SPECIFICATIONS

1.10 Scope. This specification describes the minimum technical requirements and the minimum acceptable performance standards for a Xenon Difluoride (XeF_2) Etching System to be installed by the contractor at the Naval Research Laboratory (NRL), Washington, DC. The Xenon Difluoride (XeF_2) Etching System will be placed in a multiple user facility and must provide ease of operation and safety to those in the facility.

1.20 Installation Site. The system will be installed in the Bldg. 250 Device Fabrication Facility, Class 100 cleanroom at the Naval Research Laboratory, Washington DC 20375.

1.30 Description and Primary System Components. The Naval Research Laboratory plans to purchase a Xenon Difluoride (XeF_2) etching system to support several R&D projects that have a need to isotropically and selectively etch Si, Ge, and Mo, while leaving other materials intact such as metals, photoresist, silicon carbide, gallium arsenide, gallium nitride, diamond, silicon nitride, and silicon oxide.

2.00 Required System Features:

2.01 The system must be computer controlled using Windows XP operating system with software that operates the system, logs data, and displays data.
2.02 Touch screen and keyboard interface.
2.03 Industrial grade, single board computer with built-in CD/DVD writer.
2.04 Multi-user (a minimum of 50 users) software interface with password protected access for each user.
2.05 Password protected access to maintenance software.
2.06 Recipe storage which is both separate for individual users and allows also for users to share common recipes.
2.07 Log and save process parameters for each etch, which can be exported in tab separated text for viewing in spreadsheet applications such as Microsoft Excel.
2.08 Record or log of the pressure in process chamber at a selected interval during etching. Plots the pressure in the GUI.
2.09 Set Cycle Time, Number of Cycles, XeF_2 Pressure from software user interface.
2.10 Mix XeF_2 with a second gas. Set pressure for second gas from software user interface.
2.11 Set pump down pressure for chamber and expansion chambers when etching with XeF_2 from software user interface.

2.12 Continuous flow capability: Set a continuous XeF_2 flow rate and pressure in process chamber from software user interface.
2.13 Continuous flow with mixed gas Capability: A method for very accurately mixing XeF_2 with another gas (nitrogen) in a continuous flow. Pressure of other gas can exceed the sublimation pressure of the XeF_2.
2.14 High conductance, mixed gas, pulsed flow capability: A process which alternates pulses of nitrogen with the pulses of XeF_2 for increasing the selectivity and controlling the temperature of the wafer.
2.15 Software updates supported via CD and DVD.
2.16 Access important control functions from a remote location over ethernet.

3.00 Required System Chamber Design:

3.01 A dual expansion chamber design is required for high etch rates with pulsed flow and must be capable of continuous flow delivery of xenon difluoride gas using a mass flow controller and pressure controller.
3.02 Dual expansion chambers and dual source bottles.
3.03 Expansion chamber based design for precise, repeatable pulse pressures, and ease of mixing XeF_2 with other gases.
3.04 Open load system to handle multiple types of substrates (6”, 4”, 3”, 2”, and 1” wafers, chips, dicing frames, packages) without special handling substrates.
3.05 Transparent process chamber lid and shower head over full 4” wafer allows visual inspection through built in microscope of entire wafer.
3.06 Showerhead to distribute gas injection across chamber.
3.07 Heating of key components to keep xenon difluoride from condensing in system when etching at higher pressures.
3.08 Modular gas panel to allow easy replacement of gas components.
3.09 A dry scroll pump or roots pump which is proven to be compatible with XeF_2 with greater than 16 CFM pumping speed and capable of producing a base pressure of 50 mT inside the chamber, which will be located as much as 20 feet away from the pumping unit in the utility spine.

4.00 Minimum Process Specifications:

4.01 Predetermined recipe processes for increasing selectivity, uniformity and controlling etch rate
4.02 Greater than 800:1 selectivity over SiO2, and greater than 100:1 for LPCVD Silicon nitride

4.03 Less than 10% non-uniformity on 6” wafer
4.04 Controlled and stable etch rate of 0.5 um/min.
4.05 Pulsed flow, mixed flow, mixed pulsed flow, and continuous flow etch processes.
4.06 Etch recipe that provides a rapid pulse and high flow which optimizes the XeF_2 etching cycle time by controlling both fill pressure and pump down pressure.

5.00 Inspection:

5.01 The system must provide the ability to view the sample being etched both through an included microscope with a camera mount for an optional camera.
5.02 60X zoom binocular microscope with ring illuminator and camera ready mounting. The microscope must be mounted on etcher on a swing arm allowing full coverage of sample being etched and height adjustment. The microscope must be able to swing away from etch chamber for loading and unloading.
5.03 Transparent process chamber lid and shower head over full 4” wafer to allow visual inspection through microscope of entire wafer.

6.00 Temperature Control:

6.01 The system must control the temperature of key sub systems to +/- 0.2 degree Celsius for superior wafer to wafer uniformity, and to avoid condensation. Other requirements include:
6.02 Independent temperature control of expansion chambers, gas box and process chamber.
6.03 Temperature control setpoints and temperature setpoints must be configured through the etch control software.
6.04 A means of over-temperature protection.

7.00 Safety:

The instrument must meet the following safety requirements:
7.01 Built in, retractable fume hood with hardware interlock which automatically prevents opening process chamber when fume hood is retracted yet allows good access to the chamber during processing for optimal wafer inspection.
7.02 Duplicate emergency off (EMO) button for positioning with pump in utility spine.
7.03 Pump turned off with EMO and power switch on unit.
7.04 Key access required to turn unit back on after emergency power off.
7.05 Hardware interlock automatically shuts off all valves with loss of vacuum.

7.06 Hardware interlock automatically closes XeF_2 source when process chamber is near atmosphere.
7.07 Built in exhausted gas box with inlet for purge gas.
7.08 Software guided XeF_2 source bottle change procedure.
7.09 Automatic leak check routine after changing XeF_2 source bottles.
7.10 Automatic nitrogen purge of connections to XeF_2 source bottles before and after changing XeF_2 source bottles.
7.11 Software controlled process chamber load/unload with nitrogen purge.

8.00 Documentation:

8.01 The contractor must provide all documentation, drawings and schematics necessary for full operation, troubleshooting, servicing and repair of the system and its components
8.02 The System must be shipped with one (1) complete set of operation and maintenance manuals printed on cleanroom paper and an electronic version on CD-ROM.

9.00 Optional Items:

The following items must be offered as options and must be field retrofittable to the tool.

9.01 Digital camera (minimum 5 megapixel), mounted on the included microscope, integrated with and controlled by the control software to periodically capture images either at a given time interval or at each pulse.
9.02 Additional XeF_2 Source Cylinders with 200g of XeF_2 in cylinder.
9.03 Extended Warranty (3 years)

10.00 Acceptance Criteria:

10.01 Unless otherwise specified, process performance will comply with process specifications enumerated in sections 2.00 – 8.00 of this specification. This process performance is to be demonstrated after installation of the system at the NRL. During this process performance demonstration the Contractor must provide training on maintenance and operating procedures for the system.
10.02 Contractor applications engineer will assist the Government in the complete verification of system and process performance as specified in this document.

11.00 Installation and Training

11.01 A factory-trained technician must be present at NRL to assist in the initial start up of the system and to provide initial system calibration, testing and personnel training for at least three (3) days and 12 people. NRL responsible for placement of the equipment within the Device Fabrication Facility Class 100 Cleanroom and connection of all utilities.

12.00 System Compatibility: The etching tool will be housed in a Class 100 cleanroom and therefore must be compatible with operating in this type of environment. The work piece and surrounding environment must be kept clean – free of contamination during operation. There must be no gas emission from the system.

13.00 System Operation: The system must be user friendly and easy to use by many different users. Hence, systems that are computer and/or microprocessor controlled and provide fast process control are required. Windows based systems are preferred.

14.00 Low Cost of Ownership: Systems that minimize or eliminate the need for expensive tools and consumables are preferred. Evidence supporting low cost of ownership is a plus.

15.00 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 “9.03 Options”.