Optical Fiber Preform Fabrication System
N00173-07-R-KS05
Specifications

I. Gas Delivery System

Gas and liquid reagents

Mass flow controllers (MFCs) – analog or digital acceptable. MFCs shall sense and control carrier gas flow rather than reagent. Capability for on-site calibration desirable.

MFC control ranges:

Chlorine		0.005-0.5 liter/min
Sulfur hexafluoride		0.01-1 liter/min
Silicon tetrafluoride	High	0.01-1 liter/min
	Low	0.0005-0.050 liter/min
Helium		0.02-2 liters/min
Oxygen		0.02-2 liters/min
Silicon tetrachloride	High	0.01-1 liter/min
	Low	0.0001-0.1 liter/min
Germanium tetrachloride	High	0.01-1 liter/min
	Low	0.0001-0.1 liter/min
Phosphorus oxychloride	High	0.01-1 liter/min
	Low	0.0001-0.1 liter/min
Boron trichloride		0.0002-0.2 liter/min
Spare		0.01-1 liter/min

MFC specifications:

Accuracy	±1% F.S.
Repeatability	±1% F.S.
Resolution	0.1% F.S.

MFCs for liquid reagent vapors (silicon tetrachloride, germanium tetrachloride, phosphorus oxychloride, and the spare) shall be calibrated for oxygen flow.

Boron trichloride line shall be temperature controlled; maximum temperature 45 C.

All gas flows shall be switched by on/off bellows valves. Pneumatic actuation preferred but electrical actuation acceptable.

All corrosive gas lines shall be equipped with one-way valves downstream of the MFCs for back stream prevention.

Corrosive gas channels such as silicon tetrafluoride and chlorine shall be provided with nitrogen cross-purging at the gas bottle.

MFCs shall be set by programmable logic controllers (PLCs) under computer control and data shall be logged by computer.

In the event of power failure, all corrosive lines shall revert to nitrogen purge to vent with all reagent sources closed. This nitrogen purging mode shall also be user (or computer) selectable for normal standby mode.

Vapor reagent gas paths shall be provided with valves to select Lathe or Vent gas destination.

Vapor reagent gas paths shall be in a temperature controlled environment with the temperature controlled at or above bubbler temperature.

PTFE/Glass design is preferred for longevity and versatility in changing system configuration, but stainless steel design is acceptable.

Bubblers for liquid reagents

Number of bubblers required: minimum 4

Bubbler sizes:	Silicon tetrachloride	5 - 15 liters
	Germanium tetrachloride	3 - 10 liters
	Phosphorus oxychloride	1 - 5 liters
	Spare	1 - 5 liters

Bubbler material – prefer glass; stainless steel acceptable

Thermal control required up to 45 C with control to ±0.1C:

1) Individual oil jacket with dedicated heater/chiller for each bubbler;
2) Fast response heater on each bubbler capable of controlling for full carrier gas flow of silicon tetrachloride and germanium tetrachloride

Temperatures shall be set by PLCs using a computer and actual temperatures shall be data logged

Bubblers shall be located in a moisture-free, temperature controlled (maximum temperature 45 C with control of ±1 C) enclosure purged with dry nitrogen gas. For glass/PTFE systems, the moisture level in the enclosure shall be <1 ppm water; for stainless steel systems, the enclosure shall be nominally air tight and purged with dry nitrogen gas. The enclosure shall be capable of maintaining ½" of water positive pressure.

Bubbler Refill: Bubbler fill/vent valves shall be under computer-control. Bubbler fill level shall be determined either by visual sighting or weight. Refilling plumbing shall be nitrogen purged when not refilling.

Refill source cabinet: to be provided by customer. Refill ports entering vendor-supplied gas delivery system shall be easily accessible, of a standard fitting type (e.g., Swagelock, VCR, etc.), and grouped in a single location for all chemicals. Bidding vendors shall provide details of these connections for review.

II. Lathe System

1. The lathe system shall include an enclosure with HEPA-filtered air flow. Bidder shall provide drawings of enclosure including details of doors and openings
2. Reagents shall be fed from the gas delivery system to the lathe system via a double coaxial, temperature-controlled umbilical link; the umbilical outer body shall be nitrogen-purged
3. A water-cooled, half-ring, traversing stainless steel matrix hydrogen-oxygen burner with infrared pyrometer shall be provided. A motorized pyrometer capable of tracking the burner hot zone is preferred, but manual tracking is acceptable. A computer-controlled

nitrogen gas screen on matrix burner wings is required. Temperature control precision and settling time/distance at the beginning of each pass shall be provided by bidder.

4. Tube diameter control shall include a camera for sensing preform diameter and an automatic closed loop pressure control system for precise tube diameter control ±0.1 mm.
5. Lathe shall be equipped with computer-controlled burner translation
6. Both the torch velocity and temperature profile shall be accessible for modification under computer control at the beginning of each pass.
7. Computer controlled motor-driven tail stock for preform stretching and collapse is required

The lathe shall have the following items:

- Hydrogen-oxygen hand torch with associated pipe work for setting up tubing and preform
- Double chucks holding preform at tailstock
- Hydrogen "cold flame" burner at tailstock for stress relief
- Exhaust manifold for soot removal

All lathe components shall be controlled by PLCs connected to a computer for input of preform recipes and logging of parameters.

III. Control Software and Computer

1. Must accept a set of parameters ("recipe") for each layer or each event in the deposition process and then controls them within the range specified. Parameters include, but are not limited to: mass flows of oxygen, carrier gas, liquid and gas reagent and inert gases; mass flows of hydrogen and oxygen going to the torch; lathe rotation speed; torch translation speed and ramp profile; torch temperature and ramp profile; substrate tube pressurization; substrate tube diameter; and lathe tail-stock velocity.
2. The control software must allow for changes in the recipe or parameters to be easily made at any time during the fabrication of a preform. In addition, the user interface must allow easy creation of recipes and be capable of accepting recipes from spreadsheet programs such as Excel.

IV. Installation and Training

1. The preform fabrication system shall be fully installed, and the vendor shall demonstrate full functionality.
2. The vendor shall provide training for 1 or more NRL scientists, either in-house or at the vendor facility.

V. Information to be supplied by successful bidder

1. Infrastructure requirements, including voltages and currents of electrical supply, exhaust air flows, location and configuration of ducts and vents, house or chilled water, etc.
2. User manuals

3. Relevant schematics (electrical and plumbing)
4. Consumable parts list

VI. Warranty

Standard commercial warranty against all parts and labor

VI. NRL-supplied items

1. Source cabinet for refilling bubblers
2. Gas purification system