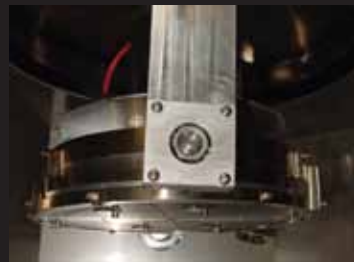


# E-Beam Evaporation Systems



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# NANO-MASTER E-Beam Evaporation Systems

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**NEE-4000**

The Electron Beam Evaporation system is available in two different configurations: A compact vertical dual chamber configuration features a 14" cube main chamber where the platen is located, and underneath the main chamber a secondary chamber is provided for housing the e-beam source. This configuration can be provided with a gate valve between the two chambers to be used as a load lock to keep the e-beam source and the evaporation pockets in vacuum while substrates are loaded and unloaded from the main chamber. For applications where automatic loading and unloading of wafers are needed a third chamber is attached to the left face of the cube for another load lock. In this case, the main chamber can be kept at low  $10^{-7}$  torr range at all times and evaporation can start just a few minutes after loading the wafer. The second configuration features a single large chamber design that allows e-beam evaporation guns, magnetrons, and thermal evaporation mounted onto the baseplate. In this configuration coating of multiple wafers are possible using planetary substrate holder.

NANO-MASTER offers combinatorial evaporation system using substrate masking and computer controlled evaporation rates for individual e-beam evaporators.



**Tilted and Rotating Substrate**



**Dual E-Beam Source**

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## FEATURES

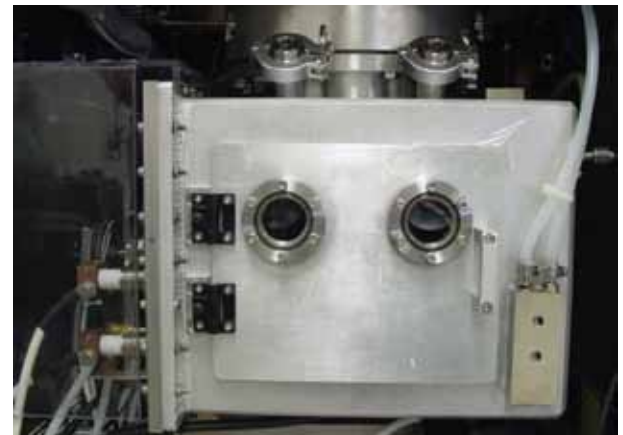
- 14" cubical or 21"x21"x22" SS chamber
- $5 \times 10^{-7}$  torr base pressure attained with turbomolecular pumping package
- 4x 15cc pocket E-gun
- Source and substrate shutters
- 6 and 10 kW switching power supply
- Automatic pocket indexing
- Programmable sweep controller
- 26"x44" footprint with SS panels for Class 100 cleanrooms
- Quartz crystal thickness sensor
- Substrate rotation
- LabVIEW user interface
- EMO protection and safety interlocks



**Platen with Lift Mechanism**

## OPTIONS

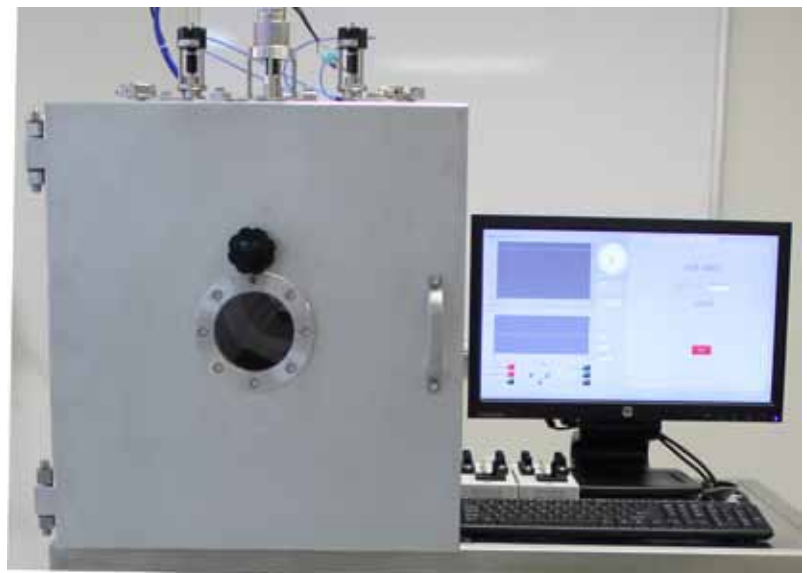
- Substrate heating up to 800°C or cooling
- Glancing Angle Deposition (GLAD) with rotation
- Planetary substrate holder
- Substrate RF/DC bias
- Dual e-beam source for co-evaporation
- Ion source for substrate cleaning and ion assisted evaporation
- Additional PVD sources (thermal, sputtering)
- MFCs for reactive evaporation
- Automatic load/unload



**Source Chamber**

## APPLICATIONS

- Lift Off
- Optical Coatings
- Thin Film Transistors
- Active CIGS layer
- Josephson Junctions



**21"x21"x22" SS Chamber**

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## Platen

NANO-MASTER excels in designing novel single wafer platens with simple or planetary used for Glancing angle deposition (GLAD). It provides a straightforward technique for fabricating nanoscale helices, chevrons, columns and other porous thin-film architectures in photonics crystals applications. The platen is heated resistively or by IR lamps and plasma cleaning prior to deposition with RF plasma or with ion beam if available. Special designs have been developed for loading and rotating wafers with a tilt, or cooling and heating them up to 700°C. In all cases, samples can be loaded and unloaded with auto load/unload mechanism completely unassisted under PC control, through the third (optional) load lock chamber. Wafers or samples on carriers are presented to the main chamber with pneumatically driven end effector and transferred to the substrate holder which can be lifted again pneumatically against the heated or cooled platen and rotated typically at 1-3RPM or optionally at faster rate. For single wafer platens a shutter (optional) can be provided which rotates or driven with a stepper motor for very controlled thin film depositions or respectively to establish a desired gradient for combinatorial work.

In the case of batch processing of multiple wafers with planetary rotation, the sample holder is loaded through the front door. Substrate planetary fixture is made of three dome shaped substrate holders that roll around their own axis as well as vertical axis resulting in a planetary motion for the wafers. The fixture can be for 3", 4" or larger wafers up to 8". For these systems larger chambers are used. The thickness monitor can maintain its geometrical relationship with the substrate as platen rotates allows the deposition process to be calibrated and automated fully.

## Vacuum Package

Turbomolecular pumps are preferred for lower cost of maintenance, less space requirement, and ease of use. A sieve filter and oil free scroll pump are used for backing the turbo molecular pump. Bearings are vented with nitrogen. Automatic pump down and soft venting sequences are provided under PC control. Low  $10^{-7}$  Torr base pressure can be achieved with 680l/sec turbomolecular pump. Having larger capacity pumps and with wider use of CF flanges, base pressures can be reduced to mid  $10^{-8}$  Torr or lower; in such systems auto load unload is recommended to maintain low background pressure at all times. NANO-MASTER, designs maximize conductance by mounting the turbo molecular pumps directly on the chamber. PC controlled downstream pressure regulation is achieved with a proprietary technique. Cryo pumps are also available as an option and mounted on the back of the main chamber with pendulum valve which act as both throttle valve for regulating the pressure and gate valve behind the liner which also acts as a heat shield.

Pressure measurement for base pressure and the pressure readings for automatic pump down and venting are done by a wide range gauge and baratron gauge for process pressure regulation. All rotating seals are ferrofluidic.

## E-Beam Source

Large variety of E-beam sources with various number or sizes of pockets can be used. One 15cc pocket, 4x15cc pockets, 6x15cc pockets and 6x25cc pockets. In NEE-4000, co-evaporation capability with multiple e-beam sources and ability to program compositions or compositional gradients through PC control can be provided. Up to 10KV switching power supplies with programmable sweep controllers are available.

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# NANO-MASTER E-Beam Evaporation Systems

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## Computer Control

The software used to control NANO-MASTER systems was created to provide the user with an easy to operate systems that provides both flexibility and repeatability. There are four password protected user levels available.

These levels are Operator, Process, Engineering and Maintenance. The Operator level gives the user the ability to load and unload samples, put the system into or out of vacuum and execute previously written recipes. The Process level gives the user access to create process recipes for the system to run in automatically. This level also allows the user to access the Operator level screens. Recipes can be written with hundreds of different steps or can be written to repeat just a few steps several different times. This recipe structure gives the user the flexibility to deposit a single layer or couple of hundred layers all automatically. The Engineering level offers the user the ability to control the system manually. This manual control is useful for optimizing recipes and finding process limits. The Maintenance level offers the user independent control of every valve, motor and power supply for trouble shooting purposes. By simply opening cabinet panels the user can access all vacuum hardware as well as all the equipment in the instrumentation side of the system.

## Vacuum Chambers

The main chamber is 14" stainless steel cube having flanges mounted on each side for different applications and options. The turbo is mounted on the back plane. Auto load/unload is mounted on the left through a low profile pneumatic isolation valve and the platen is mounted on the top plane. Front of the cubic chamber has an 8" door with 5" window.

E-beam source and thermal evaporator (option) are mounted on the base plate. Various other options such as heated platen and pneumatic lift of the substrate or shutter are part of the platen assembly that can be mounted on top. There are additional nipples providing access to the chamber for diagnostics, gauging or introducing gasses. The system comes with up to three pneumatically controlled 50 sccm MFCs (Ar, O<sub>2</sub>, N<sub>2</sub> or user specified) and associated electropolished stainless steel tubes and pneumatic shut off valves for reactive evaporation.

## Second configuration:

21"W x 21"H x 22"D SS chamber with 20" x 20" door and 5" view port. Turbo is mounted on the back plane. Auto load/unload is mounted on the left hand side of the chamber. Various other options such an additional e-beam source for co-evaporation, thermal evaporator and sputtering capability is mounted on the bottom of the base plate. Ion beam source (optional) for ion assisted deposition or ion beam cleaning of the substrate can also provided for extra applications.



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# NANO-MASTER E-Beam Evaporation Systems

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## SPECIFICATIONS

**Process Chamber:** SS 14" Cube with 8" Door and source chamber mounted on the bottom of the base plate or 21"W x 21"H x 22"D Stainless Steel chamber with large 20" x 20" access door

**Substrate fixturing:** Heated platen and rotating single substrate holder for up to 8" wafer, tiltable platen for glancing angle deposition with optional stepper motor driven shutter, high temperature platen up to 800°C. For large chamber batch systems substrate holder for various substrate sizes include 90° angle of incidence planetary rotation with 3 planetary globes having variable angle and flip chip capabilities

**Source Access:** Easy source access can be accomplished by either opening the source load flange to change materials or by lowering the source housing plate for source cleaning

**E-Vap Source:** Rotary (optional 6 Pocket) 4 pocket, 15 cc (or optional 40cc per pocket), 6 kW, directly cooled crucibles, E-Vap source Flush-top design reduces cross-contamination of materials

**E-Vap Power Supply:** 6kW, Switching power supply, air cooled, 208/220 VAC three phase, power supply

**E-Vap Source Control:** Source Control Module with remote, output 12VAC, Air Cooled

**E-Vap Sweep Control:** Sweep Controller, Programmable sweep, touch screen programming, computer interface to RS-232, stores up to eight user-modified patterns

**Instrumentation Port:** An additional port has been provided for instrumentation such as an RGA

**Pumps:** 680 l/sec, 1240 l/sec turboolecular pump or cryo pump with pendulum valve and water cooled; 21cfm dry scroll pump

**Base Vacuum:** Less than  $5 \times 10^{-7}$  torr in a clean system, with cryo pump (option) base pressure is  $10^{-8}$  torr range

## FACILITY REQUIREMENTS

Power Input:	208VAC/380VAC/415VAC, 20A/Phase, 50/60Hz
Chilled Water:	2gpm @ 50psi, 18°C
Compressed Air:	1/4" Swagelok, 80-90 PSI
Processed Gas:	1/4" Swagelok, 20 PSIG
Nitrogen:	1/4" Swagelok, 20 PSIG
Exhaust (System):	NW25

## DIMENSIONS

	Width	Depth	Height
NEE-4000	43"	26"	60"



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