TORONTECH

LOAD-LOCK MAGNETRON SPUTTERING SYSTEM

Load-Lock Magnetron Sputtering System - ToronSputter™ SD

Load-Lock Magnetron Sputtering System – Sputter-Down

The ToronSputter™ SD is a load-lock magnetron sputtering system in a sputter-down configuration, designed for high-throughput PVD research and production that requires continuous main chamber vacuum preservation between sample exchanges. A dedicated pump evacuates the load-lock to 10^{-6} Torr in 10 minutes, allowing continuous sample exchange without venting the main chamber, which holds 10^{-8} Torr base pressure. The magnetic-arm transfer mechanism loads and unloads 2", 3", 4", and 6" substrates. The rapid cycle enables 20 to 30 experiments per day.

Sputter-down sputtering guns in diameters of 1 to 6 inches are available in RF and DC configurations, with flex-head rotation and compression seals. The system deposits conductors including Au, Al, Ti, and Ni, and insulators including MgO, TiO_2, SiO_2, and TiN, at high rates with recipe control. Digital MFC gas inputs at 0.1 sccm sensitivity supply Ar, N_2, O_2, He, and CH_4 for inert and reactive sputtering. PID-controlled sample heating across 50 to 600 °C at ±1 °C supports deposition onto heated substrates.

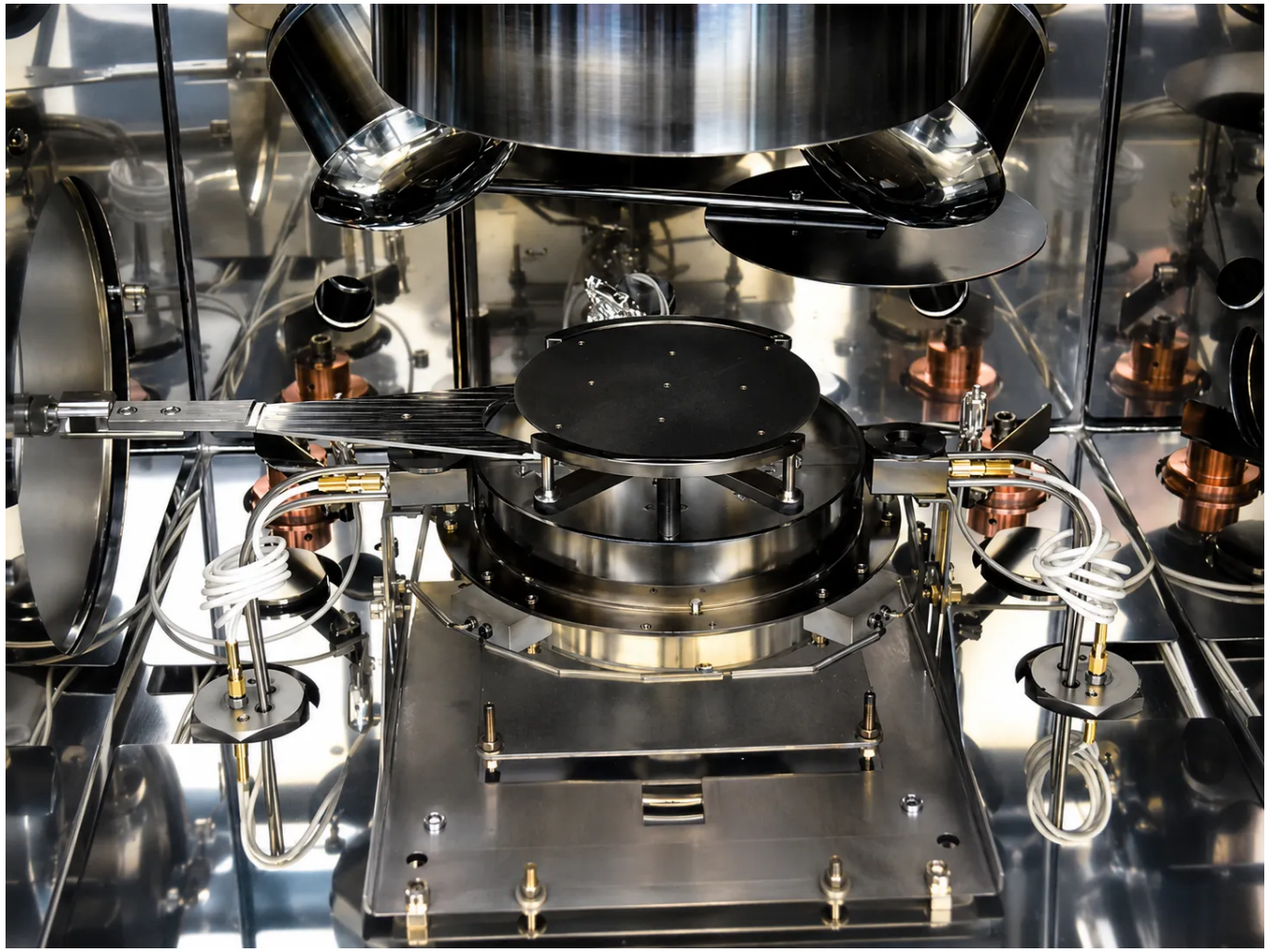
Thermal evaporation capability is available through 8V to 500A, 5000W sequential thermal sources with a design that prevents cross-contamination and allows easy material and source replacement. A dual-channel thickness controller with two QCMs monitors deposition rate at 0.1 Å/s precision, with 2 to 30 rpm sample rotation and plasma cleaning by DC/RF plasma. The pressure-control capability fixes working pressure to desired values using downstream and upstream flow control. Computer control and panel control operate with real-time LCD displays, with LabVIEW managing shutter and thickness sequences.

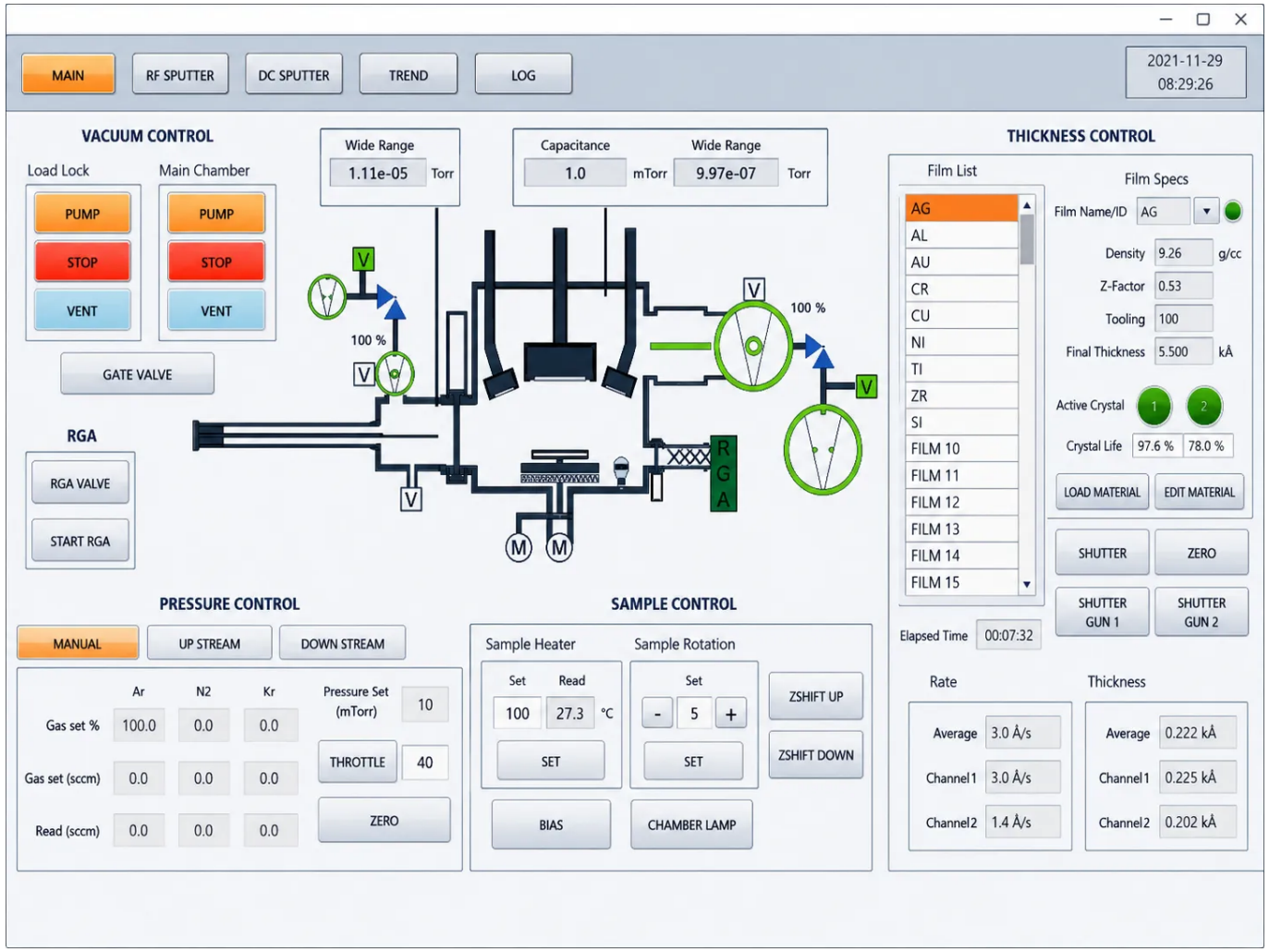
APPLICATIONS

Load-Lock Magnetron Sputtering System - ToronSputter™ SD Applications

The ToronSputter™ SD serves high-throughput PVD research and production environments where main chamber vacuum integrity, substrate cleanliness, and experiment cycle time are all primary considerations. Its load-lock architecture and sputter-down configuration make it applicable across multi-layer coating programs and research programs requiring frequent substrate changes.

- **High-Throughput PVD Research Facilities**: multiple substrate depositions per day without venting the main chamber, supporting iterative thin film research programs with rapid sample turnover
- **Semiconductor and Microelectronics Fabrication**: sputter-down deposition of metal contacts, barrier layers, and dielectric films on 2" to 6" wafers under clean, continuously maintained vacuum
- **Hard Coating and Tool Surface Engineering**: reactive sputtering of TiN, CrN, TiAlN, and DLC coatings on cutting tools and molds at high deposition rates with recipe-controlled processes
- **Optical Thin Film Production**: deposition of TiO_2, SiO_2, and other optical coatings with downstream and upstream pressure control for stoichiometric reactive sputtering
- **Electronics and RF Component Coating**: DC and RF sputter deposition of Au, Al, Ti, and other conductors for electronics, RF packaging, and precision connector metallization
- **Academic and University Research Programs**: flexible multi-source platform for materials science, device physics, and surface engineering research with rapid load-lock sample exchange
- **Medical Device and Implant Coating**: sputter deposition of TiN, DLC, and biocompatible metallic films under clean vacuum with recipe-controlled process sequences




MAIN
RF SPUTTER
DC SPUTTER
TREND
LOG
2021-11-29
08:29:26
VACUUM CONTROL
Load Lock
Main Chamber
PUMP
STOP
VENT
PUMP
STOP
VENT
GATE VALVE
Wide Range
1.11e-05
Torr
Capacitance
1.0
mTorr
Wide Range
9.97e-07
Torr
100 %
100 %
V
V
V
V
V
M
M
RGA
RGA VALVE
START RGA
THICKNESS CONTROL
Film List
AG
AL
AU
CR
CU
NI
TI
ZR
SI
FILM 10
FILM 11
FILM 12
FILM 13
FILM 14
FILM 15
Film Specs
Film Name/ID
AG
Density
9.26
g/cc
Z-Factor
0.53
Tooling
100
Final Thickness
5.500
kÅ
Active Crystal
1
2
Crystal Life
97.6 %
78.0 %
LOAD MATERIAL
EDIT MATERIAL
SHUTTER
ZERO
SHUTTER GUN 1
SHUTTER GUN 2
Elapsed Time
00:07:32
PRESSURE CONTROL
MANUAL
UP STREAM
DOWN STREAM
Ar
N2
Kr
Gas set %
100.0
0.0
0.0
Gas set (sccm)
0.0
0.0
0.0
Read (sccm)
0.0
0.0
0.0
Pressure Set (mTorr)
10
THROTTLE
40
ZERO
SAMPLE CONTROL
Sample Heater
Set
Read
100
27.3
°C
SET
Sample Rotation
Set
-
5
+
SET
ZSHIFT UP
ZSHIFT DOWN
BIAS
CHAMBER LAMP
Rate
Average
3.0 Å/s
Channel1
3.0 Å/s
Channel2
1.4 Å/s
Thickness
Average
0.222 kÅ
Channel1
0.225 kÅ
Channel2
0.202 kÅ

CAUTION
WEAR GLOVES
CAUTION
KEEP DOOR CLOSED
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TorosSputter™ SB
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Load-Lock Magnetron Sputtering System - ToronSputter™ SD Key Features

The ToronSputter™ SD integrates a load-lock sample exchange system, sputter-down gun configuration, MFC gas control, and PID substrate heating in a high-vacuum platform designed for high-throughput research and production sputtering.

- **Dedicated Load-Lock Pump, 10^{-6} Torr in 10 Minutes**: separate pumping system evacuates the load-lock independently, enabling sample introduction without disturbing the main chamber vacuum
- **10^{-8} Torr Main Chamber Base Pressure**: turbomolecular and mechanical pump combination with dry pump option achieves the base pressure level needed for high-purity magnetron sputtering
- **Magnetic Arm Sample Transfer, 2" to 6" Substrates**: magnetic arm loading and unloading mechanism handles substrates from 2" to 6" diameter for flexible substrate compatibility
- **20 to 30 Experiments Per Day Throughput**: load-lock architecture enables rapid sample exchange and compresses inter-deposition time, supporting high-volume research and production programs
- **1 to 6-Inch RF and DC Sputter Guns with Flex-Head Rotation**: wide gun diameter range with self-axis rotation and compression seals for flexible target configuration and reliable vacuum sealing
- **Conductor and Insulator Deposition at High Rates**: recipe-controlled deposition of conductors (Au, Al, Ti, Ni) and insulators (MgO, TiO_2, SiO_2, TiN) with high-rate sputter processes
- **SS304 Chamber (Prismatic or Cylindrical) with Electro-Polished Surfaces**: feather-touch, electro-polished interior with SS304 liner; water-cooled chamber surfaces available when needed
- **Standard 1-inch, QF, CF, and ISO Feedthrough Ports**: configurable port selection supports upgrades to additional thermal and sputtering sources without chamber modification
- **UV-Blocking Observation Window with LabVIEW Shutter Control**: rotatable door shutter for process timing, with LabVIEW-managed sample shutter and thickness control integration
- **Throttle, Vent, Isolation, and Gate Valve Configuration**: comprehensive valve set manages all pressure transitions; main chamber remains continuously under vacuum via isolation valve when idle
- **Fully Automatic Computer and Panel Control with LCD Displays**: all deposition operations run automatically under computer control, with panel override and real-time LCD status
- **Interlock-Protected Automatic Water Cooling**: closed-loop water cooling activates and deactivates automatically, with interlock preventing sputtering or evaporation without active coolant flow
- **Wide-Range Vacuum Control (1000 to 10^{-9} Torr)**: integrated vacuum measurement and control across the full pressure range for both process gas and deep base vacuum monitoring
- **Downstream and Upstream Pressure Control**: working pressure can be fixed to desired values using downstream or upstream mass flow control methods, supporting precise reactive sputtering

- **50 to 600 °C PID Substrate Heating with ±1 °C Sensitivity**: closed-loop temperature control supports deposition on heated substrates across a wide range for film crystallinity and adhesion
- **2 to 30 rpm Sample Rotation with DC/RF Plasma Cleaning**: adjustable substrate rotation with PC speed control, plus DC/RF plasma cleaning to remove native oxides before deposition
- **Digital MFC Gas Inputs (Ar, N_2, O_2, He, CH_4) at 0.1 sccm Sensitivity**: mixed gas delivery with digital flow control supports inert and reactive sputtering processes
- **0.1 Å/s Dual-Channel Thickness Monitoring with Two QCMs**: precision deposition rate and cumulative thickness measurement across two independent channels simultaneously
- **8V to 500A, 5000W Thermal Sources for Co-Evaporation**: high-power sequential and co-evaporation thermal sources with cross-contamination prevention design and easy material replacement
- **Load-Lock Adaptable to E-Beam and Thermal Source Systems**: the load-lock architecture can be configured for platforms combining magnetron sputtering with e-beam and thermal evaporation sources
- **Two-Year Warranty for Materials, Design, and Workmanship**: comprehensive two-year coverage for system components, design, and manufacturing quality

THEORY & METHOD

Theory and Method

A load-lock is a small separately pumped antechamber that allows substrate transfer without exposing the main process chamber to atmospheric pressure. Conventional systems vent the entire main chamber to atmosphere for each sample change, requiring a full pump-down cycle before every deposition run. A load-lock separates these vacuum spaces with gate valves, so the main chamber holds base pressure while samples enter and exit. This architecture compresses the time between consecutive depositions to minutes rather than hours, enabling 20 to 30 experiments per day.

Sputter-down magnetron sputtering positions the targets above the substrate, so sputtered atoms travel downward, reducing particulate contamination from falling debris. This orientation contrasts with sputter-up configurations, where

gravity directs target flakes and loose particles directly onto the growing film surface. The magnetron's magnetic field confines the plasma near the target face, increasing sputtering efficiency and enabling high deposition rates at low working pressures. DC power handles conductive targets while RF at 13.56 MHz extends the process to insulating materials.

The main chamber holds 10^{-8} Torr base pressure with a turbomolecular and mechanical pump, while a separate pump evacuates the load-lock to 10^{-6} Torr in 10 minutes. Throttle, vent, isolation, and gate valves control all pressure transitions, with the main chamber held continuously under vacuum by an isolation valve. Water cooling with automatic on-off interlock prevents sputtering gun or thermal source operation without active coolant flow. Thermal source capability at 8V to 500A, 5000W supports co-evaporation and sequential multi-material deposition in the same run.

TECHNICAL SPECIFICATIONS

Load-Lock Magnetron Sputtering System - ToronSputter™ SD Technical Specifications

Parameter	Specification
Main Chamber Base Pressure	10^{-8} Torr
Load-Lock Vacuum Level	10^{-6} Torr in 10 minutes
Vacuum Control Range	1000 to 10^{-9} Torr
Pump Configuration	Turbomolecular + Mechanical (dry pump optional); dedicated load-lock pump
Valve Configuration	Throttle, vent, isolation, and gate valves
Chamber Material	SS304 (prismatic or cylindrical); electro-polished; SS304 liner
Chamber Surface Cooling	Water-cooled surfaces (when needed)
Feedthrough Ports	Standard 1-inch, QF, CF, ISO

Parameter	Specification
Observation Window	UV-blocking; rotatable door shutter
Sputtering Configuration	Sputter-down
Sputtering Guns	1 to 6 inches; RF and DC; flex-head; self-axis rotation; compression seal
Sample Transfer	Magnetic transfer arm
Sample Sizes	2", 3", 4", 6"
Substrate Heating	50 to 600 °C (PID controlled, ±1 °C)
Sample Rotation Speed	2 to 30 rpm (PC controlled)
Plasma Cleaning	DC/RF plasma
Gas Inputs	Ar, N_2, O_2, He, CH_4 and others; digital MFC; 0.1 sccm sensitivity
Pressure Control Method	Downstream and upstream flow control
Thickness Monitoring	Dual-channel; 0.1 Å/s precision; 2 QCMs
Thermal Sources	8V to 500A, 5000W (sequential and co-evaporation)
Cooling System	Automatic closed-loop water cooling (interlock protected)
Control System	Fully automatic computer control; panel control; real-time LCD; LabVIEW
Experiment Throughput	20 to 30 experiments per day
Warranty	2 years (materials, design, and workmanship)

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