FerroTec

TEMESCAL PRECISION COATING SOLUTIONS

Temescal

TEMESCAL DEPOSITION SYSTEMS OVERVIEW

Load-Locked FC-4400 for Maximum Throughput in Lift-Off Processes

- Product chamber dimensions: 23.5″ high x 44″ x 44″
- 25.5″ diameter source tray
- Standard source-to-substrate distance: 38″
- S-S distance with optional source well extension collar: 42″
- Product and source chamber cryopumps
- Optional second product-chamber cryopump

Load-Locked FC-3800 for Production Lift-Off, Step-Coverage, and Dual-Sided Coating Applications

- Product chamber dimensions: 28″ high x 38″ x 38″
- 25.5″ diameter source tray
- Standard source-to-substrate distance: 34″
- S-S distance with optional source well extension collar: 38″
- Product and source chamber cryopumps

Mid-Sized Coaters for Production and Large-Wafer R&D Applications

- Non-load-locked BCD-2800; load-locked FC-2800
- Product chamber dimensions: 28″ x 28″ x 28″
- Standard source-to-substrate distance: 34″
- S-S distance with optional source well extension collar: 42″
- Source trays support multiple e-beam and resistance sources
- 3 cm or 5 cm ion source available in product chamber
- Product and source chamber cryopumps

Convertible Bell Jar Systems for Small-Scale Production and R&D Applications

- Non-load-locked BJD-2000 and load-locked FC-2000, both with a single cryopump
- Source tray supports multiple electron beam and resistance sources
- Standard source-to-substrate distance: 19.5″
- S-S distance with optional source well extension collar: 27.5″
- Field upgrade kit allows conversion into an FC-2800 or a BCD-2800

SYSTEM SELECTION CRITERIA FOR LIFT-OFF APPLICATIONS

FC/BJD-2000

Wafer Sizes
2″ to 150 mm

Source-to-Substrate Distance
19.5″ or 27.5″

FC/BCD-2800

Wafer Sizes
3″ to 200 mm

Source-to-Substrate Distance
34″ or 42″

FC-3800

Wafer Sizes
100 mm to 200 mm

Source-to-Substrate Distance
34″ or 38″

FC-4400

Wafer Sizes
100 mm to 200 mm

Source-to-Substrate Distance
38″ or 42″

Wafer Capacity by System Type

SYSTEM TYPE	FC/BJD-2000	FC/BCD-2800	FC-3800	FC-4400
System capacity: 2″ wafers	42	N/A	N/A	N/A
System capacity: 3″ wafers	17	47	N/A	N/A
System capacity: 100 mm wafers	13	25	53	55
System capacity: 150 mm wafers	5	12	25	30
System capacity: 200 mm wafers	N/A	6	14	15

Angle of Incidence as a Function of Wafer Size and Source-to-Substrate Distance

FC/BJD-2000

WAFER SIZE	2″	3″	100 mm	150 mm	200 mm
Angle of incidence at 19.5″ S-S distance	2.82°	4.30°	5.68°	8.59°	N/A
Angle of incidence at 27.5″ S-S distance	2.00°	3.04°	4.02°	6.08°	N/A

FC/BCD-2800

WAFER SIZE	2″	3″	100 mm	150 mm	200 mm
Angle of incidence at 34″ S-S distance	N/A	2.46°	3.25°	4.92°	6.58°
Angle of incidence at 42″ S-S distance	NA	1.99°	2.63°	3.98°	5.32°

FC-3800

WAFER SIZE	2″	3″	100 mm	150 mm	200 mm
Angle of incidence at 34″ S-S distance	N/A	N/A	3.25°	4.92°	6.58°
Angle of incidence at 38″ S-S distance	N/A	N/A	2.91°	4.40°	5.89°

FC-4400

WAFER SIZE	2″	3″	100 mm	150 mm	200 mm
Angle of incidence at 38″ S-S distance	N/A	N/A	2.91°	4.40°	5.89°
Angle of incidence at 42″ S-S distance	N/A	N/A	2.63°	3.89°	5.32°

HIGH-THROUGHPUT, LARGE-

Load-Lock Systems Optimized for Lift-Off Applications (Gate, Ohmic, TFR)

The FC-3800 and FC-4400 are clean-room-compatible load-locked systems designed for high-throughput lift-off applications. Engineered for continuous, efficient operation, these coaters provide high-uniformity deposition at source-to-substrate distances ranging from 34" (965 mm) in the FC-3800 to 42" (1067 mm) in the FC-4400. Both systems can be configured for either freestanding or through-the-wall clean room installation, and both support numerous combinations of deposition sources and feeding, heating, and cleaning accessories.

Standard Features

System Control

- Temescal Control System (TCS), providing Auto, Manual, and Service Modes plus process datalogging
- TCS-based process variable monitoring (PVM) allows user to set process tolerance alarms
- Inficon XTC/3 deposition controller

Electron Beam Source, Power Supply, and Sweep

- Temescal removeable-cover turret source, 4- or 6-pocket
- Temescal model CV-12SLX electron beam power supply
- Temescal SuperSweep64 programmable beam sweep controller

Vacuum Pumping and Control

- Edwards model iGX100L dry roughing pump, with a pumping speed of 62 cfm (105 m^3/h^{-1})
- Source chamber cryopump: CTI model CT-10 On-Board
- Product chamber cryopump: CTI model CT-400 On-Board
- Edwards Active Inverted Magnetron gauges and Pirani controllers, monitored and controlled by the TCS
- Cryopump temperature monitoring

Water System

- Stainless steel manifold provides cooling water for source and product chamber components
- Separate product chamber circuit for cold and optional hot water

Air System

- PLC-controlled air manifold

Miscellaneous/System-Wide

- 5 EMO switches
- Standard 19" wide electronics rack on casters
- Surfaces exposed to high vacuum are made of 304 SST

Source Chamber

- Drop-down, swing-out source tray, accessible from either front or left side of vacuum cubicle
- Wide-angle 4" viewport for source observation
- Removeable stainless-steel source tray debris shield
- Gate valve with moveable shield
- Source tray diameter: 25.5" (648 mm)

Product Chamber

- FC-4400: 23.5" high x 44^2" (597 mm x 1118 mm^2)
  FC-3800: 28" high x 38^2" (711 mm x 965 mm^2)
- Two sets of product chamber evaporation shields
- Two blanked-off RGA ports
- Left-side door for service access
- Wide-angle viewports on front and left side
- TP-8 90° angle-of-incidence substrate dome
- One fixed uniformity mask

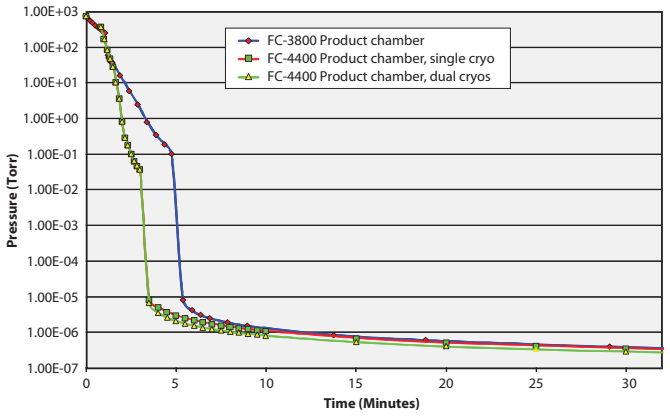
Options

- Turret source upgrade to Temescal's PopTop gun
- A second CT-400 product chamber cryopump
- Dual wire feeders on single-source systems
- Up to three resistance sources
- 4″ source well extension collar
- One 5 cm ion source
- Process gas control for up to three gases
- Throttled cryo iso valve (3-position or analog)
- A residual gas analyzer
- Substrate heaters
- Product chamber hot water circulation
- TCS-controlled auto-blowdown for turret source
- FC-3800 only: High-speed planetaries for step coverage
- Process development and film characterization
- Additional uniformity (shadow) masks
- Soft roughing and venting under TCS control
- FC-3800 only: Flip tooling for two-sided coating
- One additional fixed e-beam source
- A second XTC/3 deposition controller to support codeposition
- A second SS64 programmable beam sweep controller
- One wire feeder per e-beam source on dual-source systems
- Upgrade to a higher-capacity mechanical pump
- Power supply upgrade to 15 kW Temescal Simba2
- TCS simulator for off-line training and process development
- SECS/GEM interface to TCS

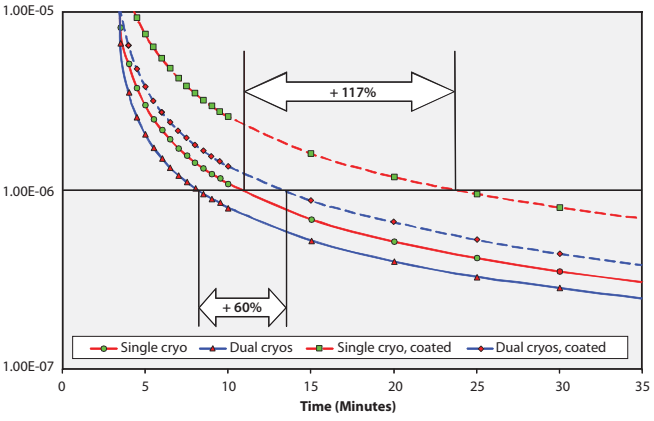
Operator Removing Lift-Off Dome Segment from FC-4400

Operator Removing HSP (Conformal Coverage) Substrate Holder from FC-3800

FC-3800 vs FC-4400 Pumpdown Comparison



Coating Impact on FC-4400 Product Chamber Pumpdown



FC-2800 AND BCD-2800: MID-SIZED COATERS FOR P

The FC-2800 and BCD-2800 are clean room-compatible coaters that offer high-throughput efficiency and lift-off capability at a source-to-substrate distance of either 34" (866 mm) or 42" (1067 mm). Both systems can be configured for either freestanding or through-the-wall clean room installation, and both support numerous combinations of deposition sources plus a variety of substrate fixtures and feeding, heating, and cleaning options.

Standard Features

System Control

- Temescal Control System (TCS), providing Auto, Manual, and Service Modes plus process datalogging
- TCS-based process variable monitoring (PVM) allows user to set process tolerance alarms
- Inficon XTC/3 deposition controller

Electron Beam Source, Power Supply, and Sweep

- Temescal removeable-cover turret source, 4- or 6-pocket
- Temescal model CV-6SLX or CV-12SLX e-beam power supply
- Temescal SuperSweep64 programmable beam sweep controller

Vacuum Pumping and Control

- Edwards model iGX100L dry roughing pump, with a pumping speed of 62 cfm (105 m^3/h^{-1})
- Source chamber cryopump: CTI model CT-8 On-Board
- Product chamber cryopump: CTI model CT-400 On-Board
- Edwards Active Inverted Magnetron gauges and Pirani controllers, monitored and controlled by the TCS
- Cryopump temperature monitoring

Water System

- Stainless steel manifold provides cooling water for source and product chamber components
- Separate product chamber circuit for cold and optional hot water circulation

Miscellaneous/System-Wide

- 5 EMO switches
- Standard 19" wide electronics rack on casters
- Surfaces exposed to high vacuum are made of 304 SST

Air System

- PLC-controlled air manifold

Source Chamber

- Drop-down, swing-out source tray, accessible from either front or left side of vacuum cubicle
- Wide-angle 4" viewport for source observation
- Removeable stainless-steel source tray debris shield
- On FC-2800 only, gate valve with moveable shield
- FC-2800 source tray diameter: 18" (457 mm)
- BCD-2800 source tray diameter: 20" (508 mm)

Product Chamber

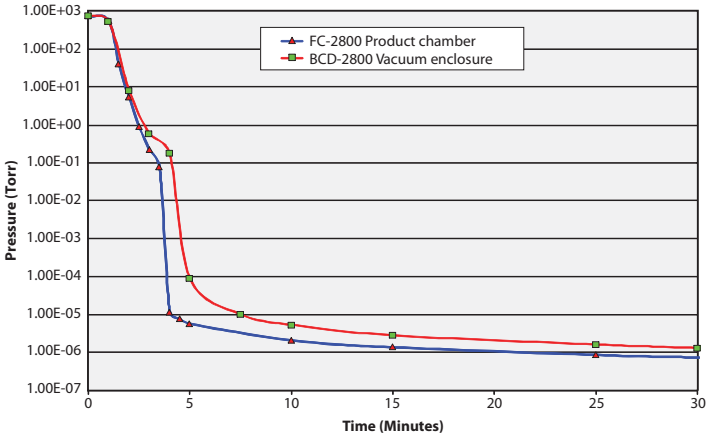
- Dimensions: 28" (711 mm) cubic
- Two sets of product chamber evaporation shields
- Two blanked-off RGA ports
- Left-side door for service access
- Wide-angle viewports on front and left side
- TP-8 90° angle-of-incidence substrate dome
- One fixed uniformity mask

RODUCTION AND LARGE-WAFER R&D APPLICATIONS

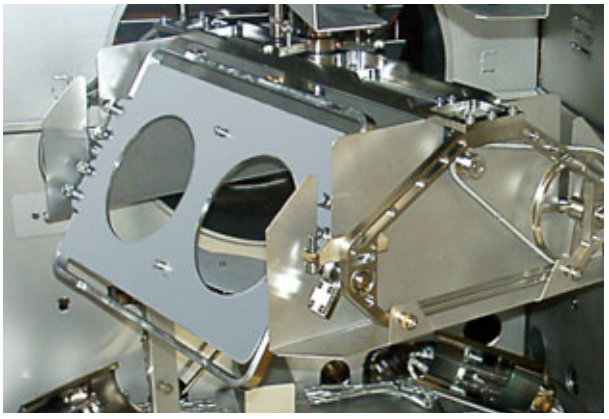
Options

- Turret source upgrade to Temescal's PopTop source
- Dual wire feeders on single-source systems
- Up to three resistance sources
- 8" source well extension collar
- One 3 cm or 5 cm ion source
- Process gas control for up to three gases
- Throttled cryo iso valve (3-position or analog)
- A residual gas analyzer
- Substrate heaters
- Chamber temperature monitoring
- Product chamber hot water circulation
- TCS-controlled auto-blowdown for turret source
- High-speed planetaries for step (conformal) coverage
- Process development and film characterization
- Additional uniformity (shadow) masks
- Soft roughing and venting under TCS control
- Flip tooling for two-sided coating
- One additional fixed e-beam source
- A second XTC/3 deposition controller to support codeposition
- A second SS64 programmable beam sweep controller
- One wire feeder on dual-source systems
- Upgrade to a higher-capacity mechanical pump
- TCS simulator for off-line training and process development
- SECS/GEM interface to TCS

FC-2800 vs. BCD-2800 Pumpdown Comparison



High Uniformity Lift-Off Assembly (HULA)



FC/BCD-2800 'Flip Tooling' for Dual-Sided Coating

5 cm Ion Source with PBN in Product Chamber

FC-2000 AND BJD-2000: BELL JAR R&D A

Temescal's FC-2000 and BJD-2000 are versatile evaporation systems that accept a variety of accessories to meet almost any requirement. Engineered for efficient operation and clean room compatibility, these systems combine maximum flexibility with ease of use. The FC-2000 is a fast-cycle, load-locked system that allows the source to remain under vacuum during substrate reloading. The BJD-2000 is non-load-locked.

Convenient Maintenance

The offset pumping port, the hinged door panels, and the swing-out source tray are high-value maintenance features in Temescal bell-jar systems. The offset pumping design reduces unscheduled downtime by minimizing the possibility of debris entering the pumping module. The hinged door panels open to the pumping system and the vacuum chamber. The electric hoist and the swing-out source tray facilitate access for cleaning, maintenance and, evaporant reloading. Access to the water manifold, the bellows-sealed high-vacuum valve, and other pumping system components is also simple and direct.

Standard Features

System Control

- Temescal Control System (TCS), providing Auto, Manual, and Service Modes plus process datalogging
- TCS-based process variable monitoring (PVM) allows user to set process tolerance alarms
- Inficon XTC/3 deposition controller

Electron Beam Source, Power Supply, and Sweep

- Temescal removeable-cover turret source, 4- or 6-pocket
- Temescal model CV-6SLX electron beam power supply
- Temescal SuperSweep64 programmable beam sweep controller

Miscellaneous/System-Wide

- 5 EMO switches
- Standard 19" wide electronics rack on casters

Vacuum Pumping and Control

- Edwards model XDS35i dry roughing pump, with a pumping speed of 21 cfm (35 m3/h-1)
- CTI model CT-8 On-Board cryopump
- Edwards Active Inverted Magnetron gauges and Pirani controllers, monitored and controlled by the TCS
- Cryopump temperature monitoring

Air System

- PLC-controlled air manifold

Water System

- Stainless steel manifold provides cooling water for the source and for components inside the bell jar

Vacuum Chamber

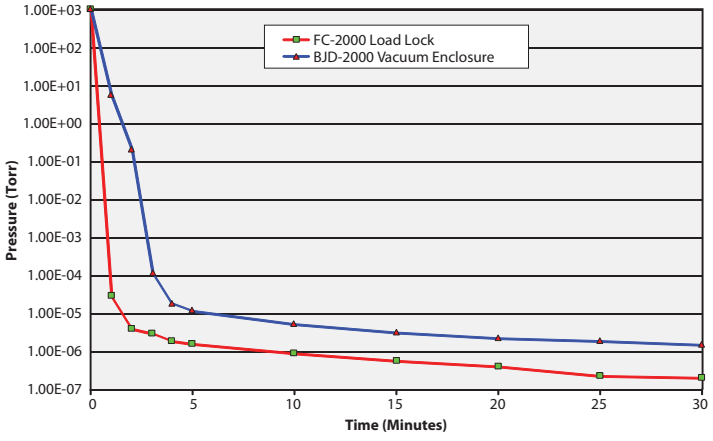
- Drop-down, swing-out source tray
- Temescal model VV 220 viewport in bell jar
- Wide-angle 4" viewport for source observation
- Removeable stainless-steel source tray debris shield
- On FC-2000 only, gate valve with moveable shield
- Bell jar diameter: 20" (508 mm)
- FC-2000 source tray diameter: 18" (457 mm)
- BJD-2000 source tray diameter: 20" (508 mm)
- Two sets of evaporation shields
- Chamber and bell jar cooling water
- Spare KF flange-port for RGA or alternate access
- TP-8 90° angle-of-incidence substrate dome
- One fixed uniformity mask

ND SMALL-WAFER PRODUCTION SYSTEMS

Options

- Turret source upgrade to Temescal's PopTop source
- Dual wire feeders on single-source systems
- Up to three resistance sources
- 8" source well extension collar
- One 3 cm ion source
- Process gas control for up to three gases
- A residual gas analyzer
- Substrate heaters
- Chamber temperature monitoring
- Vacuum chamber and bell jar hot water circulation
- TCS-controlled auto-blowdown for turret source
- High-speed planetaries for step (conformal) coverage
- Process development and film characterization
- Additional uniformity (shadow) masks
- Soft roughing and venting under TCS control
- Flip tooling for two-sided coating
- One additional fixed e-beam source
- A second XTC/3 deposition controller to support codeposition
- A second SS64 programmable beam sweep controller
- One wire feeder on dual-source systems
- Upgrade to a higher-capacity mechanical pump
- TCS simulator for off-line training and process development
- SECS/GEM interface to TCS

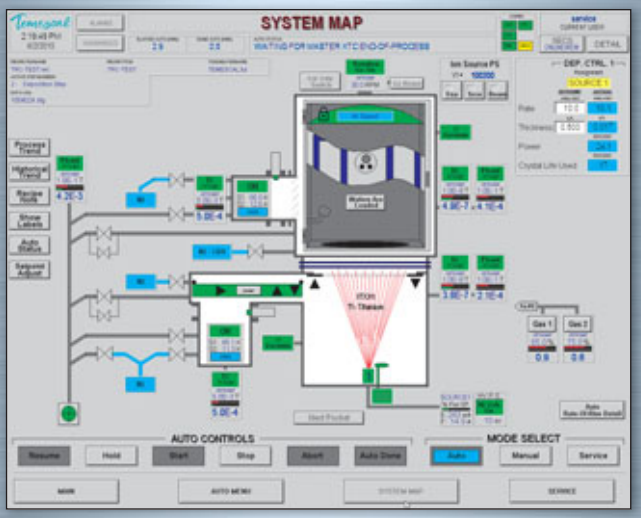
FC-2000 vs. BJD-2000 Pumpdown Comparison



Temescal Control System

The Temescal Control System (TCS) provides fully intergrated, recipe-driven process and vacuum control. Operating in any of three password-protected modes, the TCS also offers process variable monitoring, process and historical trend tracking, and process data logging.

TCS System Map During Deposition



The TCS Automatic Mode

The TCS Auto Mode provides fully automated execution of user-programmed recipes consisting of up to twenty process steps, as well as full abort diagnostics. The TCS Auto Mode also offers independent autopump and autovent operations, automated cryopump regeneration, and automated rate-of-rise testing.

Manual Mode Operation

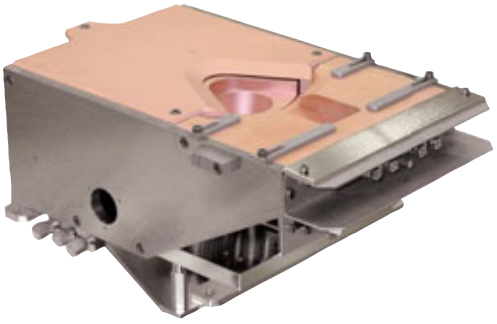
The TCS Manual Mode enables the user to set process parameters, operate major components and subsystems individually with full interlock protection, and execute nonautomated single-film deposition processes.

Service Mode Operation

The TCS Service Mode provides low-level, noninterlocked control over any of the system's valves, pumps, motors, or power supplies.

The Heart of Temescal Systems: E-Gun, Power Supply, and Sweeper

Proprietary 3D vapor cloud modeling has enabled Temescal to develop the most fully integrated e-gun/power supply/sweep controller packages available today. So for optimal results, use Temescal's removeable-cover or PopTop turret sources with the Temescal SS64 digital beam sweep controller and either the CV-6SLX or the CV-12SLX electron beam power supply.



Temescal Model 3PT PopTop E-Beam Source

PopTop Cover Down

PopTop Cover Up

Temescal 'PopTop' Supersources

Temescal's patented PopTop e-beam sources offer enhanced convenience, reliability, and throughput in applications ranging from microelectronic and optical production to specialized R&D coating. The key to these performance enhancements is Temescal's pneumatically actuated PopTop crucible cover, which rises automatically before turret rotationbut otherwise seals off all crucible pockets from the exposed pocket and from each other. The net benefit is virtual elimination of cross-contamination.

Features and Benefits

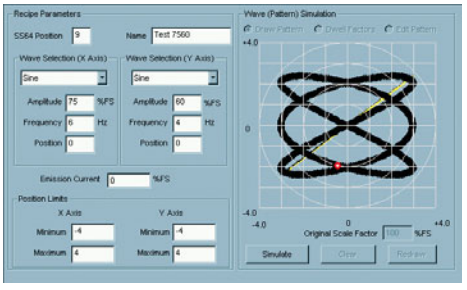
- Moveable cover rises before crucible rotation
- Pneumatically driven, low-impact cover motion
- Minimal deposition on crucible web walls and on cover margins around exposed pocket
- Reduced risk of damage to crucible and turret indexer
- Easy crucible removal facilitates source conversion

SuperSweep64 E-Beam Sweep Controller

The Temescal SuperSweep64 beam sweep controller offers fully digital operation, internal storage for up to 64 user-defined sweep patterns, and compatibility with almost any commercially available e-beam gun. With Windows™-based programming software and a hand-held remote controller, the SuperSweep64 offers the precision and flexibility required by the most demanding e-beam PVD processes.

Features and Benefits

- Each user-designed sweep pattern can address up to 1024 discrete points
- Five available waveforms: sine, sawtooth, triangular, clipped, and arbitrary
- Proprietary Windows-based software enables PC-based waveform design and modification
- Hand-held remote controller allows user to design waveforms while watching the beam sweep



Waveform Design Screen Displaying Lissajous Pattern

NENTS: AN OPTIMIZED FAMILY

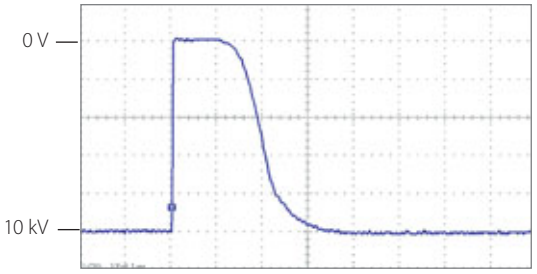
CV-6SLX Power Supply

The Temescal Model CV-6SLX is a 6 kW, constant-voltage switching power supply designed to power and control one e-beam source. Delivering up to 10kV at 0–600 mA, the Model CV-6SLX supports production at substantial deposition rates. The power supply also offers stable output at all voltage levels, rapid arc recovery, ease of integration, and convenience and safety for operating as well as service personnel.

Features and Benefits

- Autobias control feature maintains optimal bias voltage as filament ages
- Emission current linearly adjustable from 0 to 600 mA
- Emission current regulation to within ± 0.5%
- Solid-state HV regulation to within ± 0.5%
- HV linearly adjustable from 0 to 10 kV
- Arc recovery within 2.5 ms
- CE Certified

CV-6SLX Arc Recovery Waveform



Arc event to full voltage recovery in 2.5 ms.
(Graph scales are: X = 1 ms/division; Y = 2 kV/division)

CV-12SLX Power Supply

Temescal's Model CV-12SLX is a 12 kW, constant-voltage switching power supply designed to power and control either one or two electron beam guns. Delivering up to 10kV at 0–1200 mA, the CV-12SLX power supply makes it possible to achieve substantial deposition rates in any production environment. The Model CV-12SLX also offers stable output at all voltage levels, rapid arc recovery, ease of integration, and convenience and safety for operating as well as service personnel.

Features and Benefits

- Autobias control feature maintains optimal bias voltage as filament ages
- Emission current linearly adjustable from 0 to 1200 mA
- HV and emission current regulated to within ± 0.5%
- HV linearly adjustable from 0 to 10 kV
- Arc recovery within 3.5 ms
- CE Certified

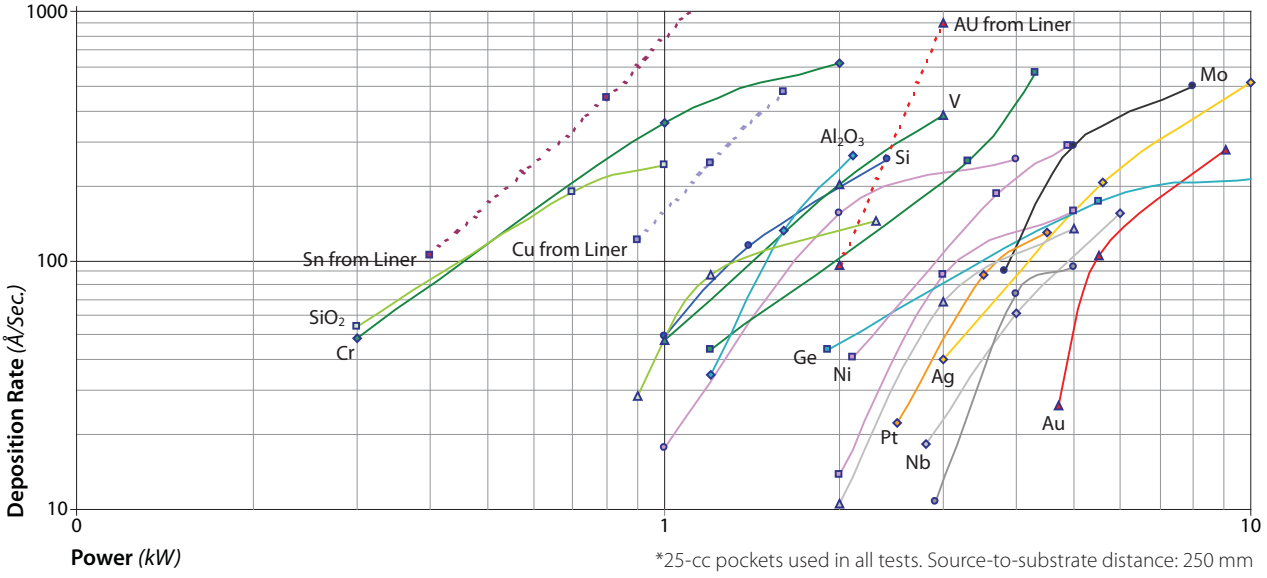
Optional Remote Controller

APPLICATION SPECIFIC PROCESS SUPPORT

To help our customers maximize uniformity and throughput while minimizing material waste, Temescal offers unparalleled process support, including:

- Scientific design of customized uniformity masks
- Advanced vapor cloud modeling for any conventional metal or binary compound
- Minimization of carrier-imposed effects (e.g., edge exclusion, framing, shadowing)
- Compensation for variations in substrate size and shape (e.g., concavity, chord height)
- Analysis of problematic material characteristics (e.g., adsorption/desorption, heat limits)
- Solutions for coating-stack issues, including stoichiometry and layer and film criteria (e.g., maximum thickness tolerance, uniformity, adhesion, spectral performance, color AB, pinholes, abrasion resistance, and chemical durability)

Deposition Rates of Various Materials from Temescal Sources*



*25-cc pockets used in all tests. Source-to-substrate distance: 250 mm

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