Sigma® *f*xP™ for Silicon Applications

Manufacturing production tools for the semiconductor industry.

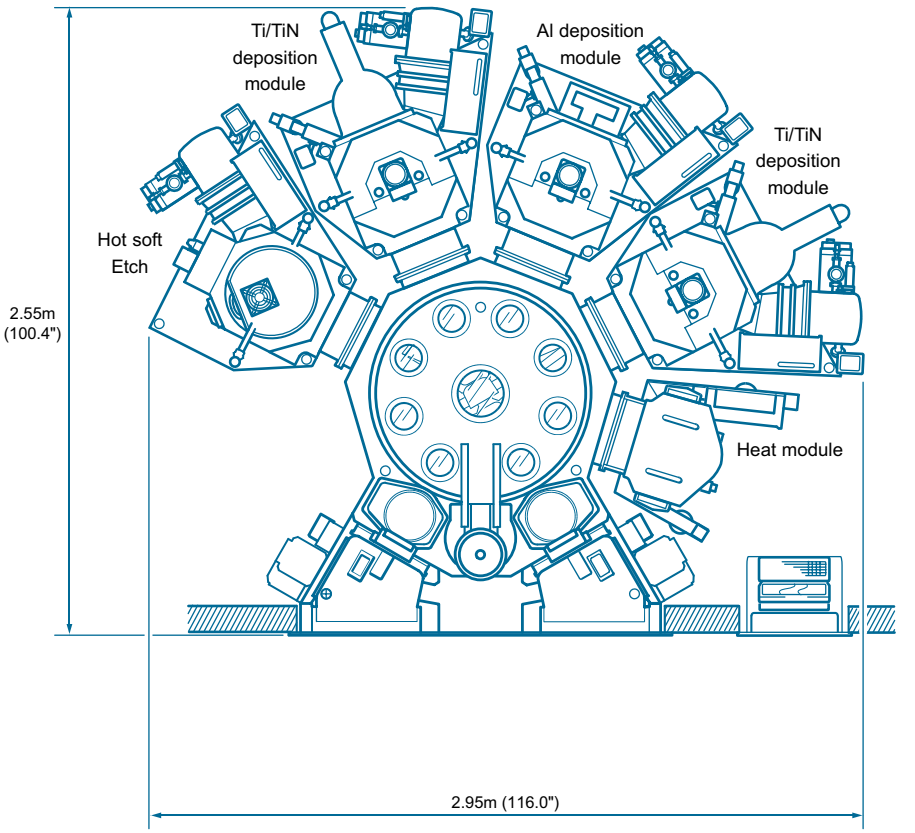
Trikon TECHNOLOGIES

Building Relationships

Sigma® ƒxP™ is the latest in a long line of PVD tools characterised by engineering excellence applied to high volume interconnect manufacture. Trikon has invested over 20 years of production experience into Sigma ƒxP resulting in a system that delivers high quality product at class leading levels of availability and costs.

For fabs demanding speed, productivity and flexibility, the Sigma ƒxP combines Trikon process expertise with Brooks Automation robotics, the acknowledged leader in wafer handling.

One of Trikon's objectives is to form a lasting relationship with customers. The Sigma ƒxP platform and modules were developed from such a relationship. For 100 to 200mm wafers, for last or next generation devices, Trikon brings the same quality of support, technical knowledge and commitment. Our customers expect nothing less.



● *Sigma® ƒxP™ cluster PVD*

Pre-deposition Treatment Modules

Heat Module

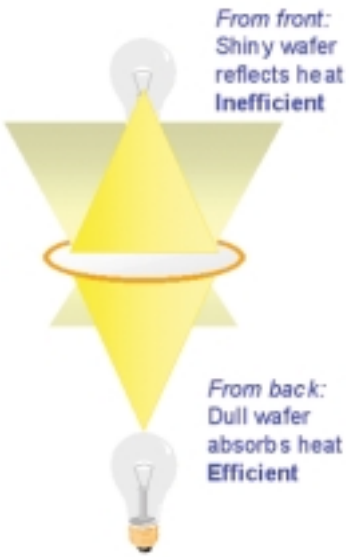
An essential part of any metal sequence, the degas step plays a critical role in delivering consistent process performance wafer to wafer.

- **High efficiency degas by backside heating**

Particularly effective when working with "wet" dielectrics such as Spin on Glass (SOG).

- **No localised "hot-spots"**

Compared to topside heaters, backside degas is less sensitive to metal pattern densities.



Efficiency of backside heating

Soft Etch Module

For via cleaning prior to metallisation, Sigma soft etch modules use Inductively Coupled Plasma technology to offer near independent control of etch rate and wafer bias.

- **High availability**

Low maintenance modules with typical cleaning intervals in excess of 10,000 wafers.

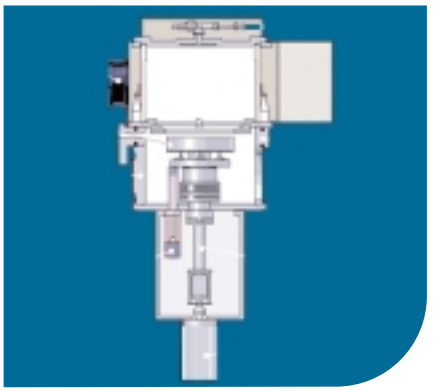
Soft Etch Modules are available in two modes:–

- **High temperature**

The Hot Soft Etch (HSE) incorporates a platen that can be run at high temperatures. Via cleaning at temperature can tighten via resistance in moisture containing dielectrics.

- **Low temperature**

The Cold Soft Etch (CSE) incorporates a low temperature electrostatic chuck. For advanced via structures, the CSE suppresses the formation of resistive metal interfaces, minimising via resistance.



Soft Etch Module

Innovation Applied to 24/7 Operation

Sigma ƒxP supports a process portfolio ranging from thick metal for >1µm power fabs to liners for sub-0.15µm devices, and is extendible to the most advanced Aluminum fill system in the world. Standard deposition modules use common platens, chamber bodies and magnetrons regardless of application – take an Aluminum module now, use it for Ti/TiN later.

All modules are designed to be field retrofittable. As design rules change, next generation long throw or i-PVD modules can be fitted to keep Sigma ahead of the roadmap.

- **Low cost by design**

Our unique wafer platen design vastly simplifies wafer size change and costs. Compared to competitive systems, expect a cost reduction of >70% for a 150-200mm size change on Sigma ƒxP.

Liners and Barriers

Ti and TiN by Long Throw Techniques

For sub-0.5µm design rules, simply moving the target further from the wafer improves the coverage of both Ti and TiN films into contacts and vias. Sigma long throw modules are the most cost effective way of boosting liner performance.

- **Extendible**

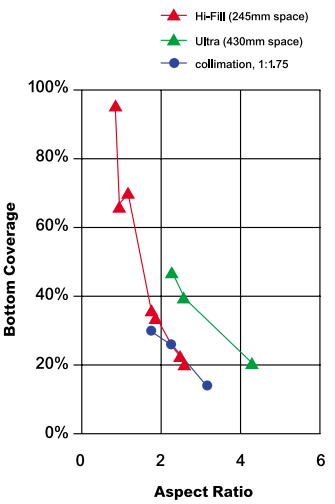
Upgrade from a standard module to Hi-Fill® in one shift. In one shift, system capability goes to deep sub-0.5µm.

- **Low CoO**

Up to 50% savings in target and shield expenses compared to collimated alternatives

- **High availability**

>70% reduction in module maintenance compared to particulate shedding collimation.



Base coverage:
Trikon long throw compared to physical collimation

Ionized PVD

In very high aspect ratio contact holes and vias, i-PVD improves liner coverage with the added advantage of a denser, smoother film that opens the process window when used under W-plug.

Uniquely, Trikon's i-PVD is the only in-situ coil approach that offers both metal and metal nitride processes in the same module.

- **Improved yield**

Improved step coverage enables reduced field thickness. Thinner films means less CMP overpolish resulting in less oxide erosion and improved yield.

- **Improved parametrics**

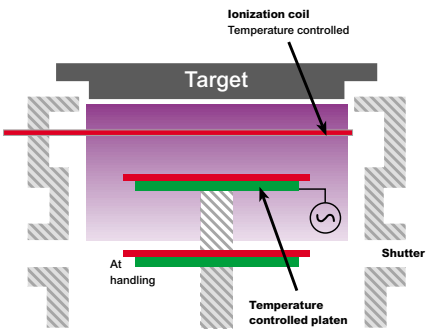
Demonstrable reduction in via resistance by running both Ti and TiN in i-PVD mode.

- **Extendibility**

Delay introduction of more complex and expensive CVD alternatives.

With i-PVD, Trikon now offer the full range of all-PVD solutions for liner applications.

Extendibility, flexibility and productivity from the technology leader in liner processing.



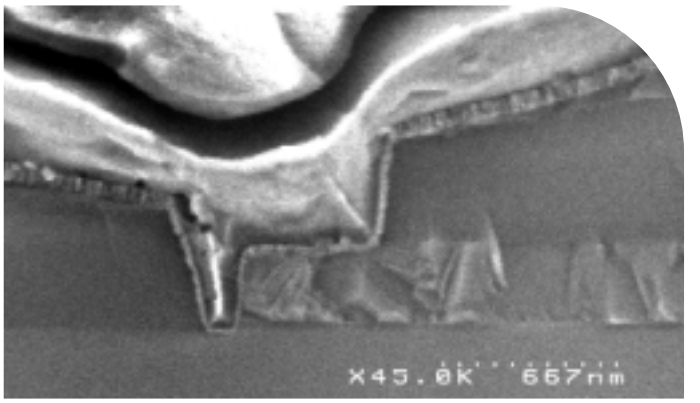
Simple chamber graphic: i-PVD

Aluminum Applications

Trikon's Al processes use heat, time and ultimately pressure to provide Al-plug solutions from 0.8µm to below 0.18µm. From single deposition steps, through reflow and finally Forcefill, Sigma ƒxP tracks device requirements.

- **Low CoO, high availability**

Other tools may require up to 4 clamp changes during one Al target lifetime. Sigma Al alloy targets can be run to exhaustion with no shield maintenance required, >25% more good wafers out, >20% CoO saving compared to other tools.



Reflow Aluminum

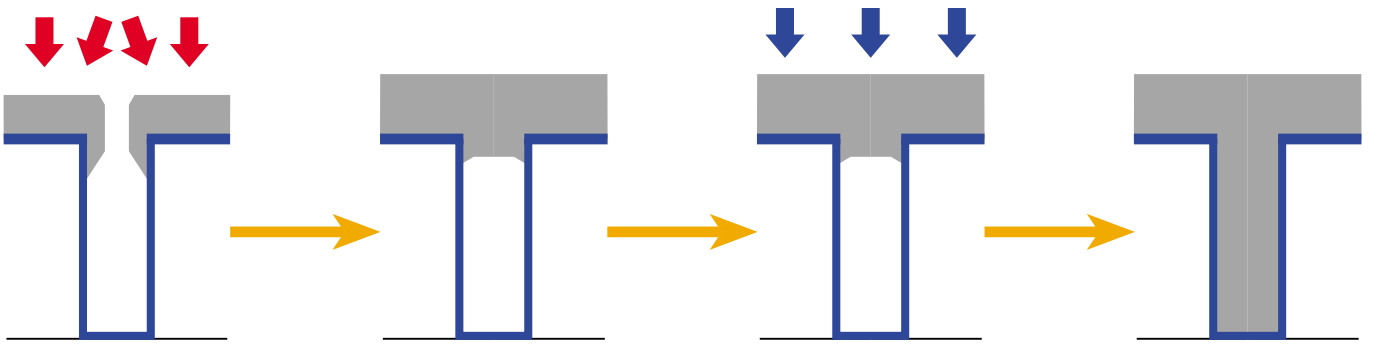
Forcefill®

For Al-plug processing in the deep sub-micron era, Trikon offers Forcefill. Application of very high pressure "pushes" Aluminum into deep sub-micron holes.

For holes of aspect ratio 3 to 10:1, for dual damascene structures, the whole sequence is performed in one pass on the one platform.

- **Low CoO through integrated processing**

Compared to a complex W-plug plus CMP sequence, Forcefill on the Sigma ƒxP reduces CoO by up to 65% per wafer.



The Forcefill process. Metal is deposited at high rate (1) to form a bridge (2). 700 bar Argon is applied (3) to fill hole (4).

Productivity and Flexibility on Sigma ƒxP

The next generation Sigma ƒxP is designed for high productivity, high volume IC production. Sigma ƒxP offers high throughput flexible processing on the industry standard Brooks Automation handler. The bisymmetric dual robot delivers high speed r, z and θ handling with unparalled placement accuracy. Parallel processing or recursive loading into previously visited modules, the Sigma ƒxP offers full recipe flexibility for R&D or production. The integral wafer aligner and cooldown provide full compatibility with SMIF installations.

Software designed for production

- **Full security protection via password control**

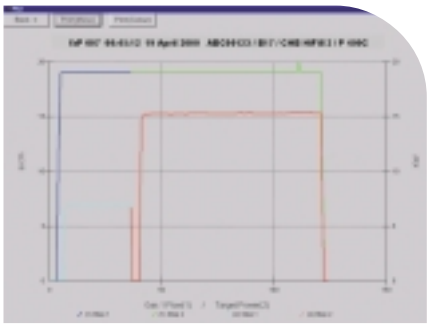
Up to 20 security levels can be set limiting personnel to the minimum of operations or full system access. Important for protecting valuable wafer data and production recipes.

- **Powerful datalogs**

Every measured value captured every second for every wafer. Stored by slot number and batch i.d., process parameters can be analysed weeks after the wafer was run. Invaluable for determining the source of problems only found much later at test.

- **Remote access from office p.c. via LAN**

Without leaving the office, recipes can be edited and datalogs can be analysed. Software upgrades are simply made over a secure ISDN line, direct from Trikon's head office.



● *Dep module datalog, gas flow & power*

Adding value to your products and to your business

Combined with other value adding processes such as salicides and high-k capacitors, the Sigma ƒxP PVD cluster tool offers a full portfolio of process solutions. Cost and performance benefits through simplicity characterise Sigma ƒxP. Whatever the application, Sigma ƒxP delivers high quality product at maximum levels of availability.

With expertise from years of experience plus in-house integration knowledge derived from Trikon activities in plasma etch and CVD, our customers value our ability to deliver on-time solutions. Trikon business depends on the relationships formed with customers. Trikon puts the customer in control.

Benefit Summary

- **Production proven system**

- **High productivity and reliability**
  - Low maintenance modules
  - High throughput processing

- **Flexibility**
  - Field retrofittable modules
  - Same magnetron and chamber for majority of materials
  - Standard to long throw conversion in one shift

- **Low CoO by design**

- **Future proof**
  - Full extendibility, all-PVD liners and Aluminum applications

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