

Specifications for Fluorine-Based Inductively-Coupled Plasma Etching System.

1. The Naval Research Laboratory (NRL) has a requirement for a Fluorine-Based Inductively-Coupled Plasma Etching System.
 - a. The primary requirement is to etch SiC, SiN, and Si layers using a fluorine-based gas chemistry.
 - b. The system must be equipped with a vacuum load-lock to minimize venting of the deposition chamber to atmosphere. The load-lock gate valve must have the provision for automatic closure at a programmed pressure (such as 200mT).
 - c. The load lock and chamber must be equipped with necessary mechanisms to load 2", 3", 4" wafers as well as the ability to handle quarters of 2" and 3" wafers and irregular pieces smaller than 4" in diameter. The use of adhesives to hold samples in place is not acceptable. Wafer carriers, if proposed, must of compatible with the required gas chemistries.
 - d. The system must include a Windows 2000 or Windows XP computer-based system controller. The parameters controlled, measured and displayed must include, at minimum: gas flow for all mass-flow controllers (MFCs), chamber pressure, load-lock pressure, directly-coupled RF power level, ICP power lever, reflected power levels, dc bias, electrode temperature, and process time. The system must be capable of automatic operation with manual override. The system must have password protected user access control.
 - e. The system must be equipped with 6 MFCs, capable of toxic gas handling if required for etching the specified materials. Gases envisioned are CF₄, SF₆, O₂, Ar, and MFCs must be calibrated for these gases.
 - f. The pumping system must be designed to handle the necessary gases and process recipes. Approximate flow conditions for ICP are 100 sccm at a pressure of 5 mT. The pumping system will require a combination of turbo-mechanical and backing pump, both of capable of corrosive service. A 200 mm pumping port is required to maximize conductance.
 - g. The system must be equipped with an ICP source with a power output of >1000W operating at a frequency of 13.56 MHz. Alternate frequencies may be acceptable, provided process specifications are achieved. Issues of electronic defect creation must be addressed if frequencies lower than 13.56 MHz are proposed.
 - h. The chamber must be equipped with 2 view ports, one suitable for end-point detection.
 - i. The system must have a vacuum gauge for the 1-1000 mT range on both the load lock and the chamber. The chamber must also have a high vacuum gauge capable of reading in the 1×10^{-8} to 1×10^{-4} Torr range. The high-vacuum gauge must be protected from chamber gases with a isolation valve.
 - j. The chamber must be equipped with an helium cooling system and wafer clamping mechanism.

- k. The system must have provisions for igniting low pressure (1-3mT) plasmas.
- l. Magnetically levitated turbo pumps must be configured to safely shutdown in the event of power failure.
- m. Complete operation manuals for the system and all system components must be provided.
- n. Optional items:
 - Provision for providing the vacuum pumps on separate NRL contract.
 - Provision for endpoint detection.
 - Provision for providing dry or oil-pumped systems.

2. Recipes (including flow rates, gas species, chamber pressure) for etching films must be provided by the manufacturer. Recipes must identify appropriate masking materials. Demonstrated etch results of SiC, SiN, and Si must be provided in the offeror’s proposal. The etch depth uniformity for all etched materials must be better than ±5% over a 4" diameter wafer. The resulting wafer surface for all etched materials must be free of residual deposits. The etch rate, depth, and morphology requirements are set forth in Table I.

Table I. Etch rate, depth, and morphology requirements.			
Material	Etch rate	Etch depth	Morphology
SiC	>0.5 μm/min	0.1-100 μm	For etch depths < 10 μm, replicate original surface roughness. For 100 μm depth, smooth, grass-free surface.
SiN	0.01-0.1 μm/min	100-3000 Å	Replicate original surface roughness.
Si	0.1-0.5 μm/min	0.1-10 μm	Replicate original surface roughness.

- 3. Vendor Demonstration – All system capabilities must be demonstrated by the contractor during the initial installation and will be reviewed prior to final acceptance of the system.
- 4. Warranty and Support: The contractor shall offer the Government at least the same warranty terms, including offers of extended warranties, offered to the general public in customary commercial practice. The warranty begins at the conclusion of installation and training.
- 5. Installation and Training: The contractor shall provide onsite installation of the equipment and demonstrate that the system meets the required specifications. The contractor shall also provide on-site training at the time of the installation and demonstration for at least two NRL personnel for 2 days.
- 6. Acceptance is contingent on passing etch requirements outlined in item 2.