TORONTECH

RF/DC MAGNETRON SPUTTERING SYSTEM

RF/DC Magnetron Sputtering System - ToronSputter™ RFDC

ToronSputter™ RFDC is an RF/DC magnetron sputtering system for multi-target thin film deposition with target sizes up to 6 inches and 1 to 4 source configurations. The RF supply (13.6 MHz, 300 to 1200 W) handles insulating and reactive targets; the DC supply (600 V, 1.7 A) covers metallic films. The SS304 chamber (30 to 60 cm) reaches 10^{-7} Torr base pressure and 10^{-6} Torr working vacuum in 30 minutes. Fully automated LabVIEW control and a 1.5-hour cycle support consistent daily throughput.

Three-channel MFM gas control (Ar, N_2, O_2, He, CH_4, H_2) with real-time display 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 600 °C and 3 to 30 rpm rotation with RF plasma cleaning via substrate biasing prepare substrates before deposition. Wide-range vacuum control (1000 to 10^{-9} Torr) and 120 °C baking maintain base pressure and chamber cleanliness.

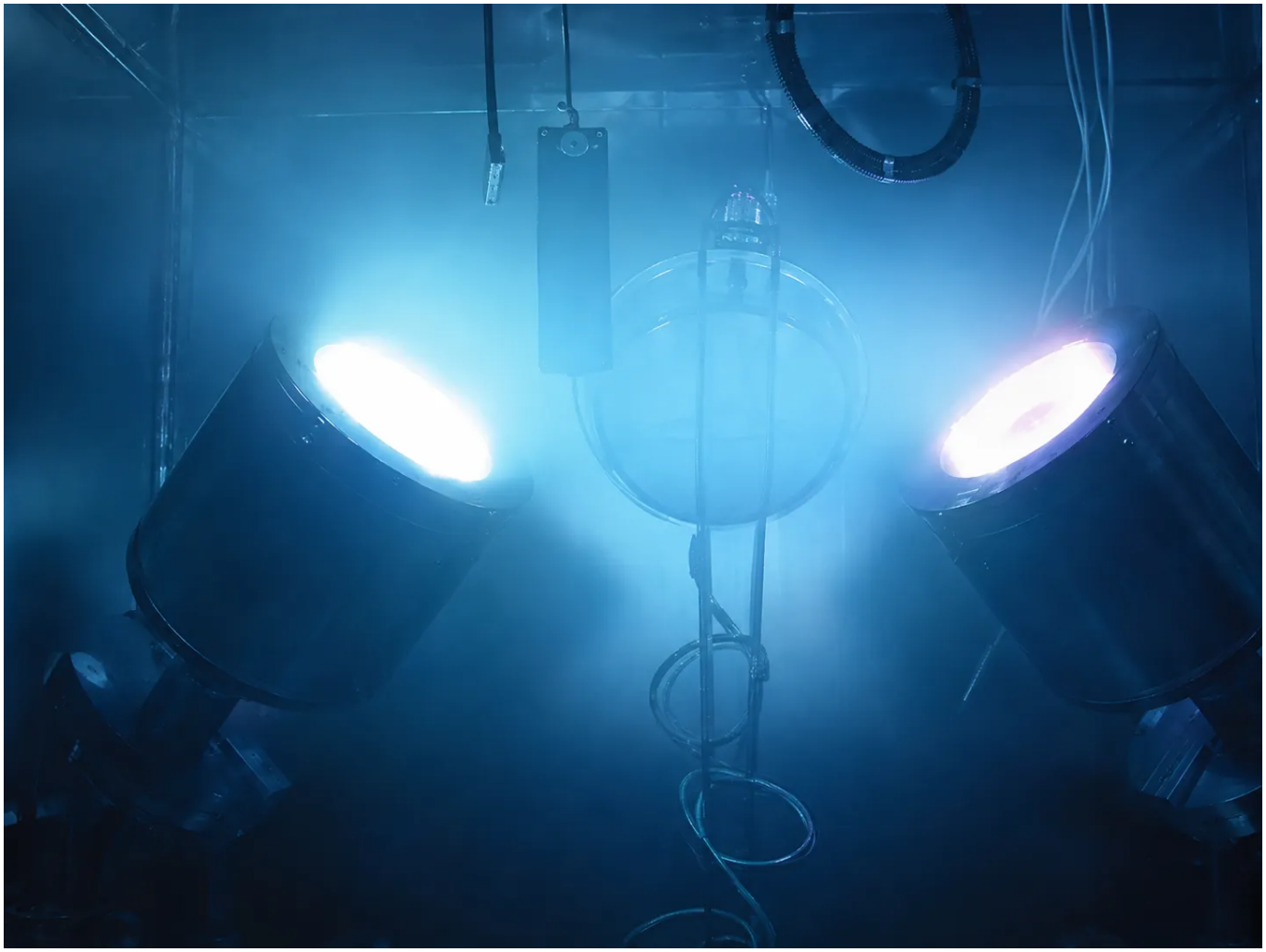
A dual-channel thickness controller with 1 to 4 QCMs at 0.1 Å/s, managed by LabVIEW automation, handles multi-layer deposition sequences fully automatically. The extended target range up to 6 inches enables deposition on larger substrates and improves throughput for production coating programs. The 75×120 cm footprint on lockable wheels passes through standard doorways; standard 1-inch, QF, CF, and ISO ports support flexible feedthrough and source configurations. Automatic start-stop closed-loop water cooling and internal baking up to 120 °C complete the process support system.

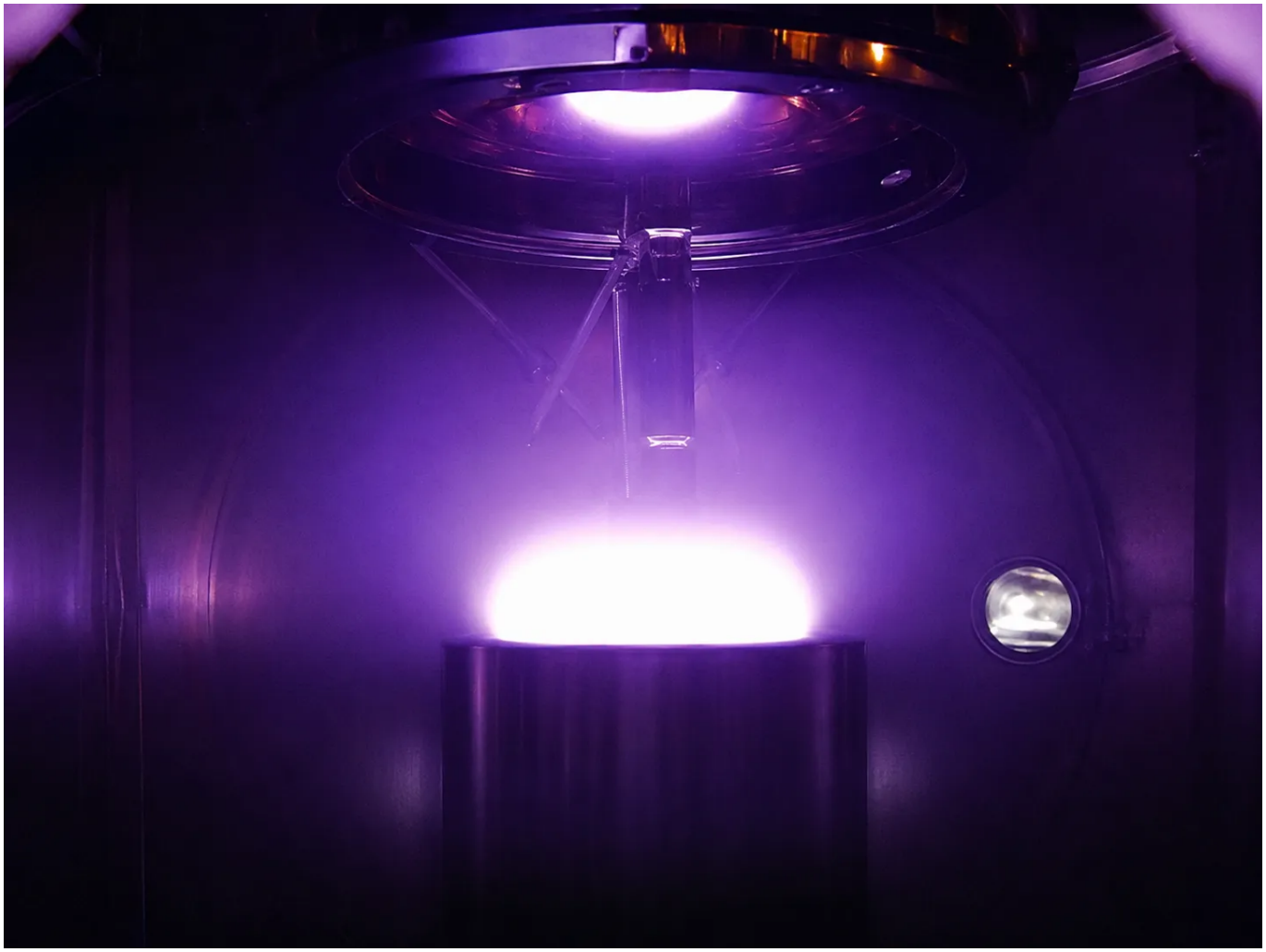
APPLICATIONS

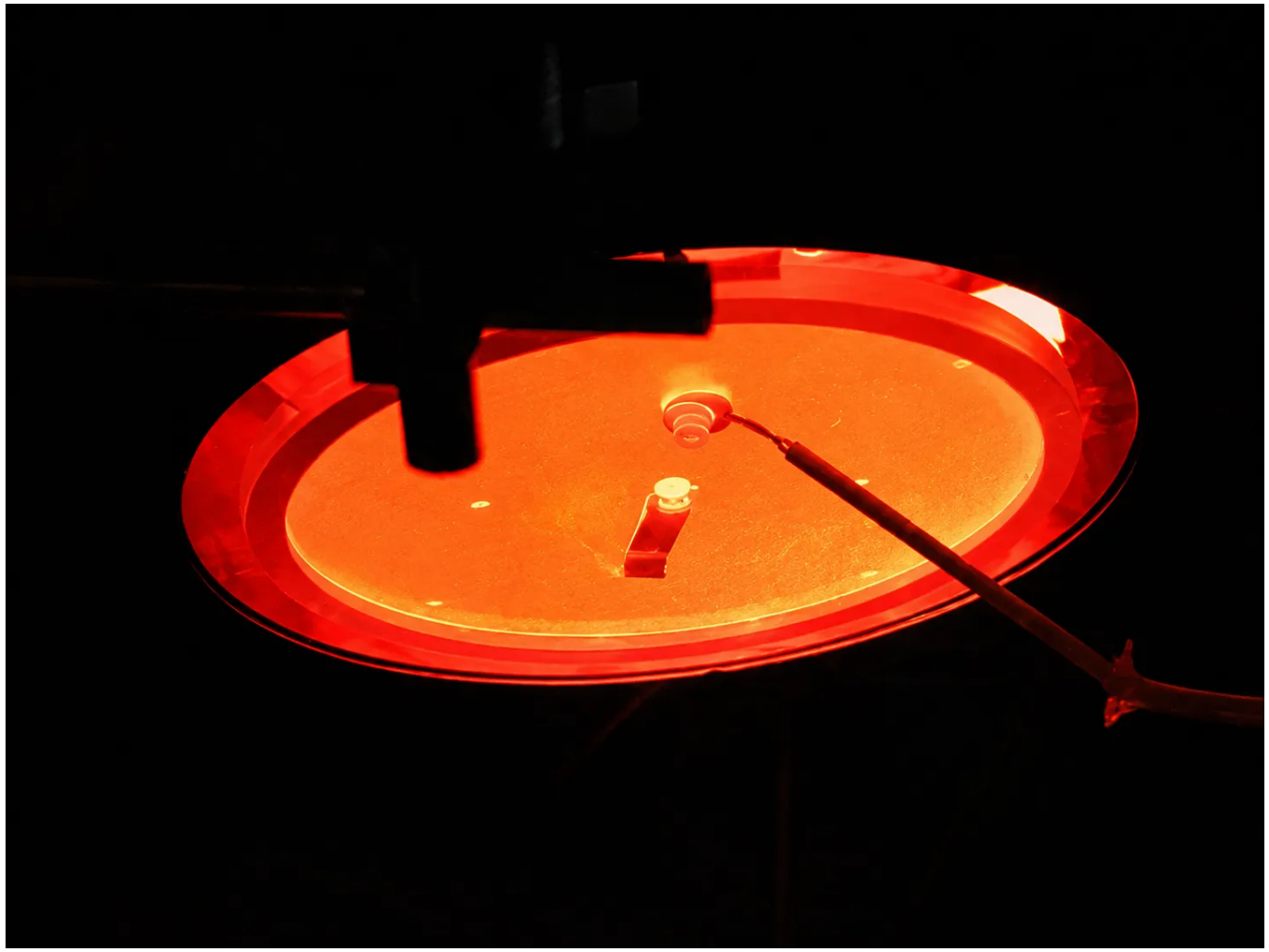
RF/DC Magnetron Sputtering System - ToronSputter™ RFDC Applications

The ToronSputter™ RFDC serves research and production PVD facilities requiring large-target magnetron sputtering with both RF and DC source configurations, reactive gas capability, and automated multi-layer deposition. The 6-inch target option makes it suited to larger substrate programs and higher-throughput coating applications.

- **Semiconductor and Microelectronics Fabrication**: DC sputtering of metallic contacts, seed layers, and barrier films, with RF for oxide and nitride dielectric layers in multi-source runs on 6-inch wafer substrates
- **Optical Coating Production**: reactive RF sputtering of TiO_2, SiO_2, and multi-layer optical stacks with capacitance manometer pressure control for stoichiometric accuracy across extended coating runs
- **Hard Coating and Tool Surface Engineering**: reactive sputtering of TiN, CrN, and TiAlN on tooling and mechanical components with 6-inch target capacity for higher deposition rates
- **Transparent Conductive Oxide Deposition**: RF sputtering of ITO, AZO, and other TCO films for solar cell, display panel, and flexible electronics applications requiring uniform large-area coverage
- **Materials Science and Alloy Film Research**: multi-target and co-sputtered alloy, compound, and mixed oxide films for composition-structure-property studies and new materials development
- **Energy Device and Photovoltaic Research**: sputtering of metallic back contacts, oxide buffer layers, and TCO front contacts for thin-film solar cell and energy device research programs
- **Academic and University Multi-Source Research**: flexible RF/DC platform for multi-layer thin film studies across conducting, semiconducting, and insulating materials in a single automated system







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FEATURES

RF/DC Magnetron Sputtering System - ToronSputter™ RFDC Key Features

The ToronSputter™ RFDC integrates RF and DC magnetron sputtering with 6-inch target support, three-channel MFM gas control, LabVIEW layer automation, and capacitance manometer plasma pressure monitoring in a multi-target high-vacuum platform.

- **1 to 4 DC/RF Sources with 6-Inch Target Capability**: configurable source layout accepting 1", 2", 3", 4", and 6" target diameters for single-target, co-sputtered, and sequenced multi-layer deposition programs
- **RF Power Supply (13.6 MHz, 300 to 1200 W)**: covers the RF power range for insulating target sputtering and reactive oxide and nitride deposition processes
- **DC Power Supply (600 V, 1.7 A)**: DC supply for conductive metallic target sputtering with controlled deposition rate
- **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 processes
- **Additional Capacitance Manometer for Plasma Pressure**: dedicated gauge for precise measurement of plasma pressure during reactive sputtering processes, independent of the main vacuum gauge
- **Throttle, Vent, and Isolation Valves with 1 to 100 mTorr Precision**: precise working pressure adjustment for reactive process control and stable plasma conditions
- **10^{-7} Torr Base Pressure, 10^{-6} Torr in 30 Minutes**: turbomolecular and mechanical pump combination; 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 all process modes
- **LabVIEW-Based Layer-by-Layer Deposition Control**: PC-controlled automation manages each deposition layer independently, supporting complex multi-layer sequences without operator intervention
- **0.1 Å/s Dual-Channel Thickness Measurement with 1 to 4 QCMs**: scalable multi-sensor thickness and rate monitoring with up to four simultaneous QCM channels

- **50 to 600 °C PID Substrate Heating**: PID-controlled substrate temperature for film crystallinity and adhesion across a wide process range
- **3 to 30 rpm Sample Rotation**: adjustable substrate rotation for 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 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
- **1.5-Hour Experiment Cycle Time**: fast pump-down and process cycle supports multi-run daily throughput
- **75×120 cm Mobile Platform on Lockable Wheels**: compact footprint passes through standard doorways and allows repositioning within the facility
- **Two-Year Warranty for Design, Materials, and Workmanship**: extended two-year coverage for system components, design, and manufacturing quality, double the one-year standard

THEORY & METHOD

Theory and Method

Magnetron sputtering ionizes a process gas to create 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 at 600 V handles conductive targets; RF at 13.6 MHz dissipates charge buildup on insulators and oxide targets. The 6-inch target format increases source material capacity and extends the accessible deposition area for larger substrates.

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 600 °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

RF/DC Magnetron Sputtering System - ToronSputter™ RFDC Technical Specifications

Parameter	Specification

RF Power Supply	13.6 MHz, 300 to 1200 W
DC Power Supply	600 V DC, 1.7 A
Number of Sputtering Sources	1 to 4 (DC/RF)
Target Diameters	1", 2", 3", 4", 6"
Base Pressure	10^{-7} Torr
Working Vacuum (Pump-Down Time)	10^{-6} Torr in 30 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
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 600 °C (PID controlled)
Sample Rotation Speed	3 to 30 rpm
Plasma Cleaning	RF plasma via substrate biasing

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	2 years (design, materials, and workmanship)

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