

Plasma Immersion Ion Implantation (PIII)

Standard Operating Procedure (SOP):-

1. Check Exhaust is ON.
2. Turn ON Chiller (Enter in logbook).
3. Turn ON main MCB of PIII and the board switches of rotary and turbo pumps.
4. Note Overnight Pressures of gauges 2 and 5 (PH3 chamber and fore-line) and gauges 3 and 6 (B2H6 chamber and fore-line).
5. Check all the four valves – gate valve, vent valve, roughing valve and backing valve, are closed.
6. Switch ON Rotary pump and wait for 2 minutes (pump warm up time).
7. Switch ON Backing valve. Pressure of gauge 5/6 should now read $<5e-01$ mbar.
8. Turn ON Turbo pump.
9. Open Vent valve, open chamber and load your sample. Close chamber and vent valve.
10. Switch OFF Backing valve.
11. Switch ON Roughing valve. Pressure of gauge 2/3 should now read $<8e-02$ mbar.
12. Switch OFF Roughing valve.
13. Switch ON Backing valve.
14. Open Gate valve.
15. Wait till pressure in gauge 2/3 reaches $\sim 8e-06$ mbar. Enter this base pressure in logbook. Note the time taken to reach this pressure after opening the gate valve.
16. Turn ON Nitrogen cylinder and Phosphine/Diborane cylinder.
17. Set the gas flow to 20sccm in the Multi Gas Controller.
18. Open Phosphine/Diborane valve and the chamber valve.
19. Note the gas pressure in logbook when it stabilizes.
20. Close the gate valve till you obtain your process pressure (say, $1e-01$ mbar) in gauge 2/3.
21. Set the required values in the function generator [say, Frequency = 5kHz, V_{pp} = 4V, Pulse Width = $20\mu\text{m}$, Duty cycle = 10%].
22. Set RF power to desired value (say, 1000 W).
23. Turn ON the high voltage power supply.
24. Set the required bias voltage (say, -2kV).
25. Turn ON the RF power and give output through function generator.
26. Allow Ion Implantation to take place for required time interval (say, 30sec).
27. Switch OFF RF source, power supply and function generator. Close Phosphine/Diborane valve. Let it evacuate.
28. Turn OFF the Phosphine/Diborane cylinder. Open the Phosphine/Diborane valve.
29. When Multi Gas Controller indicates 0sccm, turn ON Nitrogen valve. Pressure in gauge 2/3 increases from $\sim 1e-06$ to $1e-03$ mbar.
30. Close gate valve. Pressure reaches $\sim 1e-01$ mbar.
31. Purge the chamber with Nitrogen for 15 min.
32. Close the Nitrogen valve.
33. Open the gate valve. Pressure reaches $\sim 1e-03$ mbar.

34. Repeat steps 29 to 33, thrice.
35. Close gate valve.
36. Vent chamber and unload your sample.
37. Close chamber and vent valve.
38. At this stage, gate valve is closed; Roughing valve is OFF & Backing valve is ON.
39. Repeat steps 10 to 38 if a 2nd run is required.
40. Follow the following steps to keep the system in vacuum:-
 - a) Switch OFF the backing valve
 - b) Switch ON the roughing valve
 - c) After pressure in gauge 2/3 reaches around $1e-02$ mbar, switch OFF the roughing valve and switch ON the backing valve.

System Shut Down Procedure

1. Turn OFF the turbo pump (At this stage, Roughing valve is OFF, backing valve is ON).
2. Wait till the frequency of turbo reduces to 0 Hz.
3. Turn OFF the backing valve.
4. Turn OFF the rotary pump and the board switches.
5. Switch OFF PIII main switch and Chiller.