Reactive Ion Etchers Plasma System Specification

The contractor must provide two clamshell-type Reactive Ion Etcher (RIE) plasma systems. One system (**corrosive gas system**) must be equipped to handle corrosive gases such as chlorine (Cl_2) and hydrogen bromide (HBr) and the other system (**non-corrosive gas system**) must be able to handle fluorine-based etching chemistries such as sulfur hexafluoride (SF_6), tetrafluoromethane (CF_4) and trifluoromethane (CHF_3).

1. **Process Chamber –** Both process chambers must be made from anodized aluminum or materials compatible with the use of corrosive process gases such as chlorine or corrosive by-products. The chambers must accept wafers up to 6-inches in diameter. No plastic components should be used to construct the chambers, working electrodes, and internal gas delivery systems. The systems must be of the size and weight to enable use in a hood or on a bench top. The chambers must allow the wafer to be loaded from the top and the chamber/electrodes configured to ensure anisotropic etching and to maximize selectivity, uniformity and speed of the etching process. The substrates or electrodes on which the sample sits must be water cooled and under temperature control. NRL will provide the water chiller.

2. **Vacuum Pump –** As a minimum requirement, each chamber must be pumped with at least a 27 CFM rotary vane mechanical pump capable of oxygen service and achieving a base pressure less than 50 millitorr. Each pump should be charged with Fomblin 25/6 pump fluid. Each pump must also have an oil mist eliminator that is appropriate for the proposed etching chemistries. In order to improve the base vacuum pressure of the chamber beyond the capability of the mechanical pump alone, we are also interested in other pumping options (in addition to the rotary vane mechanical pump) such as a stand alone turbo or molecular drag pumping system with dry mechanical pump capable of operating in a Class 100 clean room and achieving a base pressure of at least 10^{-5} torr.

3. **Pressure Measurement and Control –** Each system must provide a means to read and independently control the chamber pressure. The vacuum gauge(s) must be able to read pressures over the range provided by the vacuum pump(s) delivered with the system. As an option, the chamber should be separated from the pumping system with a manual or automatic value as a means to isolate the pumping system from the chamber and act as a throttle valve for pressure control.

4. **RF Plasma Generator –** Each system must be equipped with a solid state RF power supply operating at 13.56 MHz with at least 600 watts of power. To maximize the transfer of energy into the chamber, each system must provide a manual and automatic tuning system.

5. **Microprocessor Control and Remote Operation Interface Software** – The plasma system operation must be microprocessor controlled and allow for manual and automatic operation of the system, the latter from stored process recipes. The microprocessor must be able to store and recall process recipes and other parameters such as mass flow controller setting. A readout display must be provided to display parameters such as pressure, time, power, and gas flow. The control system must also provide a computer interface and software to permit the remote monitoring and operation of the systems.

6. **Mass Flow Controllers** – Each system must be equipped with a minimum of 4 electronic mass flow controllers that provide digital readout through the microprocessor of the gas flow. The addition of 2 more mass flow controllers should be included as an option. [In the corrosive gas capable system, 2 of 4 mass flow controllers must be able to handle corrosive gases. For the option providing 6 mass flow controllers, at least 3 must be capable of handling corrosive gases.] The minimum flow rate for each mass flow controller should be as follows:

Corrosive Gas System	Non-Corrosive Gas System
MFC 1 (Cl_2)* 200 sccm	MFC 1 (SF_6) 100 sccm
MFC 2 (BCl_3)* 100 sccm	MFC 2 (CF_4) 100 sccm
MFC 3 (H_2) 200 sccm	MFC 3 (CHF_3) 200 sccm
MFC 4 (O_2) 200 sccm	MFC 4 (O_2) 200 sccm
MFC 5 (Ar) 200 sccm	MFC 5 (Ar) 200 sccm
MFC 6 (HBr)* 100 sccm	MFC 6 (O_2) 20 sccm

*corrosive gas

7. **Endpoint Detection –** Each system must provide a means for automatic endpoint detection.

8. **Installation and Training –** A factory-trained technician must be present at NRL to assist in the initial start up of the RIE plasma systems and to provide initial system calibration, testing and personnel training for at least three (3) days and 12 people.

9. **Warranty –** A base warranty of at least one year from first use of the system is required. Extending the warranty to three (3) years should be quoted as an option.

10. **Etch Rates & Uniformity** – The systems should be capable of achieving the following etch rates in the specified material (and process gas):

Al (BCl_3/Cl_2):	1 micron/min
GaAs (Cl_2):	1 micron/min
TiW (SF_6):	500 nm/min
SiO_2 (CF_4/O_2):	500 nm/min

The uniformity of the SiO_2 etch should be at least 20% across a 6 inch wafer.

11. **Optional Spare Parts and Accessories –** Responders should also provide a list of available options for the system including device holders and any spare parts kits that can be used for maintenance.

12. **Safety Features –** Each system must provide appropriate safety features such as emergency shut-off and safety interlocks to protect the operator from electrical shock hazards.