TORONTECH

HIPIMS SYSTEM

HiPIMS System - ToronHiPIMS™ 1000

High-Power Impulse Magnetron Sputtering (HiPIMS) System

The HiPIMS System is a fully automated high-power impulse magnetron sputtering system for research and production thin film deposition requiring high plasma ionization. High-voltage pulses of 300 to 1000 VDC at adjustable width generate 70 to 90% ionization density, producing an ionized metal vapor flux that promotes film density, adhesion, and conformality. The SS304 chamber (30 to 60 cm, prismatic or cylindrical) reaches 10^{-7} Torr base pressure with one to four HiPIMS sources. Touch screen and real-time LCD displays manage the automated deposition cycle.

A synchronized Pulsed-DC plasma option provides in-situ substrate surface cleaning before deposition, removing native oxides and contaminants without breaking vacuum. Target-sample synchronization with voltage-current-timing monitoring gives precise control over the pulse delivery sequence, supporting film structure optimization in HiPIMS processes. Mass flow meter controlled gas inputs with isolation valves support Ar, N_2, and other process gases for reactive HiPIMS deposition of nitrides, oxides, and carbides. The chamber holds vacuum with an isolation valve between runs, reducing cycle time overhead.

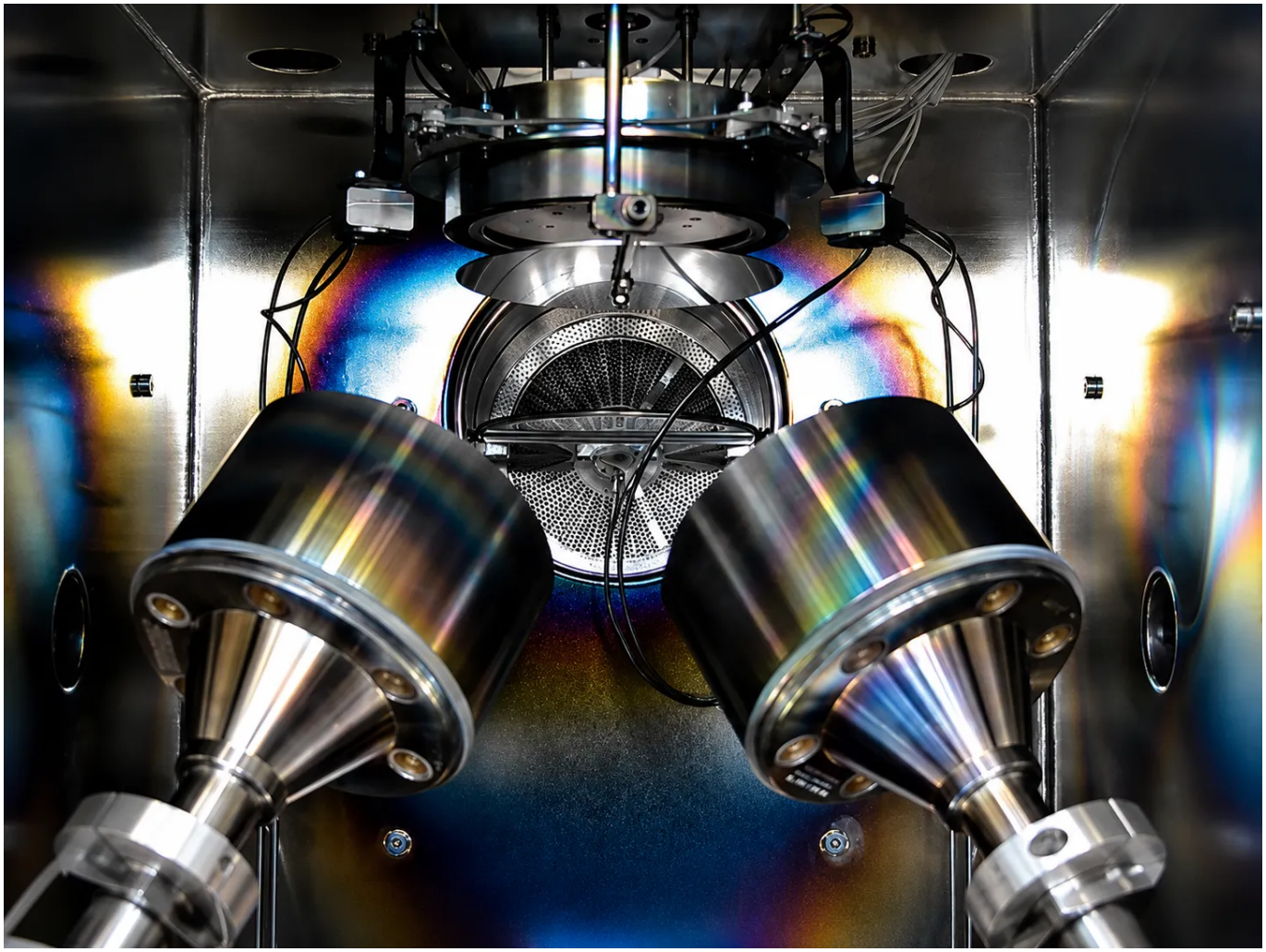
Substrate temperature is PID controlled across 50 to 600 °C with 2 to 30 rpm rotation for homogeneous film deposition across the substrate surface. Film thickness and deposition rate are tracked in real time by a dual-channel controller with 1 to 4 QCMs at 0.1 Å/s, with averaged output across sensors. The system includes internal lighting and 120 °C baking capability for chamber conditioning and moisture removal before deposition. A 75×120 cm footprint on lockable wheels passes through standard 85 cm doorways.

APPLICATIONS

HiPIMS System - ToronHiPIMS™ 1000 Applications

The HiPIMS System addresses thin film deposition requirements where conventional magnetron sputtering falls short of the density, adhesion, and conformality needed for advanced coating and device applications. Its high ionization fraction, reactive gas capability, and target-sample synchronization make it applicable across a broad range of materials and substrate geometries.

- **Hard Coating and Wear-Resistant Film Deposition**: HiPIMS deposition of TiN, CrN, TiAlN, DLC, and related hard coatings on cutting tools, molds, and mechanical components requiring high film density and strong adhesion
- **Optical Thin Film Research**: reactive HiPIMS deposition of TiO_2, SiO_2, and other optical oxide coatings with excellent stoichiometry control and low optical scatter
- **Semiconductor and Microelectronics Research**: deposition of barrier layers, contact metals, and functional oxide films on wafer substrates requiring void-free, dense films at controlled substrate temperatures
- **Energy and Solar Cell Research**: reactive HiPIMS deposition of transparent conductive oxides, nitride absorbers, and functional contact layers for thin-film photovoltaic and energy storage research
- **Biomedical Implant Coating**: HiPIMS deposition of biocompatible TiN, DLC, and related coatings on implant surfaces requiring strong adhesion and low defect density at the film-substrate interface
- **Diffusion Barrier and Encapsulation Layer Deposition**: deposition of dense, conformal nitride and oxide barrier layers for microelectronic packaging and OLED device encapsulation applications
- **Reactive Nitride and Carbide Film Research**: controlled reactive HiPIMS deposition of transition metal nitrides, carbides, and carbonitrides for materials science and surface engineering research programs.



TORONTECH
ToronHiPIMS™ 1000
HiPIMS System
VACUUM CONTROL - MVC
THICKNESS & TEMPERATURE CONTROL - MVT
GAS CONTROL - MVGCO

FEATURES

HiPIMS System - ToronHiPIMS™ 1000 Key Features

The HiPIMS System integrates high-voltage pulsed magnetron sputtering with PID substrate heating, MFM gas control, synchronized Pulsed-DC surface cleaning, and automated layer-by-layer deposition in a single high-vacuum platform.

- **70 to 90% Ionization Density with 300 to 1000 VDC Adjustable Pulses**: very high plasma ionization distinguishes HiPIMS from conventional sputtering, enabling controlled ion energy at the substrate surface for improved film density, adhesion, and conformality
- **1 to 4 Configurable HiPIMS Sputtering Sources**: single or multi-target configuration for single-material, co-sputtered, or sequenced multi-layer deposition in one vacuum cycle
- **Target-Sample Synchronization with Voltage-Current-Timing Display**: pulse timing between target and substrate bias is synchronized, with real-time display of voltage, current, and timing parameters for process optimization and reproducibility
- **Synchronized Pulsed-DC Plasma Surface Cleaning**: in-situ substrate surface preparation by synchronized plasma removes native oxides and contaminants without breaking vacuum before deposition begins
- **Fully Automatic Computer Control with Touch Screen**: all system operations managed automatically through a touch screen panel with real-time LCD display status throughout the deposition process
- **SS304 Chamber (30 to 60 cm, Prismatic or Cylindrical)**: clean, electro-polished stainless steel chamber in multiple size options for different substrate and load configurations
- **Standard 1-inch, QF, CF, and ISO Feedthrough Ports**: configurable port selection supports flexible feedthrough, gauge, and process access integration
- **Internal Lighting and 120 °C Baking Capability**: internal lighting for visual chamber inspection and a baking option for moisture removal and chamber conditioning before high-purity runs
- **10^{-7} Torr Base Pressure with Fast Pump-Down**: reaches 10^{-6} Torr in 30 minutes; turbomolecular and mechanical pump combination with cryo-pump and dry pump as options

- **Wide-Range Vacuum Control (1000 to 10^{-9} Torr)**: integrated vacuum measurement and control covers the full pressure range for both process gas introduction and base vacuum monitoring
- **50 to 600 °C PID Substrate Heating**: PID-controlled substrate temperature across a wide range, supporting deposition at elevated temperature for film crystallinity and adhesion
- **2 to 30 rpm Adjustable Sample Rotation**: continuously adjustable rotation for even film thickness distribution across the substrate during deposition
- **MFM Controlled Gas Inputs with Isolation Valves**: mass flow meter controlled delivery of Ar, N_2, and other process gases for inert and reactive HiPIMS processes, with Ar or N_2 chamber backfill
- **0.1 Å/s Dual-Channel Thickness Monitoring with 1 to 4 QCMs**: precision deposition rate and cumulative thickness measurement with averaged-value output across multiple QCM sensors
- **Automatic Closed-Loop Water Cooling**: active water cooling manages heat from power supplies, targets, and chamber walls throughout HiPIMS operation
- **Vacuum Hold Between Runs**: isolation valve keeps the chamber under vacuum when not in use, reducing pump-down time between successive experiments
- **Fully Automated Layer-by-Layer Deposition**: automated deposition control covers each layer independently, supporting multi-layer process sequences without manual intervention
- **75×120 cm Mobile Platform**: 75×120 cm footprint on lockable wheels passes through standard 85 cm doorways for flexible laboratory and production floor placement
- **One-Year Full Warranty**: coverage for design, materials, and workmanship

THEORY & METHOD

Theory and Method

HiPIMS applies extremely high power densities to a magnetron target during brief high-voltage pulses, reaching instantaneous power levels far above conventional DC or RF sputtering. At peak pulse power, plasma density near the target

rises sharply, ionizing a large fraction of sputtered metal atoms before they reach the substrate. These ionized metal species travel under plasma and applied bias fields, enabling controlled deposition angle and improved film density on complex substrate geometries. Pulse width, voltage, and repetition rate are independently adjustable per material and process.

The 300 to 1000 VDC pulse range and adjustable width set the ionization fraction for a given target. Ionization densities of 70 to 90% distinguish HiPIMS sharply from conventional sputtering, where most sputtered flux reaches the substrate as neutral atoms with broad angular distribution. Target-sample synchronization coordinates ionized flux arrival with the applied substrate bias, allowing ion energy at the growth surface to be controlled independently of the plasma condition. A synchronized Pulsed-DC option extends the same pulse-gating approach to in-situ surface cleaning before deposition.

Reactive HiPIMS introduces N_2, O_2, or other reactive gases through MFM-controlled inputs, forming nitride, oxide, or carbide films from pure metal targets. The high ionization fraction reduces the hysteresis effect limiting rate stability in conventional reactive sputtering, widening the stable process window. An isolation valve maintains chamber vacuum between depositions, and a 120 °C baking option conditions chamber walls for low base pressure. A turbomolecular and mechanical pump combination, with cryo-pump and dry pump options, reaches 10^{-7} Torr base pressure.

TECHNICAL SPECIFICATIONS

HiPIMS System - ToronHiPIMS™ 1000 Technical Specifications

Parameter	Specification
HiPIMS Pulse Voltage	300 to 1000 VDC
HiPIMS Pulse Width	Adjustable
Plasma Ionization Density	70 to 90%
Number of HiPIMS Sources	1 to 4 (configurable)
Target-Sample Synchronization	Yes; voltage-current-timing display

Parameter	Specification
Plasma Surface Cleaning	Synchronized Pulsed-DC plasma
Gas Inputs	Ar, N_2, and others; MFM controlled; isolation valves; Ar or N_2 backfill
Chamber Material	SS304 (prismatic or cylindrical)
Chamber Sizes	30/40/50/60 cm box size
Chamber Surface Finish	Electro-polished
Feedthrough Ports	Standard 1-inch, QF, CF, ISO
Internal Lighting	Yes
Baking Capability	Up to 120 °C (internal)
Base Pressure	10^{-7} Torr
Working Vacuum Level (Pump-Down Time)	10^{-6} Torr in 30 minutes
Vacuum Control Range	1000 to 10^{-9} Torr
Pump Configuration	Turbomolecular + Mechanical (cryo-pump and dry pump as options)
Sample Heating Range	50 to 600 °C (PID controlled)
Sample Rotation Speed	2 to 30 rpm
Thickness Monitoring	Dual-channel; 0.1 Å/s precision; 1 to 4 QCMs; averaged value
Cooling System	Automatic closed-loop water cooling
Control System	Fully automatic computer control; touch screen panel; real-time LCD
Footprint	75 × 120 cm
Door Clearance	Passes through standard 85 cm doorway
Mobility	Lockable wheels

Parameter	Specification
Warranty	1 year (design, materials, and workmanship)

TORONTECH.com

TORONTECH

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