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PECVD TUBE FURNACE

PECVD Tube Furnace - ToronTF™ PECVD

Plasma-Enhanced Chemical Vapor Deposition (PECVD) Tube Furnace System

The ToronTF™ PECVD is a PECVD tube furnace combining a 1100 °C quartz tube furnace with a 300 W, 13.56 MHz inductively coupled plasma source. The ICP plasma activates precursor gases within the quartz sample zone, enabling deposition at lower temperatures than thermal CVD and improving film quality. Quartz tubes in 50, 80, or 100 mm diameter and 1000 mm length accommodate different sample sizes. PID control at ±1 °C maintains stable deposition conditions across the full 1100 °C operating range.

Three-channel MFC gas control manages Ar, N_2, O_2, H_2, CH_4, and NH_3 in pure or mixed combinations, with additional channels available as an option. Throttle, vent, and isolation valves maintain working pressure across 1 to 100 mTorr under automated PLC vacuum control. User-defined programmable heating profiles with adjustable steps control the thermal ramp and soak sequence for each run. PC touch screen and panel control offer flexible operation; closed-cycle water cooling protects system components during deposition.

The quartz sample holder confines the plasma to the sample deposition zone, preventing plasma contact with chamber walls and reducing contamination. An easy sample load door provides straightforward access for sample loading and unloading between deposition runs. The 75×120 cm footprint on lockable wheels passes through standard doorways, and a 220V, 16A power requirement simplifies facility installation. Quartz tube diameter options of 50, 80, and 100 mm accommodate different sample sizes and process gas volumes.

APPLICATIONS

PECVD Tube Furnace - ToronTF™ PECVD Applications

The ToronTF™ PECVD serves research and academic laboratories requiring plasma-enhanced chemical vapor deposition across a broad range of film materials, where the combination of plasma activation and tube furnace heating enables processes not achievable with thermal CVD or plasma alone. Its compact tube format and flexible gas configuration suit materials science, semiconductor, and energy research programs.

- **Diamond and DLC Film Deposition**: plasma-activated hydrocarbon gas decomposition for diamond-like carbon and nanocrystalline diamond film research at substrate temperatures below those required for thermal CVD
- **Silicon Nitride Thin Film Research**: NH_3 and N_2 precursor plasma decomposition for Si_3N_4 passivation layers, gate dielectrics, and encapsulation films in semiconductor and photovoltaic device research
- **Silicon Oxide Film Deposition**: O_2 plasma-enhanced oxidation and co-deposition processes for SiO_2 gate dielectric, insulator, and passivation film research at controlled deposition temperatures
- **Carbon Nanotube and Graphene Growth**: plasma-activated hydrocarbon decomposition on catalyst substrates for CNT growth and graphene synthesis under controlled temperature and gas environments
- **Amorphous Silicon and Thin-Film Solar Cell Research**: PECVD deposition of amorphous silicon and silicon nitride films for thin-film photovoltaic device layer research and prototyping
- **Surface Nitridation and Plasma Treatment**: plasma nitridation of metal and semiconductor surfaces using N_2 or NH_3 plasma for surface property modification without full film deposition
- **Academic Materials Science Research**: flexible plasma CVD platform for exploratory thin film deposition across oxide, nitride, carbide, and carbon-based material systems


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FEATURES

PECVD Tube Furnace - ToronTF™ PECVD Key Features

The ToronTF™ PECVD integrates a high-temperature tube furnace, inductively coupled plasma source, three-channel MFC gas system, and PLC vacuum automation in a compact, mobile plasma CVD platform for research and academic laboratories.

- **1100 °C Maximum Furnace Temperature**: continuous operation up to 1100 °C for high-temperature PECVD processes including oxide, nitride, carbon, and refractory material deposition
- **±1 °C PID Furnace Temperature Control**: precise closed-loop temperature management maintains stable deposition conditions and enables accurate thermal recipe reproduction
- **300 W, 13.56 MHz Inductively Coupled Plasma Source**: external coil ICP design generates high-density plasma without electrode materials entering the deposition zone
- **Quartz Sample Holder with Plasma Confinement to Sample Zone**: plasma is geometrically confined to the sample region, concentrating reactive species at the substrate surface while protecting the rest of the chamber
- **Quartz Tube (1000 mm Length, 50/80/100 mm Diameter)**: interchangeable quartz tube diameter options accommodate different sample sizes and process gas volumes; custom diameters available on request
- **3-Channel MFC Gas Control (Ar, N_2, O_2, H_2, CH_4, NH_3)**: mass flow controller system for six precursor gas types with real-time digital display of individual and mixed flows
- **Expandable Gas Line Configuration**: additional gas channels can be added beyond the standard three-channel configuration to support a wider range of precursor chemistries
- **Real-Time Digital Gas Flow Display**: continuous on-screen display of individual and mixed gas flow rates for process monitoring and documentation
- **User-Defined Programmable Heating Profiles**: multi-step heating sequences with adjustable ramp rates and soak times for different film materials and post-deposition annealing treatments
- **Automated PLC Vacuum Control Unit**: one-button start, stop, and vent operation for automated vacuum sequencing during experiment setup and shutdown

- **Throttle, Vent, and Isolation Valves with 1 to 100 mTorr Precision**: precise working pressure control for stable plasma conditions during PECVD processes
- **PC Touch Screen Control Option**: computer interface for remote operation, recipe management, and real-time process monitoring alongside panel control
- **Easy-Access Sample Load Door**: straightforward sample loading and unloading without extensive chamber disassembly, enabling efficient between-run sample exchange
- **Closed-Cycle Water Cooling System**: active water cooling of the plasma source and system components throughout deposition operation
- **220V, 16A Single-Phase Power Requirement**: standard single-phase electrical connection simplifies laboratory installation
- **75×120 cm Mobile Platform on Lockable Wheels**: compact footprint passes through standard doorways for installation and repositioning within the laboratory
- **One-Year Warranty for Design, Materials, and Workmanship**: annual coverage for system components, design quality, and manufacturing

THEORY & METHOD

Theory and Method

Plasma-enhanced CVD activates precursor gases with a low-pressure plasma, enabling film deposition at lower substrate temperatures than thermal CVD. Plasma energy dissociates reactive gases into free radicals and ions that form thin films upon contact with the substrate surface. The plasma energy substitutes for thermal activation, expanding the deposition temperature range and accessible film compositions. Confining the plasma to a quartz sample holder concentrates reactive species at the substrate while limiting plasma exposure to the rest of the system.

Inductively coupled plasma (ICP) couples 300 W of RF energy at 13.56 MHz through a coil outside the quartz tube, generating high-density plasma without electrode materials entering the deposition zone. The ICP produces plasma dense

enough to dissociate O_2, N_2, H_2, CH_4, and NH_3 for oxide, nitride, and carbon-based film deposition. Furnace temperature up to 1100 °C combines with plasma activation to access film compositions requiring both thermal and plasma energy. User-defined heating profiles with adjustable steps control the thermal ramp and soak per run.

Three-channel MFC gas control manages Ar, N_2, O_2, H_2, CH_4, and NH_3 in pure or mixed combinations, with additional channels available as an option. Throttle, vent, and isolation valves maintain process pressure across 1 to 100 mTorr under automated PLC vacuum control. PC touch screen operation provides remote oversight of the gas, vacuum, and heating sequence. Closed-cycle water cooling protects the plasma source and chamber throughout the deposition process.

TECHNICAL SPECIFICATIONS

PECVD Tube Furnace - ToronTF™ PECVD Technical Specifications

Parameter	Specification
Furnace Temperature	Up to 1100 °C (continuous)
Temperature Control	PID, ±1 °C
Quartz Tube Length	1000 mm
Quartz Tube Inner Diameter	50, 80, or 100 mm (custom diameters available)
Plasma Source Type	Inductively coupled plasma (ICP)
Plasma Source Power	300 W
Plasma Source Frequency	13.56 MHz
Gas Control	3-channel MFC (Ar, N_2, O_2, H_2, CH_4, NH_3); expandable
Gas Display	Real-time digital; individual and mixed flow rates
Working Pressure Range	1 to 100 mTorr

Parameter	Specification
Valve Configuration	Throttle, vent, and isolation valves
Vacuum Control	Automated PLC unit with start, stop, and vent functions
Heating Profile Control	User-defined programmable profiles with adjustable steps
Sample Holder	Quartz (plasma confined to sample zone)
Control Interface	PC touch screen (optional) and panel control
Cooling System	Closed-cycle water cooling
Power Requirement	220V, 16A (110V is also available)
Footprint	75 × 120 cm
Door Clearance	Passes through standard doorways
Mobility	Lockable wheels
Warranty	1 year (design, materials, and workmanship)

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