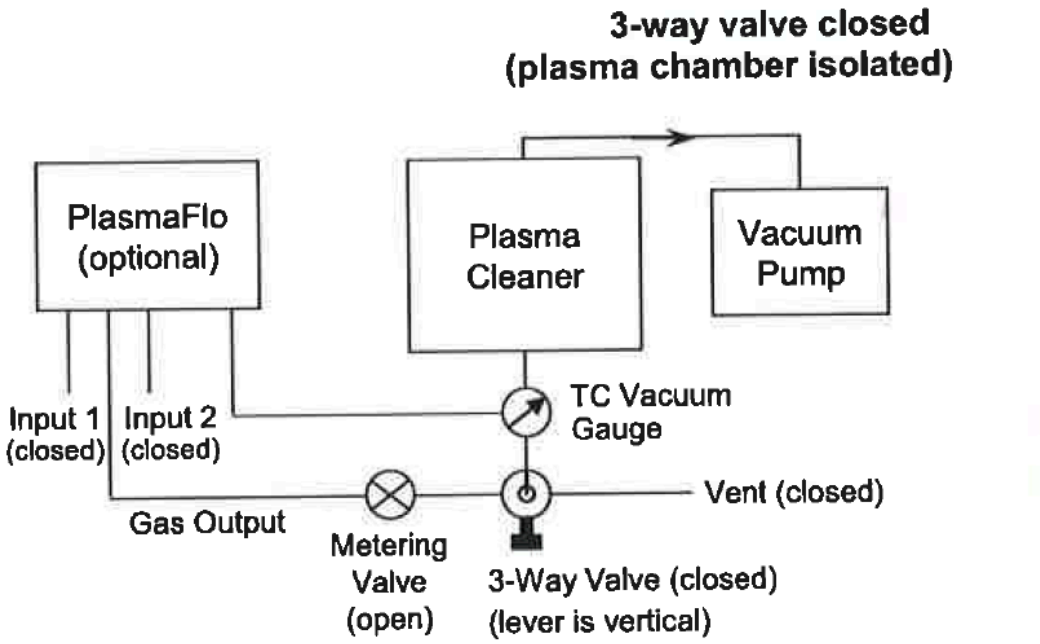


6.1.3. There will be a loud hiss as air rushes in – do not be alarmed. The pressure will rise to atmosphere quickly. The door should be easy to open once you get to atmospheric pressure. Pull the door open once the pressure reading is about 630 torr and unchanging.

6.1.4. Load your sample on to a quartz boat and place boat in chamber (remove quartz plate to create space) or place sample directly onto the quartz plate.

6.1.5. Load your sample towards the center of the chamber. If placing sample on quartz plate, a glass slide placed at the front edge of the quartz plate will prevent your sample from sliding out.

6.1.6. Close the chamber door. Turn the 3-way valve to closed (lever is vertical – see below)



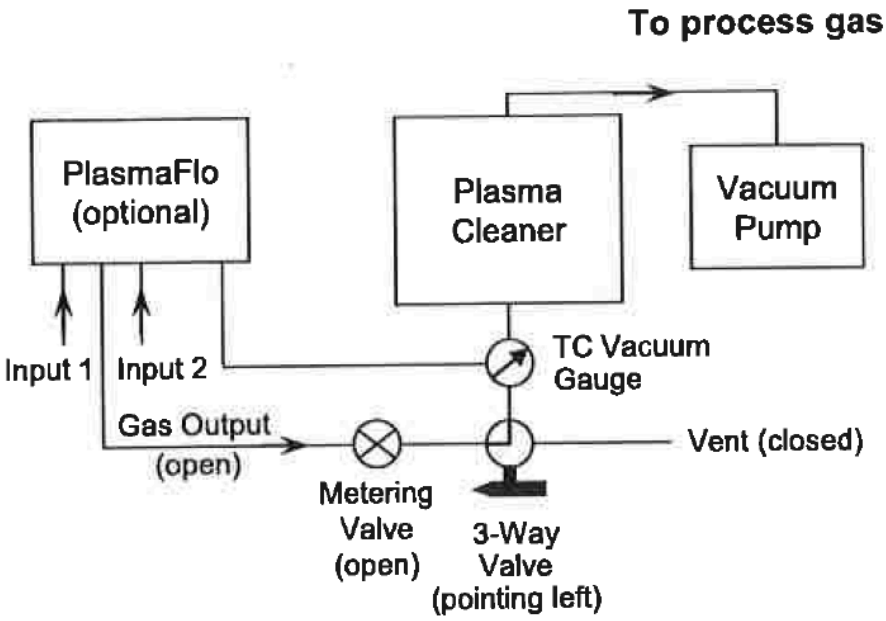
6.1.7. Hold the door in place briefly as you turn on the vacuum pump switch

6.1.8. Wait for the pressure to reach **0.200 torr** or below before continuing. It takes about 1 – 2 minutes to reach this pressure.

6.2. Setting parameters

6.2.1. Determine the amount of time needed for your run and set it on a timer.

6.2.2. Turn the **gas** flow on. Do this by turning the 3-way valve so that lever points to the metering valve.



6.2.3. Using the flowmeter adjust the gas flow needed for your run for the pressure value you need. The flowmeter is closed when fully turned clockwise (should never need to be turned too tight). **The flowmeters have a 65 nm reference scale. Use the flowrate table in the appendix for the specified process gas to convert the millimeter (mm) scale reading to an actual flowrate (mL/min).**

6.2.4. Turn on the **RF power.** Select low (30W), medium (38W) or High (45w) RF power. You should see a glow through the viewing window (not too bright) when plasma turns on. It may take a couple of seconds to glow.

6.2.5. Start your timer.

6.3. Unloading substrate

6.3.1. Once the cleaning or activation is complete, turn off the RF power and wait about 10 sec. Turn the 3-way valve to vertical and turn off the pump switch

6.3.2. Turn **the 3-way valve to the right (see 6.1.2) to vent. The chamber will vent to atmosphere.**

6.3.3. Unload your sample

6.3.4. Close the door, turn the 3-way valve to vertical (closed) and hold onto the door briefly.

6.3.5. Turn on the vacuum pump and let the pump run briefly. Leave the chamber in a pumped down state.

6.3.6. Once the chamber has pumped down to 1 Torr or less, turn off the vacuum pump. The chamber will rise briefly but remain pumped down even with the vacuum off.

7. Etch rates

7.1. Etch rates are under development and will be updated when complete

Figure: *Etch rates of common resists in different orientation.*