TORONTECH

MAGNETRON SPUTTERING SYSTEM - TORONSPUTTER™ MAG

Magnetron Sputtering System - ToronSputter™ Mag

ToronSputter™ Mag is a fully automated magnetron sputtering system for research and production thin film deposition using DC and RF power. The DC supply provides 0 to 1000 V, 2000 W for conductive targets; the RF supply at 13.56 MHz, 300 to 1200 W covers insulators and reactive processes. One to four sources in 1 to 4-inch target diameters enable single-target and multi-target deposition. The SS304 chamber (30 to 60 cm) reaches 10^{-8} Torr base pressure and 2×10^{-6} Torr in 20 minutes.

Three-channel MFM gas control (Ar, N_2, O_2, He, CH_4, H_2) supports inert and reactive sputtering across 1 to 100 mTorr, with throttle, vent, and isolation valves for precise pressure setting. A capacitance manometer provides additional plasma pressure measurement during reactive processes. PID heating at 50 to 700 °C and 2 to 30 rpm rotation with RF plasma cleaning via substrate biasing prepare substrates. Wide-range vacuum control (1000 to 10^{-9} Torr) and 120 °C baking maintain base pressure and chamber condition.

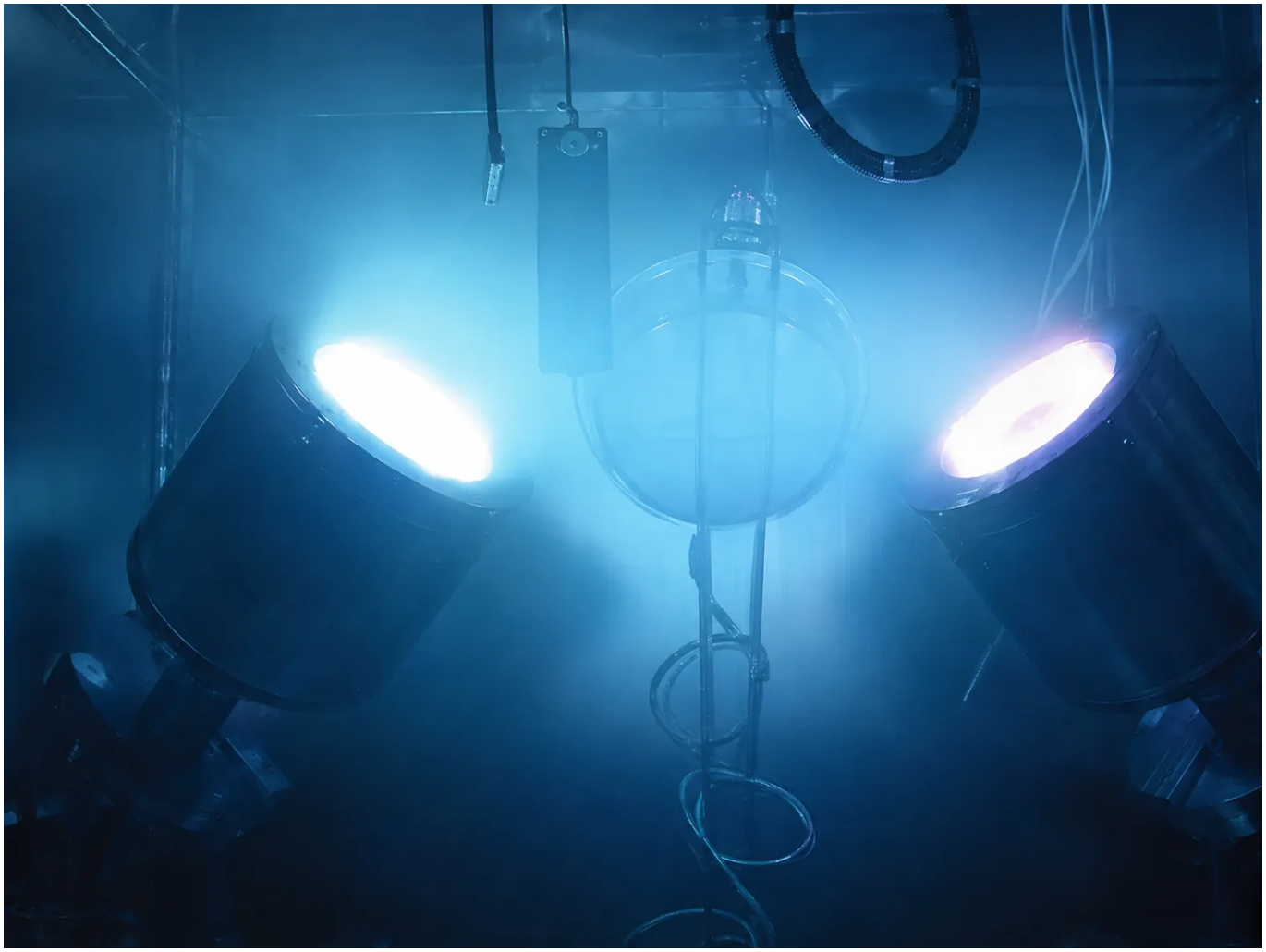
A dual-channel thickness controller with 1 to 4 QCMs at 0.1 Å/s, managed by LabVIEW automation, controls each layer sequence fully automatically. The SS304 chamber in 30/40/50/60 cm configurations has electro-polished surfaces and standard 1-inch, QF, CF, and ISO ports. Automatic start-stop closed-loop water cooling and an observation window with rotatable shutter support monitored deposition. The 75×120 cm footprint on lockable wheels passes through standard doorways, with internal lighting and 120 °C baking capability.

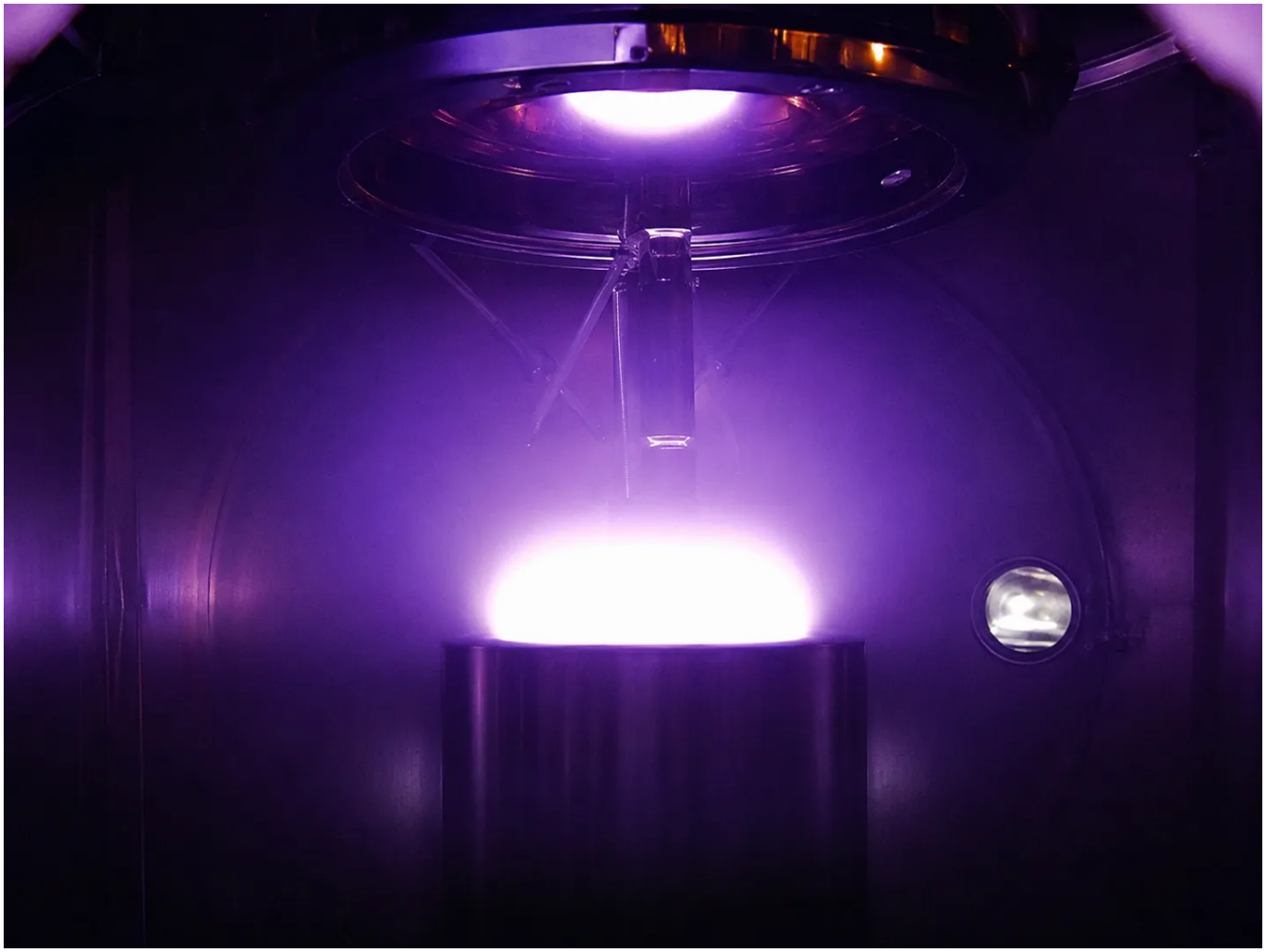
APPLICATIONS

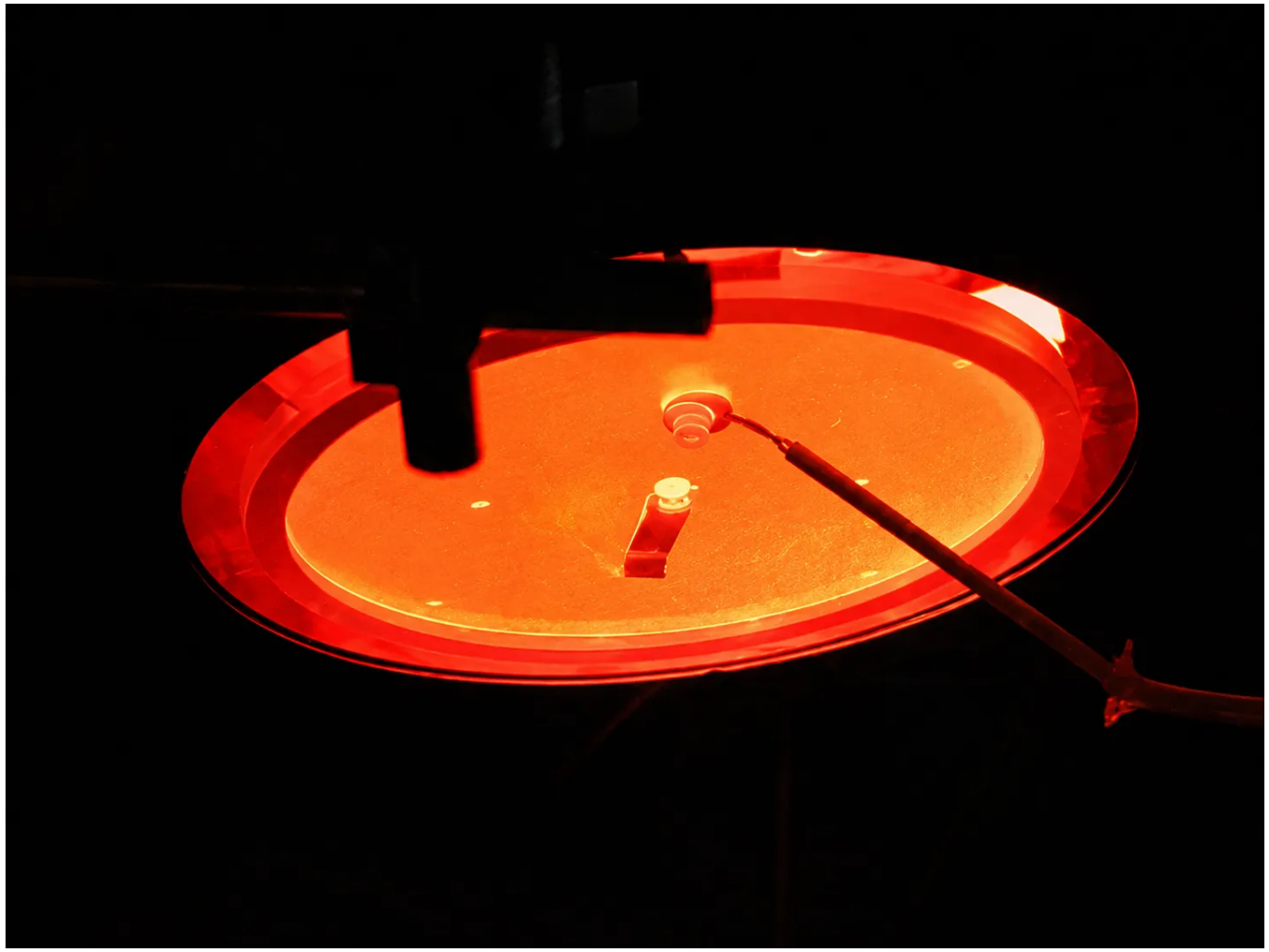
Magnetron Sputtering System - ToronSputter™ Mag Applications

The ToronSputter™ Mag serves PVD research and production facilities requiring DC and RF magnetron sputtering across a wide range of conductive and insulating materials, with multi-target flexibility and precise reactive sputtering control.

- **Semiconductor and Microelectronics Research**: deposition of metal contacts, barrier layers, and dielectric films on wafer substrates using DC and RF magnetron sputtering at controlled rates and compositions
- **Optical Thin Film Deposition**: reactive RF sputtering of TiO_2, SiO_2, and other optical oxide coatings with capacitance manometer pressure control for stoichiometric accuracy
- **Hard Coating and Wear-Resistant Surface Engineering**: reactive DC and RF sputtering of TiN, CrN, TiAlN, and DLC films on cutting tools, molds, and mechanical components
- **Energy Device Research**: sputtering of transparent conductive oxides, barrier layers, and metallic contacts for thin-film solar cells, fuel cells, and energy storage device research
- **Materials Science and Alloy Film Research**: multi-target and co-sputtering of alloys, compound films, and mixed oxides for compositional studies and structure-property research
- **Electronics and RF Component Coating**: DC sputtering of Au, Al, Ti, and other conductive metals for electronics packaging, RF connectors, and precision component metallization
- **Academic and University PVD Laboratories**: flexible multi-source platform for teaching and materials research across a broad range of thin film deposition materials and techniques







TORONTECH
ToronSputter™ Mag
Magnetron Sputtering System
VACUUM CONTROL - MV
THICKNESS CONTROL - MV
GAS CONTROL - MVGC64
MVAC 2000 POWER SUPPLY - MVPS/01

FEATURES

Magnetron Sputtering System - ToronSputter™ Mag Key Features

The ToronSputter™ Mag integrates DC and RF magnetron sputtering with three-channel MFM gas control, LabVIEW layer automation, and capacitance manometer plasma pressure monitoring in a multi-target high-vacuum sputtering platform.

- **1 to 4 DC/RF Magnetron Sputter Sources (1" to 4" Targets)**: configurable single to four-source layout for single-material, co-sputtered, and sequenced multi-layer thin film deposition
- **DC Power Supply (0 to 1000 V, 2000 W)**: high-power DC supply for conductive target sputtering with voltage-controlled deposition rate
- **RF Power Supply (13.56 MHz, 300 to 1200 W)**: covers the RF power range needed for insulating target sputtering and reactive oxide and nitride processes
- **3-Channel MFM Gas Control (Ar, N_2, O_2, He, CH_4, H_2)**: real-time electronic control and display for three independent gas channels supporting inert and reactive sputtering
- **Additional Capacitance Manometer for Plasma Pressure**: dedicated capacitance manometer provides precise plasma pressure measurement during reactive sputtering processes
- **Throttle, Vent, and Isolation Valves, 1 to 100 mTorr Precision**: precise working pressure adjustment for reactive process gas control and plasma stability
- **10^{-8} Torr Base Pressure, 2×10^{-6} Torr in 20 Minutes**: fast pump-down to working vacuum with turbomolecular and mechanical pump; cryo and dry pump available as options
- **Wide-Range Vacuum Control (1000 to 10^{-9} Torr)**: integrated vacuum measurement and control from atmospheric to deep vacuum for both process gas and base pressure monitoring
- **LabVIEW-Based Layer-by-Layer Deposition Control**: PC-controlled LabVIEW automation manages each deposition layer independently, supporting complex multi-layer process sequences
- **0.1 Å/s Dual-Channel Thickness Measurement with 1 to 4 QCMs**: scalable multi-sensor thickness and rate monitoring across up to four QCM channels simultaneously

- **50 to 700 °C PID Substrate Heating**: PID-controlled substrate temperature management for deposition at elevated temperatures for film crystallinity and adhesion
- **2 to 30 rpm Sample Rotation**: adjustable substrate rotation promotes uniform film thickness distribution across the substrate surface
- **Sample Plasma Cleaning Unit (RF via Substrate Biasing)**: in-situ RF plasma cleaning removes native surface oxides before deposition without breaking vacuum
- **Automatic Start-Stop Closed-Loop Water Cooling**: automatic thermal management activates and deactivates cooling based on system state, protecting sources and chamber throughout operation
- **Vacuum Hold with Isolation Valve**: main chamber stays under vacuum when not in use, reducing pump-down time between successive experiments
- **SS304 Chamber (30 to 60 cm, Prismatic or Cylindrical)**: clean, electro-polished inner surfaces in multiple box size options with SS304 liner
- **Standard 1-inch, QF, CF, and ISO Feedthrough Ports**: configurable port selection for flexible feedthrough, gauge, and process gas integration
- **Internal Lighting and 120 °C Baking Capability**: internal lighting for chamber inspection and baking for conditioning and residual moisture removal
- **Front Viewing Window with Rotatable Shutter**: direct visual access for process monitoring with rotatable shutter for precise deposition timing
- **Fully Automatic Computer Control with Touch Screen Panel**: touch screen and real-time LCD displays manage all system operations automatically throughout the process
- **1.5-Hour Experiment Cycle Time**: fast pump-down and process cycle supports consistent multi-run throughput for research and production programs
- **75×120 cm Mobile Platform on Lockable Wheels**: compact footprint passes through standard doorways and allows repositioning within the facility
- **One-Year Warranty for Design, Materials, and Workmanship**: annual coverage for system components, design, and manufacturing quality

THEORY & METHOD

Theory and Method

Magnetron sputtering ionizes a process gas to produce ions that bombard a cathode target, ejecting atoms that condense on the substrate as a thin film. A magnetic field confines the plasma near the target face, increasing ion density and sputtering yield at low working pressures. DC power handles conductive targets at 0 to 1000 V; RF at 13.56 MHz dissipates charge buildup on insulators. This extends the material range to oxides, nitrides, and dielectric films from ceramic targets.

Multi-target configurations of one to four sources allow sequential deposition in a single pump-down cycle, reducing contamination between material layers. Co-sputtering from simultaneously powered sources enables composition-graded and alloy films without separate deposition steps. Reactive sputtering introduces N_2 or O_2 through MFM-controlled inputs during metallic target sputtering, forming nitride or oxide films without compound targets. Throttle valve and capacitance manometer control maintain stable plasma pressure across the 1 to 100 mTorr reactive process window.

LabVIEW automation manages the complete layer sequence, controlling shutter timing, power levels, and gas flow for each step without operator intervention between layers. RF plasma cleaning via substrate biasing removes native oxides before deposition, improving adhesion at the film-substrate interface. PID substrate heating at 50 to 700 °C promotes film crystallinity and surface diffusion during growth. The isolation valve holds the main chamber under vacuum between runs, eliminating pump-down overhead for successive depositions.

TECHNICAL SPECIFICATIONS

Magnetron Sputtering System - ToronSputter™ Mag Technical Specifications

Parameter	Specification
DC Power Supply	0 to 1000 V DC, 2000 W

Parameter	Specification
RF Power Supply	13.56 MHz, 300 to 1200 W
Number of Sputtering Sources	1 to 4 (DC/RF)
Target Diameters	1", 2", 3", 4"
Base Pressure	10^{-8} Torr
Working Vacuum (Pump-Down Time)	2×10^{-6} Torr in 20 minutes
Vacuum Control Range	1000 to 10^{-9} Torr
Pump Configuration	Turbomolecular + Mechanical (cryo and dry pump as options)
Sputter Working Pressure Range	1 to 100 mTorr (throttle valve controlled)
Plasma Pressure Measurement	Additional capacitance manometer
Chamber Material	SS304 (prismatic or cylindrical); electro-polished
Chamber Sizes	30/40/50/60 cm box size
Feedthrough Ports	Standard 1-inch, QF, CF, ISO
Observation Window	Front viewing window; rotatable shutter
Internal Lighting	Yes
Baking Capability	Up to 120 °C (internal)
Gas Inputs	Ar, N_2, O_2, He, CH_4, H_2; 3-channel MFM; real-time electronic display
Valve Configuration	Throttle, vent, and isolation valves
Substrate Heating	50 to 700 °C (PID controlled)
Sample Rotation Speed	2 to 30 rpm
Plasma Cleaning	RF plasma via substrate biasing

Parameter	Specification
Thickness Monitoring	Dual-channel; 0.1 Å/s precision; 1 to 4 QCMs
Control System	Fully automatic computer control; touch screen panel; real-time LCD; LabVIEW
Cooling System	Automatic start-stop closed-loop water cooling
Experiment Cycle Time	1.5 hours
Footprint	75 × 120 cm
Door Clearance	Passes through standard doorways
Mobility	Lockable wheels
Warranty	1 year (design, materials, and workmanship)

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