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LOAD-LOCK SPUTTER-UP DEPOSITION SYSTEM

Load-Lock Sputter-Up Deposition System - ToronSputter™ SU

Load-Lock Magnetron Sputtering System – Sputter-Up

The Load-Lock Sputter-Up Deposition System combines upward-facing magnetron sputtering sources with organic effusion cells in a load-lock chamber for combined inorganic and organic thin film deposition. The sputter-up configuration positions targets below the substrate, which faces downward, enabling confocal deposition geometry and multi-source integration. A dedicated load-lock pump reaches 10^{-6} Torr in 10 minutes, keeping the main chamber at 10^{-8} Torr base pressure. Load-lock sample exchange via magnetic arm enables 20 to 30 experiments per day.

Organic evaporation uses PID-controlled effusion cells across 50 to 800 °C at ±1 °C for organic semiconductor and OLED material deposition. Inorganic sputtering uses 1 to 6-inch RF and DC guns, depositing conductors and insulators including Au, Al, TiN, and SiO_2 at high rates with recipe control. Digital MFC gas inputs at 0.1 sccm sensitivity enable inert and reactive sputtering. High-power thermal sources at 8V to 500A, 5000W add sequential and co-evaporation capability in the same run.

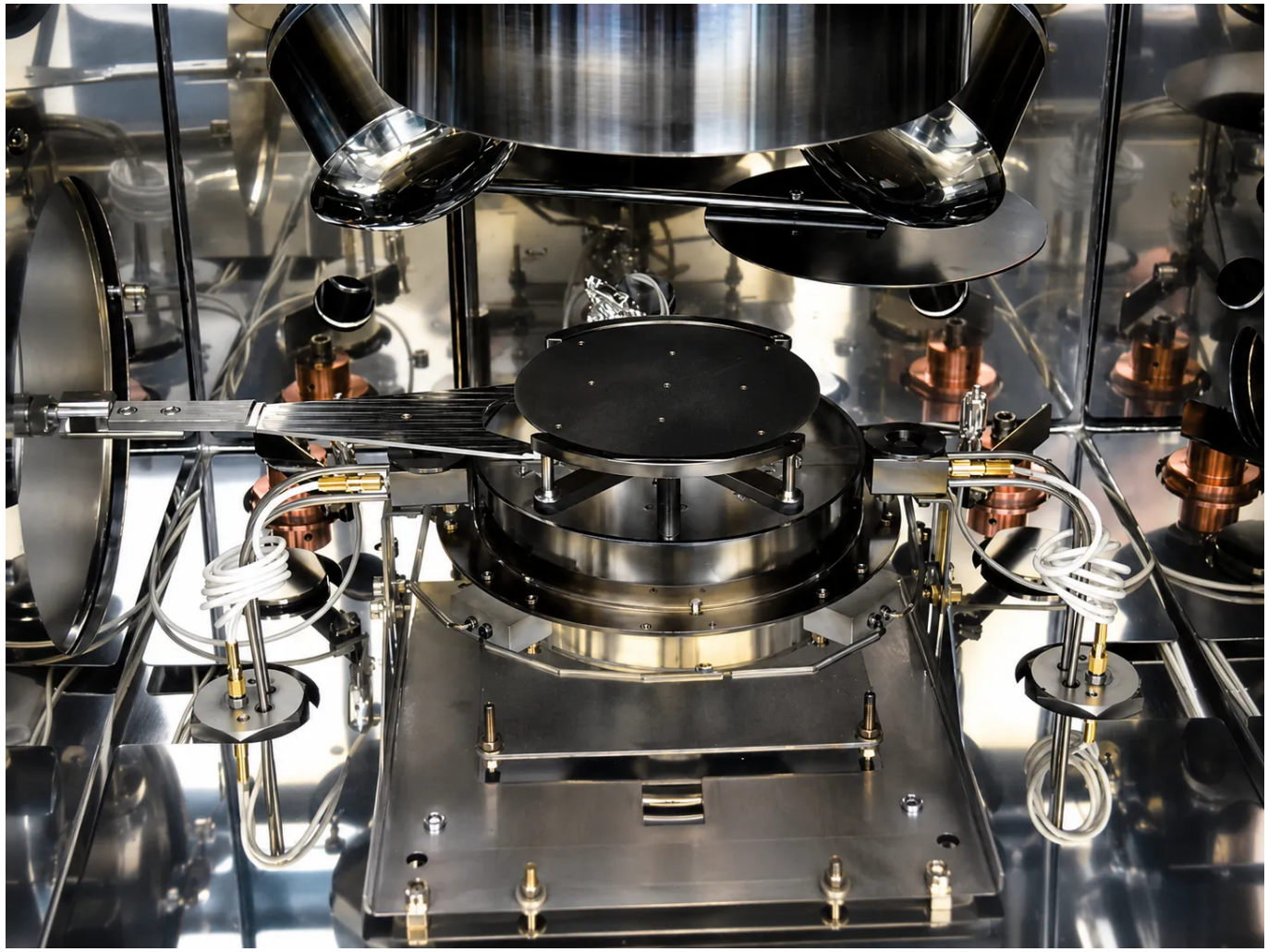
PID-controlled substrate heating across 50 to 600 °C at ±1 °C, combined with 2 to 30 rpm rotation and DC/RF plasma cleaning, supports deposition onto heated substrates. A dual-channel thickness controller with two QCMs tracks deposition rate and cumulative thickness at 0.1 Å/s. Vacuum control spans 10^{-1} to 10^{-9} Torr with downstream and upstream pressure-fixing capability. Automatic on-off water cooling interlock and a UV-blocking observation window with LabVIEW shutter control manage process safety and deposition timing.

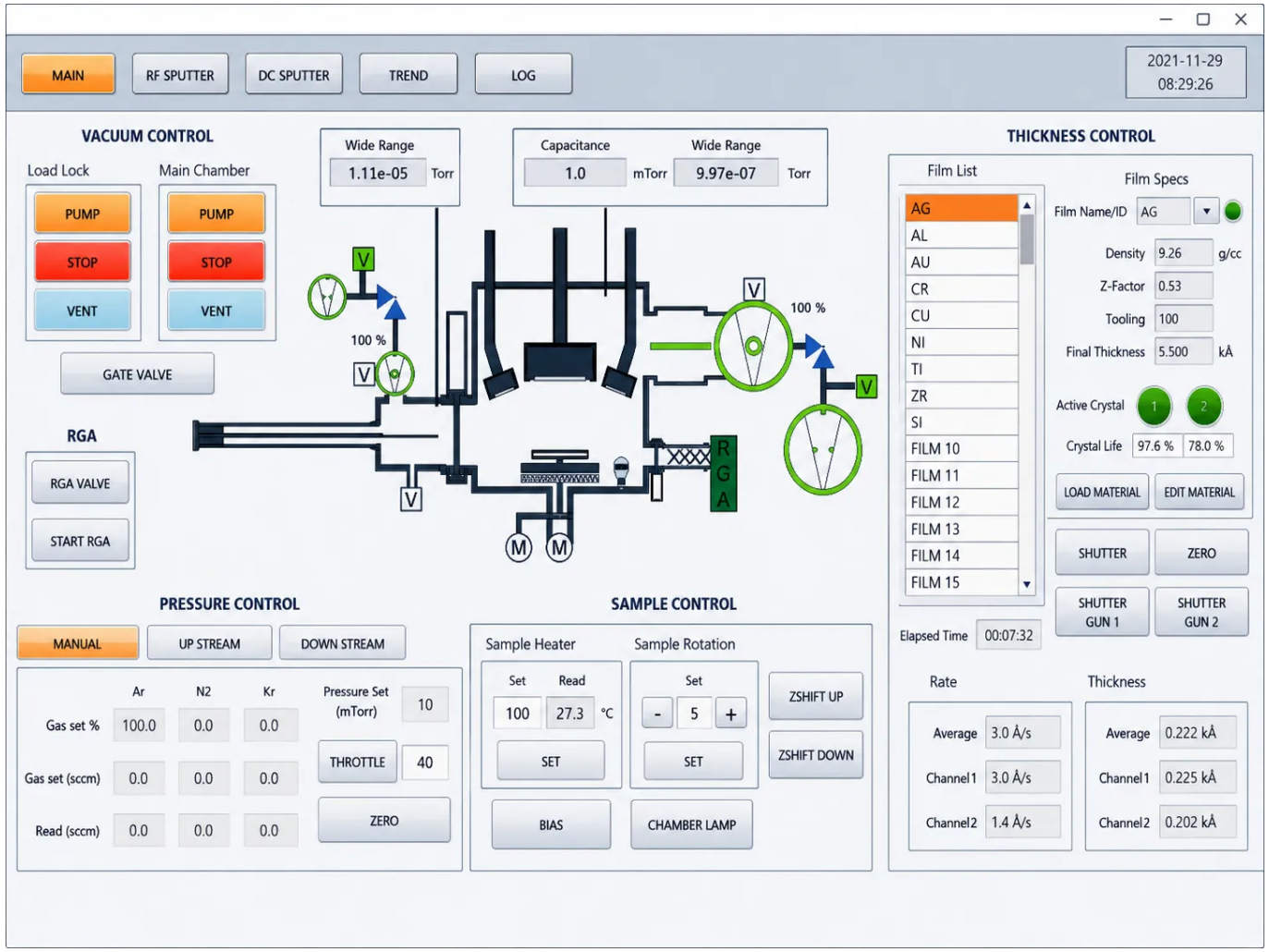
APPLICATIONS

Load-Lock Sputter-Up Deposition System - ToronSputter™ SU Applications

The Load-Lock Sputter-Up Deposition System serves organic and inorganic thin film research requiring combined sputter deposition and organic evaporation in a continuous-vacuum platform. Its confocal sputter-up geometry, organic effusion cells, and load-lock architecture make it suited to multilayer organic-inorganic device fabrication and high-throughput PVD research programs.

- **OLED and Organic Light-Emitting Device Fabrication**: combined in-situ deposition of organic emitter and transport layers by effusion cell and metal electrode layers by sputtering, without air exposure between steps
- **Organic Photovoltaic Cell Research**: sputter-up deposition of transparent contact layers and reactive-sputtered oxide films alongside effusion-deposited organic active layers for OPV device prototyping
- **Perovskite Solar Cell Development**: combined organic hole-transport and metallic contact deposition in a single vacuum environment, reducing defects from atmospheric moisture and oxygen exposure
- **Organic Semiconductor and OFET Research**: precise effusion-cell deposition of small-molecule organic semiconductors with confocal sputter-up metallization for device contact fabrication
- **Optical Thin Film Research**: reactive sputter-up deposition of TiO_2, SiO_2, and other optical coatings with downstream pressure control for stoichiometric accuracy
- **Hard Coating and Surface Engineering**: reactive RF sputtering of TiN, CrN, DLC, and related films from below-mounted upward-facing targets on tooling and mechanical components
- **High-Throughput Multi-Material PVD Research**: 20 to 30 experiments per day with load-lock sample exchange supporting iterative multilayer organic-inorganic deposition programs




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
KEEP DOOR CLOSED
CAUTION
WEAR GLOVES
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FEATURES

Load-Lock Sputter-Up Deposition System - ToronSputter™ SU Key Features

The Load-Lock Sputter-Up Deposition System integrates confocal sputter-up magnetron guns, Knudsen effusion cells for organics, MFM gas control, and load-lock sample exchange in a high-vacuum platform for combined organic-inorganic thin film research.

- **50 to 800 °C Effusion Cells for Organic Evaporation (±1 °C PID)**: Knudsen effusion cells provide precise organic semiconductor, OLED emitter, and hole-transport material deposition alongside sputtering sources in the same chamber, distinguishing this system from sputter-down configurations
- **1 to 6-Inch RF and DC Sputter-Up Guns with Flex-Head Rotation**: upward-facing guns with self-axis rotation and compression seals for confocal multi-source deposition geometry on downward-facing substrates
- **Confocal Sputter-Up Geometry**: multiple gun axes converge at a common substrate center point, improving co-deposition uniformity and enabling multi-material deposition without substrate repositioning
- **10^{-8} Torr Main Chamber Base Pressure**: turbomolecular and mechanical pump combination with dry pump option maintains the base pressure level needed for high-purity organic and inorganic film deposition
- **Dedicated Load-Lock Pump, 10^{-6} Torr in 10 Minutes**: separate pumping system evacuates the load-lock without disturbing main chamber vacuum; adaptable to e-beam and thermal source platforms
- **Magnetic Arm Sample Transfer, 2" to 6" Substrates**: magnetic arm loading and unloading for 2" to 6" diameter substrates with easy sample exchange options
- **20 to 30 Experiments Per Day**: load-lock architecture enables rapid sample cycling, supporting high-throughput multilayer research and iterative device fabrication programs
- **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
- **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
- **UV-Blocking Observation Window with LabVIEW Shutter Control**: rotatable door shutter and LabVIEW-integrated sample shutter for precise deposition timing and thickness control integration
- **Throttle, Vent, Isolation, and Gate Valve Configuration**: comprehensive valve set manages all pressure transitions; main chamber held 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 process monitoring
- **Interlock-Protected Automatic Water Cooling**: closed-loop water cooling activates and deactivates automatically, with interlock preventing source operation without active coolant flow

- **Wide-Range Vacuum Control (10^{-1} to 10^{-9} Torr) with Pressure Fixing**: vacuum measurement and downstream or upstream pressure-fixing capability for precise reactive sputtering process windows
- **50 to 600 °C PID Substrate Heating with ±1 °C Sensitivity**: closed-loop substrate temperature for film crystallinity, adhesion, and interface management across a wide range
- **2 to 30 rpm Sample Rotation with DC/RF Plasma Cleaning**: PC-controlled substrate rotation for deposition uniformity, plus DC/RF plasma cleaning to remove surface oxides before deposition
- **Digital MFC Gas Inputs (Ar, N_2, O_2, He, CH_4) at 0.1 sccm Sensitivity**: MFC-controlled mixed gas delivery supports inert and reactive sputtering processes
- **0.1 Å/s Dual-Channel Thickness Monitoring with Two QCMs**: simultaneous rate and thickness measurement across organic and inorganic deposition channels
- **Load-Lock Adaptable to E-Beam and Thermal Source Systems**: 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

Sputter-up magnetron sputtering positions targets below the substrate, which faces downward with its deposition surface presented to the upward-traveling sputtered flux. This substrate-down, source-up geometry enables confocal arrangements where multiple gun axes converge at the substrate center, improving composition uniformity during co-deposition. The downward-facing substrate sits directly above organic effusion cells, allowing sequential or simultaneous organic and inorganic deposition in the same vacuum cycle. Load-lock access keeps the main chamber under vacuum while samples cycle in and out through the antechamber.

Organic material evaporation uses Knudsen effusion cells rather than the high-current boats used for inorganic metals. PID control at ±1 °C across 50 to 800 °C maintains stable molecular flux, since organic materials respond disproportionately to small temperature shifts. QCM thickness monitoring at 0.1 Å/s tracks organic and inorganic film buildup across two channels in real time. Target-sample geometry in the sputter-up configuration places organic and metallic sources on the same side, depositing both on the same substrate face without repositioning.

The main chamber holds 10^{-8} Torr base pressure with a turbomolecular and mechanical pump, while a separate load-lock pump reaches 10^{-6} Torr in 10 minutes. Throttle, vent, isolation, and gate valves control all vacuum transitions, with the main chamber held continuously under vacuum when the system is idle. Vacuum measurement and control spans 10^{-1} to 10^{-9} Torr, with downstream or upstream pressure-fixing capability. High-power 8V to 500A, 5000W thermal sources supplement sputtering with co-evaporation and sequential deposition capability.

TECHNICAL SPECIFICATIONS

Load-Lock Sputter-Up Deposition System - ToronSputter™ SU Technical Specifications

Parameter	Specification
Deposition Configuration	Sputter-up (substrate-down, sources-up)
Organic Evaporation	Knudsen effusion cells; 50 to 800 °C; PID controlled; ±1 °C
Main Chamber Base Pressure	10^{-8} Torr
Load-Lock Vacuum Level	10^{-6} Torr in 10 minutes
Vacuum Control Range	10^{-1} to 10^{-9} Torr
Pump Configuration	Turbomolecular + Mechanical (dry pump optional); dedicated load-lock pump

Parameter	Specification
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
Observation Window	UV-blocking; rotatable door shutter
Sputtering Guns	1 to 6 inches (upward-facing); RF and DC; flex-head; self-axis rotation; compression seal
Thermal Sources	8V to 500A, 5000W (sequential and co-evaporation)
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
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)

TORONTECH.com

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Torontech Inc.
251 Consumers Road, Suite 1200
Toronto, Ontario, M2J 4R3, Canada

Phone: +1 416 368 2721 | Fax: +1 416 981 7652
Email: info@torontech.com

Torontech, LLC
601 Brickell Key Drive, Suite 700
Miami, FL 33131, USA

Toll-Free: 1-866-383-7919
Email: sales@torontech.com

Torontech ME FZE
Meydan Grandstand, 6th Floor,
Meydan Road, Nad Al Sheba,
Dubai-261440, UAE

Phone: +971 488 19252
Email: me@torontech.com

USA | Canada | EU | UAE | GCC | KSA | India | Africa | Latin America | Asia