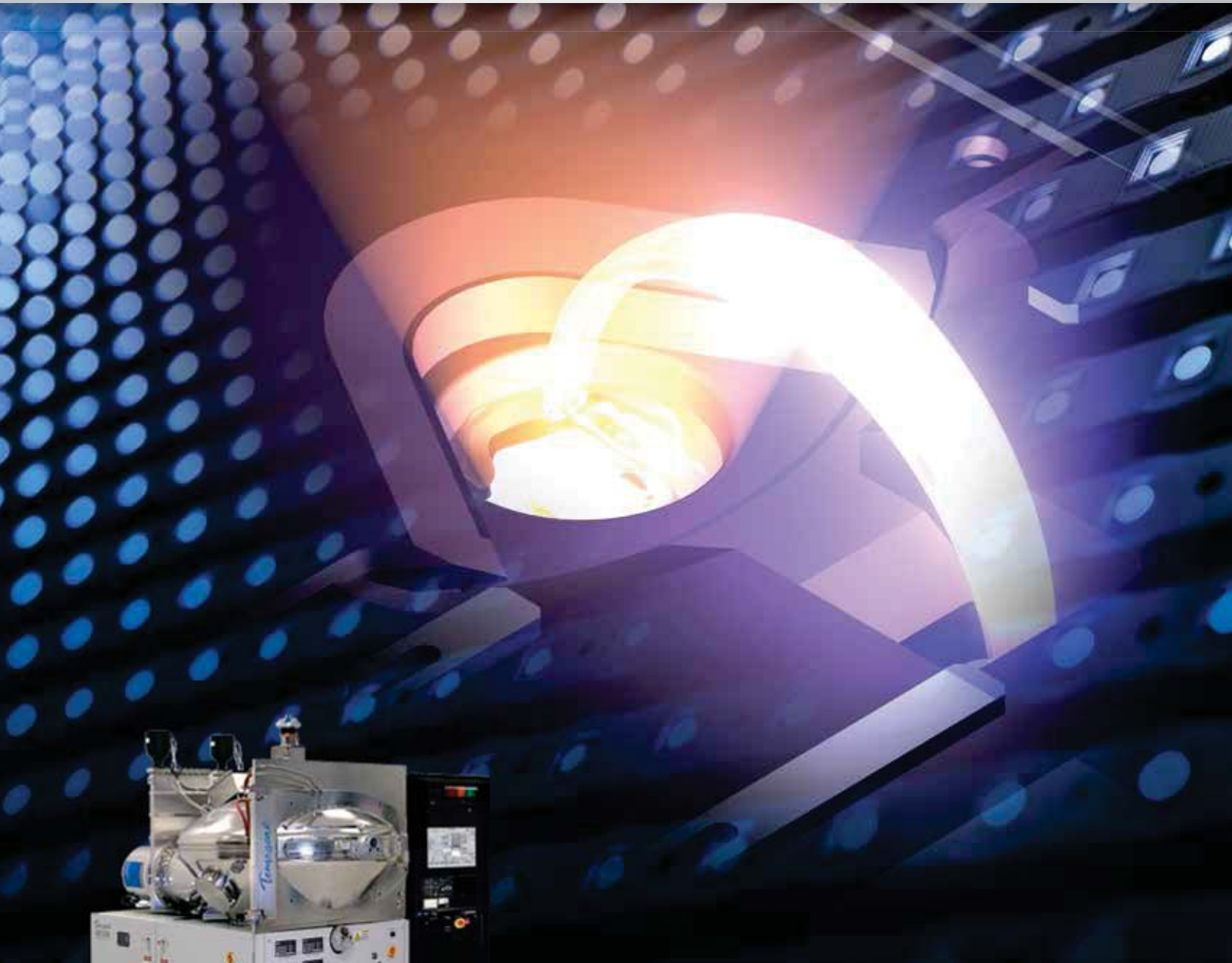


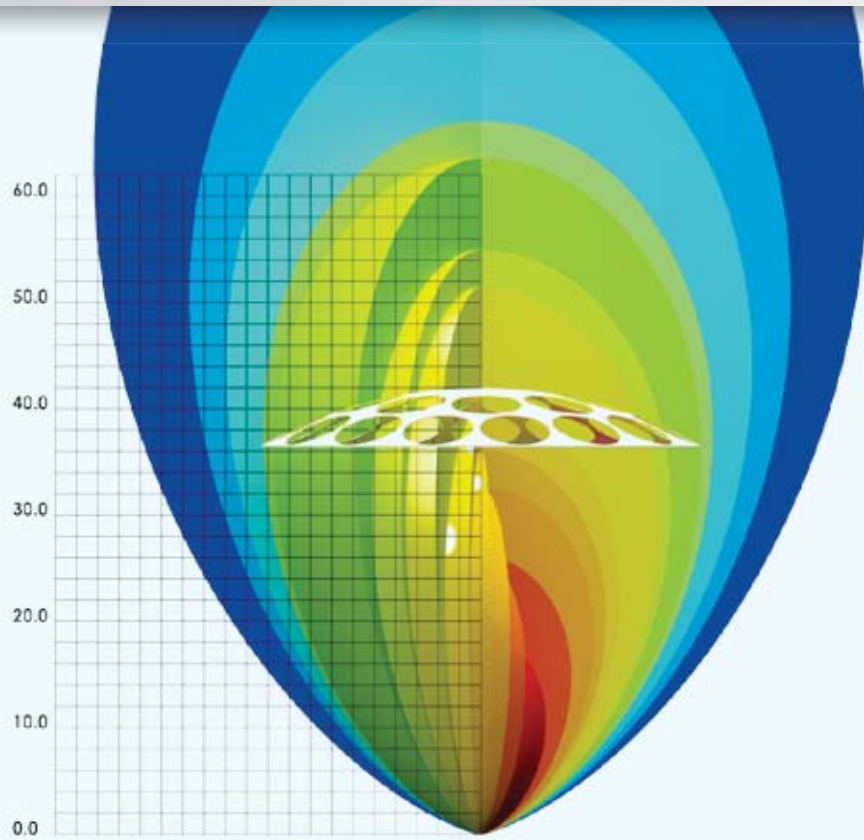
FerroTec

TEMESCAL PRECISION COATING SOLUTIONS



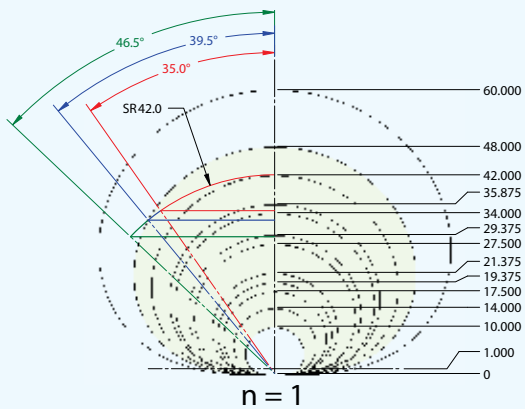
Temescal

UNDERSTANDING THE SCIENCE



A vapor cloud forms the heart of every electron beam evaporation system. Each material evaporated by an electron beam produces a unique, repeatable flux distribution characteristic of radiation from a point source.

But these flux clouds can vary. They change because of a variety of factors in the deposition process—like deposition material, deposition power, crucible size, the use of a crucible liner and beam spot focus.



With precision lift-off coating, the goal is an even, predictable deposition layer across a batch of wafers. Uniformity masks are the conventional solution for managing the fluxcloud, trimming the heaviest zones of deposition to match that of the least flux zones' collection.

EMBRACE

NCE OF THE VAPOR CLOUD

FROM HARNESSING THE FIRST ELECTRON BEAMS

The roots of a Temescal system run deep, back to labs in Berkeley in the 1950s where we pioneered the first electron beam evaporation components and began patenting the first e-gun designs. Over the years, electron beam evaporation has become a well-established method for thin film coating, so well established that some might believe that a system is simply the sum of a vacuum chamber, an electron beam gun, and a high-voltage power supply.

TO VOLUME COMPOUND SEMICONDUCTOR METALIZATION

With our long history in designing and building electron beam evaporation systems, we know that a system is more than an assembly of parts. A precision tool for high-volume uniform coating is a symphony of specialized components, operating in precise relationships with careful optimizations that harmonize the system with multi-step coatings and the heart of the entire process, the flux cloud.

WE BUILD HIGHLY OPTIMIZED PRODUCTION TOOLS

From our most basic systems designed for R&D or pilot production to our top-of-the-line lift-off coaters, every Temescal system is designed for precision, efficiency and throughput. It's one reason why the world's leading compound semiconductor manufacturers depend upon Temescal systems, batch after batch, day after day.

WE ENGINEER PROCESS MATERIAL UNIFORMITY

For us, the vapor cloud is the heart of every electron beam evaporation system. Each material evaporated by an electron beam produces a unique cloud, a repeatable flux distribution characteristic of radiation from the point source. Coating uniformity depends on the relationship between the wafer surface and the cloud. But the flux cloud isn't static; it's dynamically shaped by everything from deposition material, power, beam spot focus, crucible size—even factors like whether you're using a crucible liner. We engineer Temescal systems to manage these variations, to harmonize with the cloud and deliver unparalleled uniformity.

WE ARE EXPERTS IN THE SCIENCE OF THE VAPOR CLOUD

For over a decade, Temescal has been dedicated to mapping and better understanding the dynamics of the flux cloud. Through extensive testing and research, we have collected hundreds of vapor cloud maps and used these maps to advance and automate the process of Lift-off uniformity mask design. Now, Temescal systems incorporate this expertise in our Auratus deposition enhancement methodology, ensuring that your process is always harmonized to the cloud.

THE CLOUD

WHAT'S INSIDE A

A TEMESCAL SYSTEM IS A PRODUCTION TOOL, DESIGNED FOR MAXIMUM EFFICIENCY, HIGH THROUGHPUT PRECISION COATING. THIS GUIDING PHILOSOPHY DICTATES MANY OF THE SYSTEM DESIGN DECISIONS THAT RUN THROUGH OUR ENTIRE PRODUCT LINE.

Vacuum Pumping

Nobody likes waiting for a system to pump down, but when it's a production tool, waiting is expensive. That's why Temescal systems maximize the vacuum pumping capacity, so you pump down fast instead of waiting.

This is also why Temescal systems feature a load lock separation between the process chamber and the source chamber. This feature enables you to service your process materials, then pump back down without losing vacuum in your process chamber. Practically speaking, what it means is faster process cycles, shorter wait times and increased process throughput.

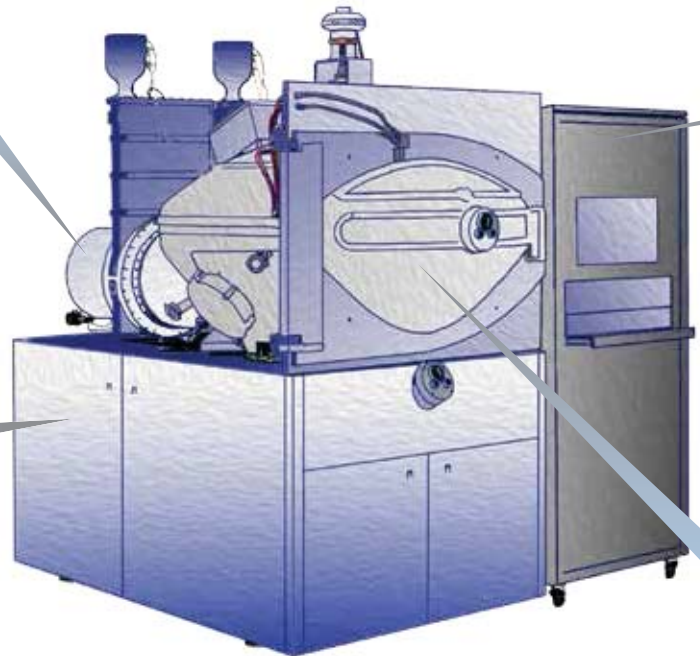
TemEBeam EBC Integrated Controller

Our TemEBeam EBC controller bundles all of the sophisticated sweep pattern and system management capabilities required to achieve ultimate uniformity into a single, easy-to-operate integrated platform.



The Temescal Poptop Supersource

The Poptop gun is an electron beam source that has been uniquely optimized for processes that use multiple materials. With its pneumatically actuated Poptop crucible cover, the Poptop is able to seal inactive crucible pockets, eliminating cross-contamination and improving process results.



Fast Recovery Power Supply

Temescal power supplies are exceptionally responsive with fast arc handling, low arc rates, consistent deposition rate and high source utilization. These characteristics lead to a more stable processes and better control of final thickness and reduced batch-to-batch variation.

TEMESCAL SYSTEM?

Auratus Deposition Enhancement Methodology

Our unique Auratus Deposition Enhancement Methodology takes advantage of specialized components, optimizations and features designed to improve efficiency, maximize uniformity, and lower material consumption.

Auratus Enhanced Uniformity Masks

We have built a comprehensive library of materials, mapping the unique characteristics of their flux clouds, and we've used this expertise to help us optimize our systems for ultimate uniformity.

Auratus Enhanced Conic Chamber

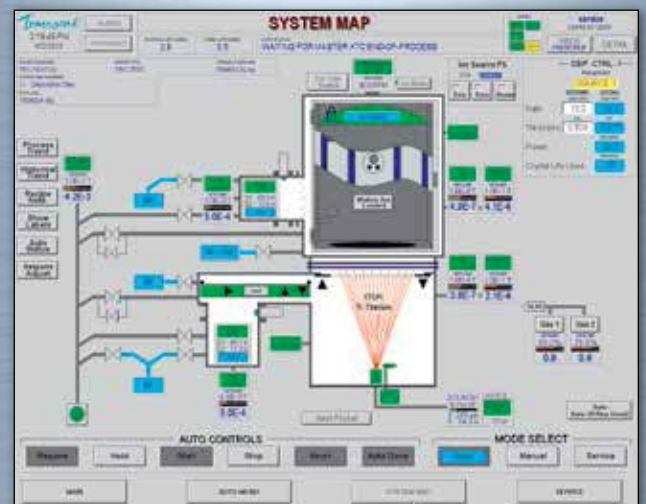
Another enhancement available only on a Temescal is our unique conical chamber design. The conical chamber offers significant advantages over traditional box-shaped chambers by eliminating wasted chamber space and surface area, reducing pump down time, and decreasing in-chamber debris accumulation.



Temescal Control System

The Temescal Control System (TCS) provides fully integrated, 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

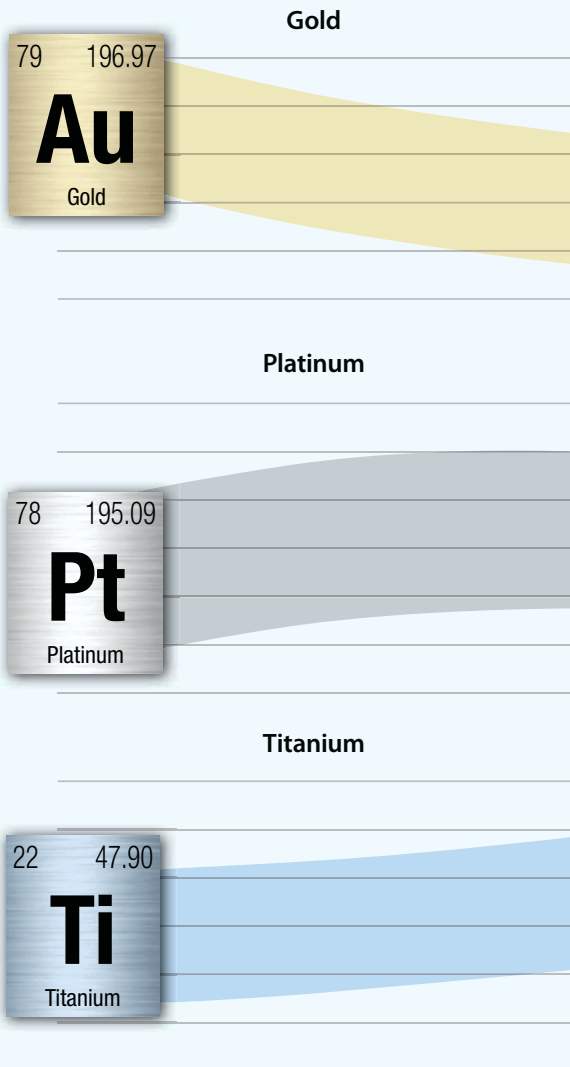


HULA

One of the most significant elements in the Auratus enhancement package is the patent-pending High-Uniformity Lift-off Assembly (HULA) with a unique, magnetically-driven dome assembly. With its dual-axis motion, the HULA ensures that all wafers spend equivalent periods in the high-density and low-density regions of the vapor cloud.

As shown in these uniformity curves, each process material exhibits different uniformity characteristics. This makes a one-size-fits-all uniformity mask problematic. Auratus eliminates this problem, delivering consistent uniformity across all process materials.

Uniformity Before Auratus

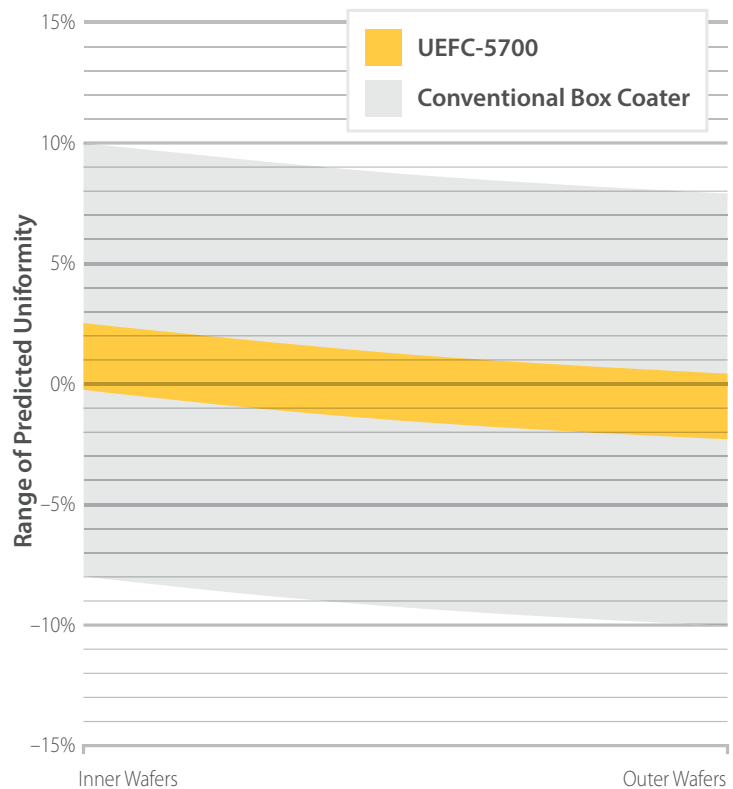


Unprecedented Uniformity

The Auratus™ deposition process enhancement methodology enables Temescal customers to coat wafers with near perfect uniformity, resulting in more consistent, better quality products and fewer defects.

- Achieve near perfect uniformity
- No new uniformity mask development when changing the process layers (film stack)

Uniformity Comparison: Conventional Box Coaters vs UEFC-5700



ARMONY WITH THE CLOUD

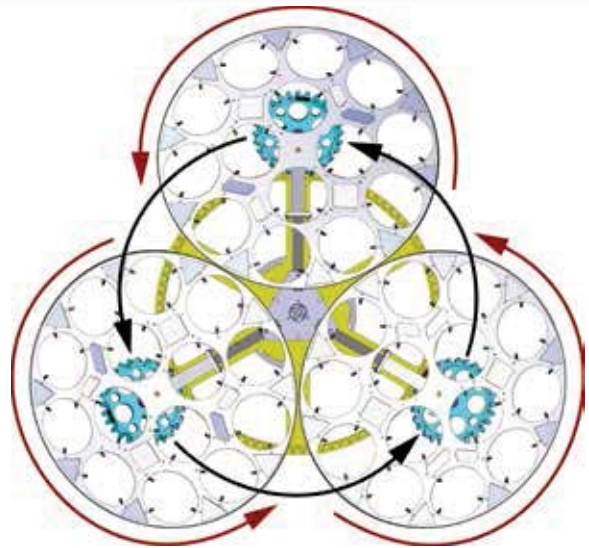
Dramatic Savings

With a revolutionary product chamber and a unique substrate holder, an Auratus empowered system offers significant reductions in material consumption. For evaporants such as gold and platinum, this can mean savings of up to 40% in material costs.

Unique Chamber Design

Auratus is enhanced with a unique conical vacuum chamber. This complex fabrication of stainless spun and conic elements offers significant advantages over conventional box-shaped chambers. The conical shape reduces volume and surface area, allowing faster pumpdown times for large chamber volumes, increasing process throughput and providing real operational savings.

- Eliminates wasted chamber space & surface area
- Significantly reduces pumpdown time
- Reduces in-chamber debris accumulation



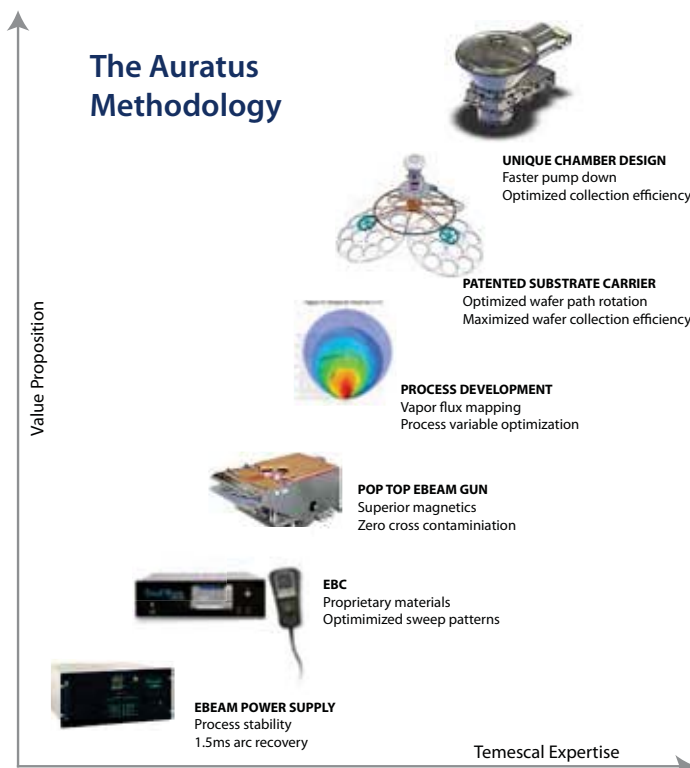
Magnetically driven, non-contact, High Uniformity Lift-off Assembly (HULA) without vapor shields

High-Uniformity Lift-off Assembly (HULA)

Auratus enhances the deposition process using a patent-pending High-Uniformity Lift-off Assembly (HULA) design. The unique, magnetically-driven dome assembly produces rotational motion with zero metal-to-metal contact, minimizing the generation of particulates for improved process quality and fewer defects.

With its dual-axis motion, the HULA ensures that all wafers spend equivalent periods in the high-density and low-density regions of the vapor cloud. This complex motion optimizes collection efficiency and also radically minimizes the size of the deposition mask. This enhancement enables operators to run processes with numerous metals, deposited at varying rates using a universal mask, while realizing minimal variations in film uniformities.

The Auratus Methodology



EMPOWERED WITH AURATUS—THE ULT

THE UEFC-5700 WITH AURATUS: ULTIMATE THROUGHPUT FOR 150 OR 200MM WAFERS

The UEFC-5700

The UEFC-5700 is the first Temescal system to incorporate the Auratus deposition process enhancement methodology, dramatically improving lift-off coating processes. Experience near-perfect uniformity with minimal or no uniformity masking while reducing material consumption by as much as 40%.

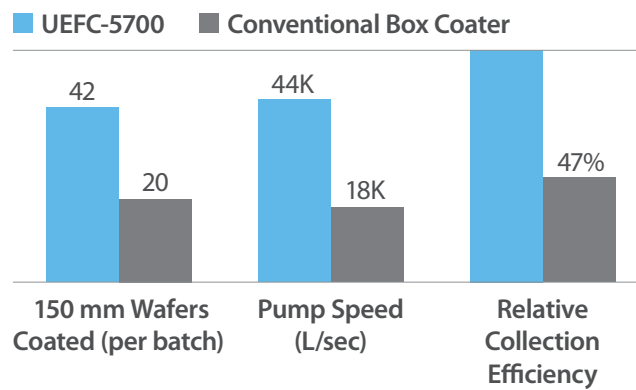
Ultra-High Throughput Tool

The UEFC-5700 is the ultimate high-throughput coater for lift-off processes. The Auratus methodology increases the effective deposition rate, enabling customers to produce wafers faster. Compared with conventional box coaters, the UEFC-5700 provides:

- Large capacity 42 x 150 mm wafers
- 40% more wafers with no increase in footprint or power consumption
- Less than 10 minutes to 5E-07 Torr
- 44,000 L/sec pumping
- Significantly less surface area and volume



UEFC-5700 vs Conventional Box Coater
(150 mm)



	Conventional Box Coater	UEFC-5700
Performance		
Wafers per batch	20	42
Batches per day	15	20
Wafers per day	300	840
Operational Cost of Unreclaimable Gold*		
Cost of lost gold per wafer	\$9.64	\$4.80
Cost per 100,000 wafers	\$964,000	\$480,000

*Assuming Au cost of \$55/gram and reclaim cost of 80%/wafer.

EMBRACE

ULTIMATE LIFT-OFF METALIZATION TOOLS

THE UEFC-4900 WITH AURATUS: ULTIMATE UNIFORMITY OPTIMIZED FOR 150MM WAFERS

UEFC-4900

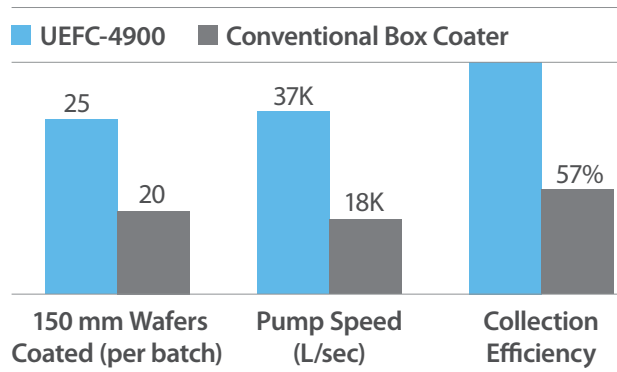
The UEFC-4900 is the compact version of the UEFC-5700. This system features source-to-substrate and chamber angles that have been optimized for 150mm wafer production.

The Ultimate Mid-sized Tool

The UEFC-4900 is the ultimate high-uniformity mid-sized coater for lift-off processes. The Auratus methodology increases the effective deposition rate, enabling customers to produce wafers faster. Compared with conventional box coaters, the UEFC-4900 provides:

- Large capacity 25 x 150 mm wafers
- 40% more wafers with no increase in footprint or power consumption
- Less than 15 minutes to 5E-07 Torr
- 36,500 L/sec pumping
- Significantly less surface area and volume

UEFC-4900 vs Conventional Box Coater



	Conventional Box Coater	UEFC-4900
Performance		
Wafers per batch	20	25
Batches per day	15	24
Wafers per day	300	600
Operational Cost of Unreclaimable Gold*		
Cost of lost gold per wafer	\$9.64	\$5.73
Cost per 100,000 wafers	\$964,000	\$573,000

*Assuming Au cost of \$55/gram and reclaim cost of 80%/wafer.



THE CLOUD

TEMESCAL CLASSIC

WITH A LEGACY OF EXCEPTIONAL UNIFORMITY, PRECISION AND RELIABILITY, THE WORLD'S LEADING COMPOUND SEMICONDUCTOR FABRS AND FOUNDRIES HAVE BEEN DEPENDING UPON TEMESCAL SYSTEMS FOR DECADES. TEMESCAL CLASSIC SYSTEMS REPRESENT OUR TRADITIONAL DESIGNS THAT MANUFACTURERS AND SCIENTISTS TRUST, WITH WELL CHARACTERIZED PERFORMANCE, STRONG THROUGHPUT AND HIGH UNIFORMITY.

FC-4400 and FC-3800 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.



COATING SYSTEMS

FC-2800 and BCD-2800

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.



FC-2000 and BJD-2000

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.

CUSTOMIZABLE OPTIONS AND CONFIGURATIONS

Customized for Your Application

When you choose a Temescal system, you are selecting a platform. While every Temescal system is designed around our standard architecture, we offer a broad range of options that enable you to customize each system to your unique application, process and budget requirements. From crucible sizes and source configurations to chamber components and substrate carriers, Temescal systems can be mixed and matched to your custom requirements.

And because your needs evolve over time, Temescal systems are built around our standard configurations platform, making it possible for you to upgrade or reconfigure your system with some simple component changes. This is just one reason why you'll still find vintage Temescal systems actively working in production facilities around the world—our systems are built to last.

SYSTEM OPTIONS

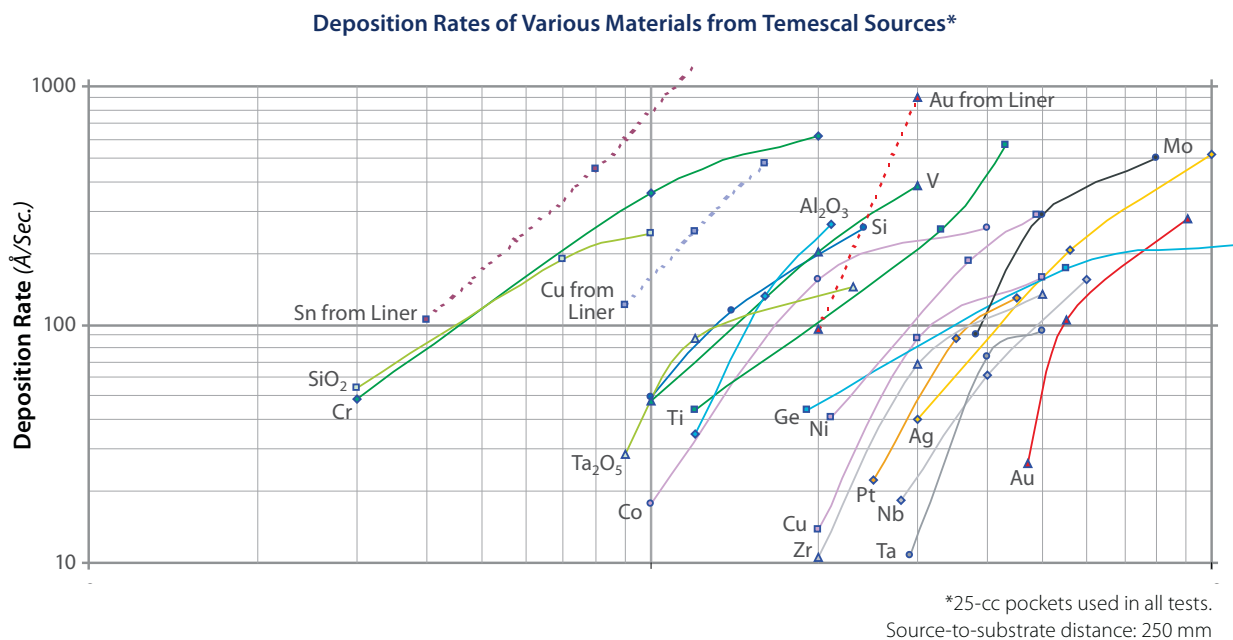
SYSTEM	UEFC-5700	FC-4400	UEFC-4900	FC-2800
Sources				
Additional fixed e-beam source	•	•	•	•
Additional turret e-beam source	•	•		
Single or dual wire feeders	•	•	•	•
Up to three resistance sources	•	•	•	•
Ion source: MKII HC or Filament	•	•	•	•
Ion source: MKI Filament				•
System				
Process gas control for up to three gases	•	•	•	•
Throttling for PC cryopumps	•	•	•	•
Residual gas analyzer	•	•	•	•
Substrate heaters	•	•	•	•
Chamber temperature monitoring	•	•	•	•
Product chamber hot water circulation	•	•	•	•
Soft roughing and venting under TCS control	•	•	•	•
A second deposition controller & EBC to support co-deposition	•	•	•	•
Upgrade to a larger-capacity mechanical pump	•	•	•	•
SECS/GEM interface to the TCS	•	•	•	•
Process development and film characterization	•	•	•	•
TCS simulator for off-line training and process development	•	•	•	•
Additional uniformity (shadow) masks	•	•	•	•
Source extension Collar: increase source-to-substrate distance		•		•

SOLUTIONS FOR YOUR PROCESS REQUIREMENTS

Custom Uniformity Masks

A Temescal system is more than simply the hardware that your process runs on. When you select a Temescal system, we work with you to understand your process. Using our library of materials characteristics, we craft custom

uniformity masks for your system and process, ensuring that your Temescal system delivers exceptional uniformity, day in and day out.



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)



SYSTEM	UEFC-5700	FC-4400	UEFC-4900	FC-2800	FC-2000	BJD-2000
	Ultimate Uniformity Production: 150 & 200mm	Production: 150 & 200mm	Ultimate Uniformity Production: 150 mm	Production: 100mm	University, R&D, Pilot Production	University, R&D, Pilot Production
Product Chamber Type	conic	box	conic	box	bell jar	bell jar
Load Lock to isolate Product Chamber	yes	yes	yes	yes	yes	
Cryopump water L/sec	44,000	44,000	36,500	21,500	4,000	4,000
Pump down time:	1E-06 < 10mins	1E-06 < 10mins	1E-06 < 10mins	1E-06 < 20mins	1E-06 < 10mins	1E-06 < 15mins
E-gun (max pkg)	2 6x25cc PopTops + 1 fixed pocket	2 6x25cc PopTops + 1 fixed pocket	2 6x25cc PopTops + 1 fixed pocket	4x25cc PopTop + 1 fixed pocket	4x25cc PopTop + 1 fixed pocket	4x25cc PopTop + 1 fixed pocket
E-gun Power Supply	6, 12, or 15 kW	6, 12, or 15 kW	6, 12, or 15 kW	6 or 12 kW	6 or 12 kW	6 or 12 kW
Ion gun	MKII HC	MKII HC	MKII HC	MKII filament	MKI filament	MKI filament
Max wafer count: Lift off	42x150mm, 21x200MM	30x150mm, 15x200MM	25x150mm	25x100mm, 12x150mm	42x2", 13x100mm	42x2", 13x100mm
Source to Substrate: std	43"	38"	35.5"	34"	19.5"	19.5"
Source to Substrate: ext		42"		42"	27.5"	27.5"
System Control						
Temescal Control System (TCS), with Auto, Manual modes plus process datalogging	•	•	•	•	•	•
Security code-based access for multiple classes of users	•	•	•	•	•	•
TCS-based process variable monitoring (PVM), allowing user to set tolerance alarms for critical process variables	•	•	•	•	•	•
17" high resolution color touch screen interface	•	•	•	•	•	•
E-Beam						
Temescal 4- or 6-pocket Standard or PopTop turret source	•	•	•	•	•	•
Temescal model CV-6SLX or CV-12SLX e-beam power supply (Simba option available)	•	•	•	•	•	•
TemEBeam Controller: Sweep, Index, Gun & HV	•	•	•	•	•	•
Substrate						
HULA: High Uniformity Lift-off Assembly	•	•	•	•		
Lift-off dome or dome frame with segments	•	•	•	•	•	•
Step coverage High Speed Planatary				•	•	•
Flip tooling: allows for two sided or edge coating	•	•	•	•	•	•
VAP: Variable Angle Planatary	•	•	•	•	•	•
Vacuum Pumping & Control						
Market leading dry roughing pump >60 cfm (102 m3/h)	•	•	•	•	•	•
CTI On-Board Cryopumps	•	•	•	•	•	•
Cryopump temperature monitoring	•	•	•	•	•	•
Active Inverted Magnetron gauges and Pirani controllers, monitored and controlled by the TCS	•	•	•	•	•	•



SYSTEM	UEFC-5700	FC-4400	UEFC-4900	FC-2800	FC-2000	BJD-2000
	Ultimate Uniformity Production: 150 & 200mm	Production: 150 & 200mm	Ultimate Uniformity Production: 150 mm	Production: 100mm	University, R&D, Pilot Production	University, R&D, Pilot Production
Product Chamber						
Dimensions in inches	57 conic	23.5 ² x44H	49 conic	28 ³	20 bell jar	20 bell jar
Product chamber cryopump	Dual CT-400 35,000 L/Sec	Dual CT-400 35,000 L/Sec	CT-500 30,000 L/Sec	CT-400 17,500 L/Sec	CT-400 17,500 L/Sec	
Water cooled product chamber walls	•	•	•	•	•	•
Two sets of product chamber evaporation shields	•	•	•	•	•	•
Wide-angle viewport on front of system	•	•	•	•	•	•
Maskless uniformity	•		•			
One fixed uniformity mask		•		•	•	•
Spare port(s) for RGA or alternate access	•	•	•	•	•	•
10" and 12.75" diameter side ports for optional components	•		•			
Left-side door for service access		•		•		
Source Chamber						
Source-isolation valve allows product chamber access while source chamber remains under vacuum	•	•	•	•	•	
Source chamber cryopump	CT-10 (9,000 L/Sec)	CT-10 9,000 L/Sec	CT-10 9,000 L/Sec	CT-8 4,000 L/Sec	CT-8 4,000 L/Sec	CT-8 4,000 L/Sec
Source Tray Dimensions in inches	25.5	25.5	20	20	20	18
Drop-down, swing-out source tray, accessible from either clean room or chase side of vacuum cubicle	•	•	•	•	•	•
Wide-angle 4" viewport	•	•	•	•	•	•
Removable stainless-steel source shields	•	•	•	•	•	•
Water & Air System						
Stainless steel manifold provides cooling water for source and product chamber components	•	•	•	•	•	•
Separate product chamber circuit for cold and optional hot water	•	•	•	•	•	•
TCS-controlled auto-blowdown for turret source	•	•	•	•	•	•
PLC-controlled air manifold	•	•	•	•	•	•
System Wide						
3 EMO switches	•	•	•	•	•	•
Standard 19" wide electronics rack on casters	•	•	•	•	•	•
Surfaces exposed to high vacuum are made of 304 SST	•	•	•	•	•	•

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