Specifications for a Rapid Thermal Processing System

1.10 Scope. This specification describes the minimum technical requirements and the minimum acceptable performance standards for a Rapid Thermal Processing system to be installed at the Naval Research Laboratory (NRL), Washington, DC. The system will be in a multiple user facility and must provide flexibility, 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 Rapid Thermal Processing system to support multiple R&D projects that require high temperature annealing and processing in various gas environments (or vacuum) for various materials, to include silicon, III-V and II-VI semiconductors, silicon carbide, and carbon-based materials (diamond, graphite, nanotubes).

2.00 Required Performance Characteristics

2.01 System must achieve temperatures up to 1200ºC at ramp rates of up to 150ºC per second. Standard wafer susceptors should tolerate ramp rates up to 50ºC per second.
2.02 Temperatures should be stable and reproducible to within ±1ºC.
2.03 System should achieve base pressures of 10^{-6} torr.
2.04 System process environments should be compatible with the following gases: nitrogen, rare gas, forming gas, oxygen, ammonia. Process under high vacuum (10^{-5} torr) must also be possible.
2.05 Temperature of the interior surface of the sample chamber must remain below 80ºC during processing in order to minimize outgassing of impurities.

3.00 Required System Features

3.01 System should be equipped with at least five stainless steel gas lines with individual flow controllers.
3.02 System should be equipped with both thermocouples and pyrometer for temperature measurement. Susceptors should be designed for direct contact with or insertion of a thermocouple.
3.03 A turbomolecular pump should be integrated inside the system.

3.04 Vacuum forelines should have standard fittings accessible from the rear of the unit that allow attachment of a roughing pump provided by the user. Foreline fittings correspond to a tube diameter that allows adequate pumping speed for a forepump located at least 3 feet away from the unit.

3.05 Vacuum system should have a valved bypass for the turbo pump, in order to directly pump the chamber with the forepump.

3.06 The processing chamber should be constructed of stainless steel and cooled with water during operation.

3.07 The system should be supplied with silicon carbide-coated graphite susceptors to hold either full wafers or small sample pieces. The susceptors should withstand ramp rates up to 50ºC per second.

3.08 The interior of the processing chamber should contain a structure for mounting a 6" wafer or wafer susceptor.

3.09 System must be designed for removal and reinstallation of processing chambers by the user. Water, vacuum, and electrical connections must be designed for efficient and frequent (weekly) disconnect/reconnect in under an hour by experienced users.

3.10 An EMO emergency shutoff button must be mounted on the front of the system.

4.00 <u>Software requirements</u>

4.01 System will be controlled by computer software operating under Windows XP.

4.02 System software should control pumpdown, purge, process (temperature, pressure, gas flow), venting, safety interlocks.

4.03 System software and electronics should provide for safety of the user and should protect the equipment itself. Interlocked parameters must include power, control and measurement of temperature, water flow, lamp performance, gas flow, chamber pressure, foreline pressures, pump operation.

4.04 Multi-user (minimum of 50 users) software interface with password protected access for each user and password-protected access to maintenance functions.

4.05 Recipe storage which is both separate for individual users and allows users to share common recipes.

4.06 Graphical display and saved numerical data logs of system parameters (flow rates, pressures, temperatures) in process chamber, gas lines, and vacuum forelines during operation.

5.00 <u>Documentation:</u> The contractor must provide documentation and drawings necessary for full operation, troubleshooting, and maintenance of the system and its components. Paper documentation must be printed on cleanroom-compatible paper.

6.00 Acceptance Criteria

6.01 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.

6.02 Contractor applications engineer will assist the Government in the complete verification of system and process performance as specified in this document.

7.00 Installation and Training: 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 two (2) days and 12 people. NRL is responsible for placement of the equipment within the Device Fabrication Facility Class 100 Cleanroom and connection of all utilities.

8.00 System Compatibility: The RTA system 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.

9.00 Warranty: The contractor must provide a twelve (12) month commercial warranty from the date of installation and acceptance at the NRL site.