Atomic Layer Deposition Systems

## NANO-MASTER, Inc.

NANO-MASTER Atomic Layer Deposition Systems

Atomic Layer Deposition is an important technique for depositing thin films for a variety of applications. ALD is able to meet the needs for precise thickness control and conformal deposition in high aspect ratio structures to a level that far exceeds other deposition techniques. The nature of the sequential, self-limiting surface reactions in ALD produces a non statistical deposition because the randomness of the precursor flux is not a factor. As a result, ALD films remain extremely smooth, continuous, and pin-hole free allowing for excellent film properties. ALD processing can also be scaled to very large substrates.

NANO-MASTER has patents on Plasma Enhanced ALD where plasma contact with substrate is totally eliminated, unique "Continuous Flow" process which doubles the throughput of any PE ALD process, and a "Hybrid Chamber" design allows ALD and PECVD deposition to be performed in the same chamber without any hardware modification; as a result, thin ALD films can be deposited followed with a thick PECVD film automatically within the same recipe.

NLD-4000

The NLD-3500 and NLD-4000 are stand alone, PC controlled ALD systems with LabVIEW software featuring three levels password-controlled user authorization. The systems are fully automated and safety-interlocked and offers flexibility to deposit multiple films (ex. Al_2O_3, AlN, TiN, ZrO_2, LaO_2, HfO_2) for Semiconductor, Photovoltaic and MEMS applications. They have a 13" aluminum reaction chamber with heated walls and a pneumatically lifted top for easy chamber access and cleaning. The systems features an onboard gas pod containing up to seven heated 50cc cylinders for precursors and reactants with fast-pulse heated delivery valves using N_2 or Ar as a carrier gas.
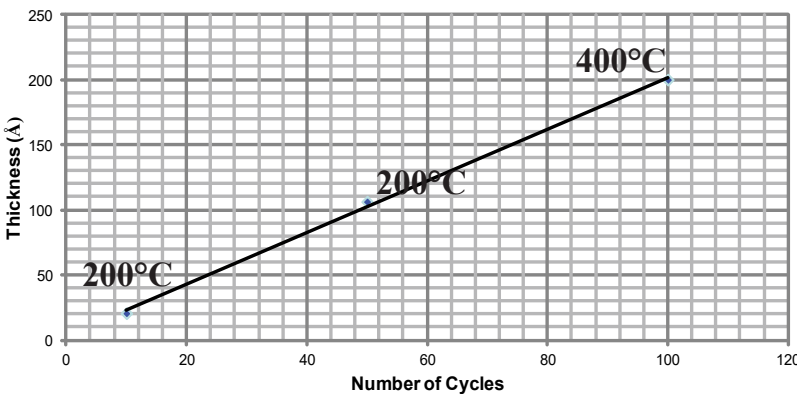
Linear Relationship between Thickness and Number of Cycles

Unreacted precursor can be captured with a heated filter on the chamber exhaust port. All heater set points are PID controlled. Automatic PC control of recipes, temperatures, flows, pumpdown/vent cycles, and delivery line flusing. Options include automatic load-unload (without changing system footprint), planar ICP source with remote plasma for Plasma Enhanced ALD (Planar ICP geometry maintains a small reaction chamber volume, speeding up cycle times), turbomolecular pump (only for NLD-4000 model) for faster cycles and a lower base pressure.

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FEATURES
• Less than 1Å uniformity
• 13" anodized aluminum chamber
• Minimal volume for fast cycle time and throughput
• Up to 8" substrate
• Heated chamber walls
• 400°C substrate heater
• Onboard precursor glovebox
• Up to seven 50cc precursor cylinders
• 300 l/sec maglev turbomolecular pumping package
• 5×10^{-7} torr base pressure
• Fast pulse gas delivery valves
• Large area filter to capture unreacted precursors
• High aspect ratio structure coating
• Fully automated PC based, recipe driven
• LabVIEW user interface
• Computer controlled safety interlocks
• Compatible with Class 100 cleanrooms

OPTIONS
• SS Chamber
• 10" Chamber
• Auto load/unload
• Additional precursors
• Biasable Platen
• Ellipsometer   • QCM   • RGA
• Downstream planar ICP source for PE-ALD process

APPLICATIONS
• High-k dielectrics
• Hydrophobic coating
• Passivation layer
• High aspect ratio diffusion barriers for Cu interconnects
• Conformal coatings for micro fluidics applications
• Fuel cells, e.g. single metal coating for catalyst layers

NLD-3500
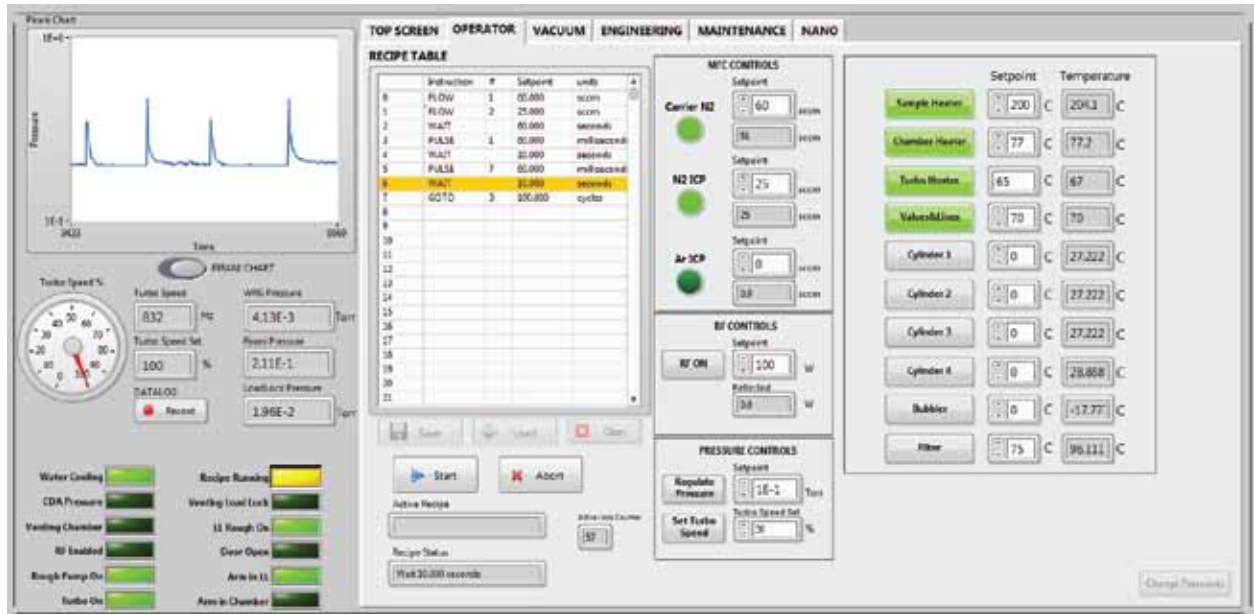

Precursor Glove Box

Chamber with ICP Source

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NLD-4000 with ICP Source and Auto Load/Unload

Software in Automatic Recipe Mode

Patents US 9,972,501, US 10,361,088, US 10,366,898 and US 11,087,959

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GENERAL SPECIFICATIONS

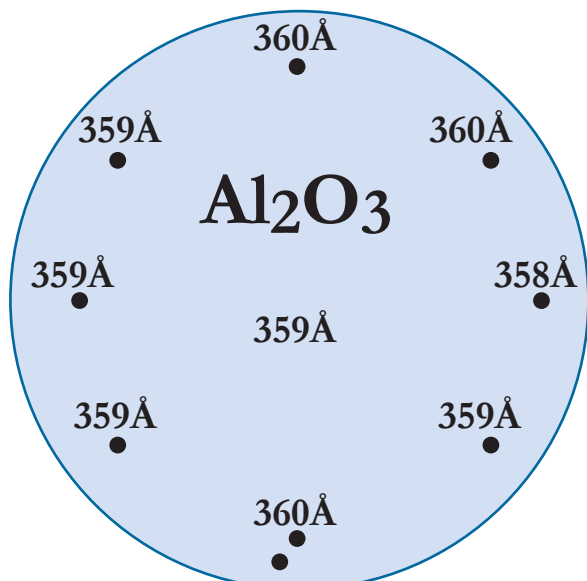|	
Maximum Substrate Size:	8"
Substrate Temperature Range:	Up to 400°C
Gas Lines:	Heated and Electropolished
Precursors:	Up to 7 Precursor/Reactant Cylinders
MFC's:	2 Standard, Extras Optional
Plasma Enhanced ALD:	Downstream ICP (Optional)
System Control:	PC Controlled with LabVIEW and Touchscreen User Interface
Loading and Unloding:	Manual or Automatic

FACILITY REQUIREMENTS

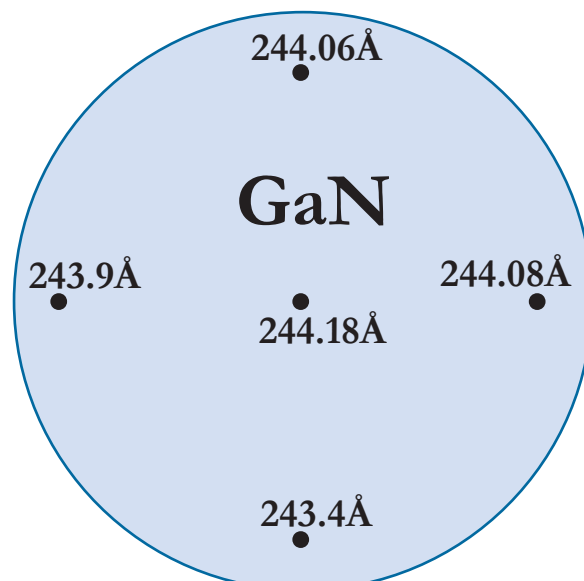|	
Power Input:	110V/208V/380V/415V, 20A/Phase, 50/60Hz
Chilled Water:	2gpm @ 50psi, 18°C
Compressed Air:	1/4" Swagelok, 80-90 PSI
Processed Gas:	1/4" Swagelok, 20 PSIG
Nitrogen:	1/4" Swagelok, 10 PSIG
Exhaust (System):	NW25

DIMENSIONS

DIMENSIONS	Width	Depth	Height
NLD-4000	26"	44"	44"
NLD-3500	26"	24"	44"
NLD-3000	26"	26"	32"

NLD-4000 Uniformity Data on 6" Wafer

Al_2O_3

360Å 359Å 360Å 359Å 358Å 359Å 359Å 359Å 360Å

Cycles: 300
(TMA + H_2O)
Uniformity: 0.27%

GaN

244.06Å 243.9Å 244.08Å 244.18Å 243.4Å

Cycles: 150
(GaCl$_3$ + N$_2$ Plasma)
Uniformity: 0.3%

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