

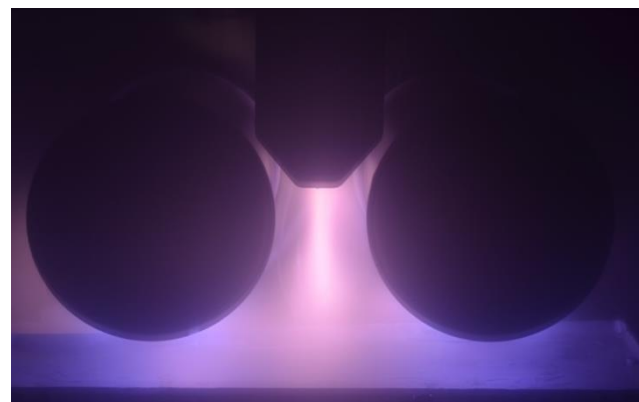
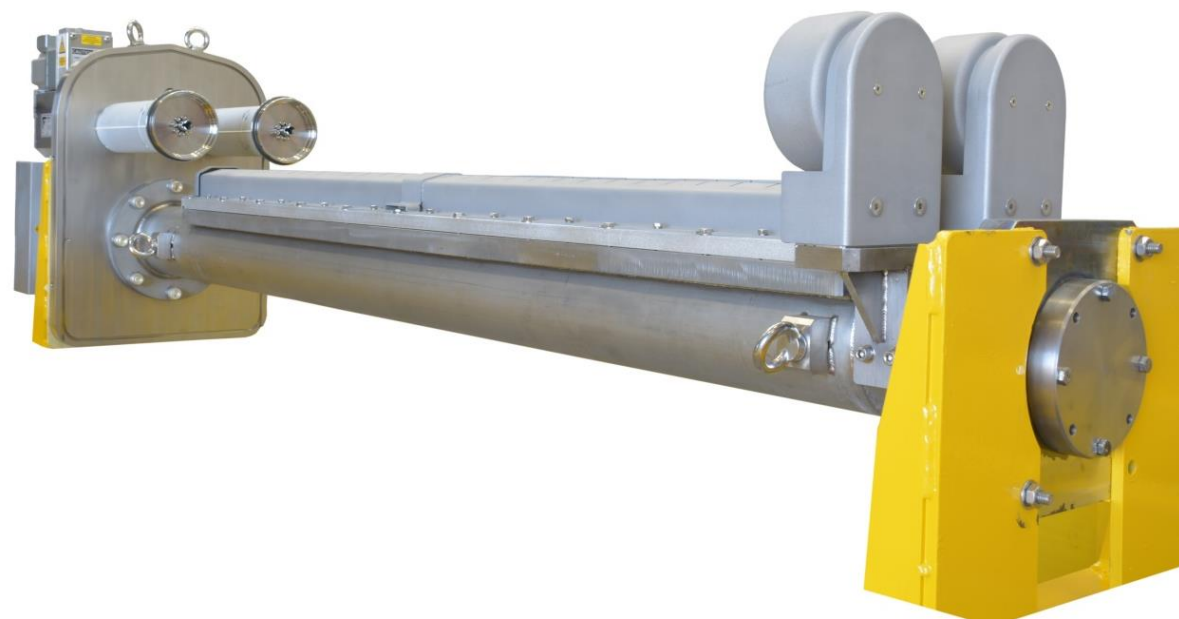


# GRS-C Cantilever Mount



## Sputtering Solutions for Vacuum Web Coating

***• Components or Process  
Ready Modules with Process  
Tuning Available***





# GRS-C Cantilever Mount

## GENCOA ROTATABLE SYSTEM



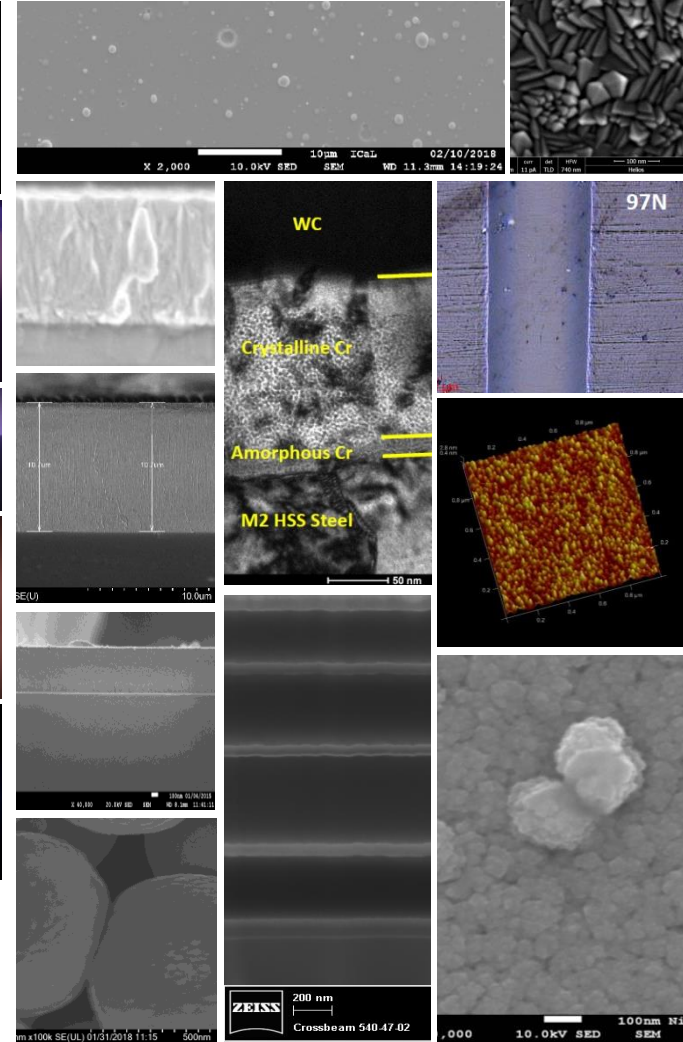
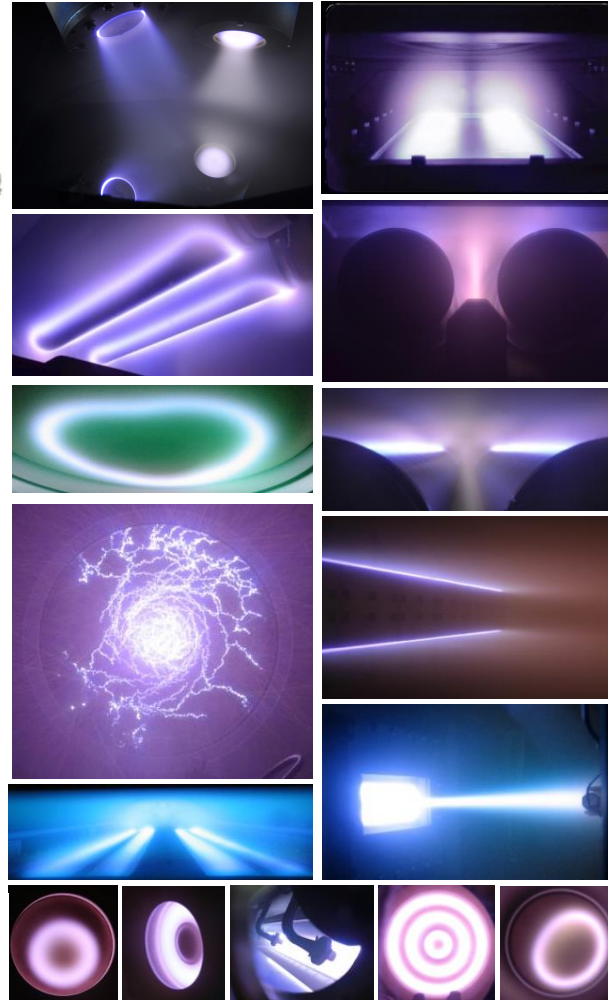
- *A range of components for vacuum web coating with rotatable magnetrons*
- **GRSC rotatable end-blocks**
- **Standard, High Strength and Assymmetric Magnetic Arrays**
- **Active Anodes for low temp coating and low R ITO**
- **Multi-zone gas delivery bars**
- **OPTIX web, chamber & process monitoring**
- **SPEEDFLO reactive gas feedback control for high rates**
- **Linear ion sources**
- **AC dual electrode pre-treat**
- **Pulsed electrode pre-treat / etcher**
- **Cantilever supports or design service for self-manufacture**





# 23 Years of Products and Technology from Gencoa

Rotatable & Planar Magnetron Sputter Cathodes • Retrofit magnetic packs • Plasma Treaters • Speedflo Reactive Gas Controllers • IM Ion Sources & power supplies • Arc MAX sources & power supplies • Active Anodes and Gas Delivery Bars • OPTIX Gas and Chemical Sensing • S and Se Sensor • PEC Pulsed Effusion Cell • V<sup>+</sup>DLC - Transparent DLC • IC Nano antimicrobial layer technology • Process implementation & tuning •



# Genco Rotatable System GRS end-blocks

GRS-S



End Block	Target Diameter	Target Length	Power
Genco GRS-S Ultra compact drop-in flange plate mounted	75, 90, 100/105mm	0.15 to 1.2m – target weight and orientation dependant	40 kW
Genco GRS-C Side mounted - cantilever	75, 90, 105, 152-165mm	0.15 to 1.2 m pure cantilever Upto 2.4m with outer end support	>100 kW
Genco GRS-M Drop-in flange plate mounted	75, 90, 105, 152-165mm	≤ 1.8 m vertical (up) ≤ 2.5 m horizontal with end support	<100 kW
Genco GRS-V Top mounted hanging down	75, 100/105, 152-165mm	≤ 2.5 m vertical	>100 kW

GRS-V



GRS-M

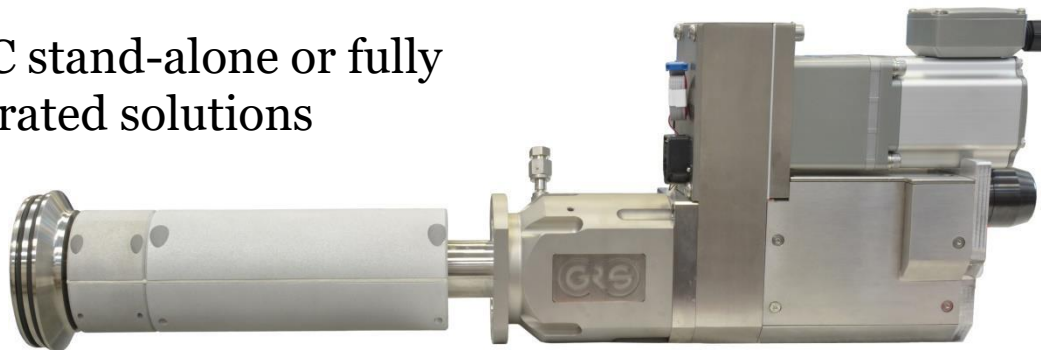


GRS-C



## Gencoia Rotatable System GRS C end-blocks

GRSC stand-alone or fully integrated solutions



Gencoia GRSC cantilever end-block is a high capacity product for web coating

- Up to 180Amps of current ~ 100 kW of power, DC/AC
- Targets up to 2.5m long with out-bound support
- Fully EMC shielded and no debris or water ingress from atmosphere side
- Manual magnetic bar angle adjustment from atmos. side
- 152mm target OD, plus 100/105mm option
- Rotation encoder
- Helium leak rates in the  $<5 \times 10^{-8}$  mbar l/s
- 550, 750, 1000 Gauss field options
- Active Anode for low temp dep
- Cantilever supports optional
- Complete process packages







## Gencoa GRS-C cantilever mounted rotatable for insertion from the chamber side typically for web coating systems for target sizes of 75, 100 & 150+mm

Gencoa's GRS-C represents high performance in a small package. The GRS-C cooling and power capacity matches the largest cantilever style rotatable magnetrons on the market.

- 3/4" ID water connections (60-100l/min)
- 250A current capacity (patent pending power delivery)
- LS, DLIM, SSF, HS, PP, CVD magnet packs
- Target size can be adapted up or down – 75 – 160mm
- Target length depends upon weight – typically upto 0.6m cantilever loaded or 2.4m with outer end support

GRS-C150



GRS-C100



# Gencoa Rotatable System GRS-C

Gencoa currently supply a full package of products for the coating of flexible substrates:

- Single, Dual and Triple GRSC cathodes
- 250 to 2400mm long magnetic arrays
- Combination Active Anode and Gas bar
- Segmented gas bar
- Cantilever assembly, flange plate out-board support, electrical enclosure (optional)
- OPTIX for Vacuum Process Monitoring
- Speedflo CCD for reactive gas control





# Gencoa Rotatable System GRS-C complete integrated process solution



*Benefits of using Gencoa supplied parts for flexible web coating.*

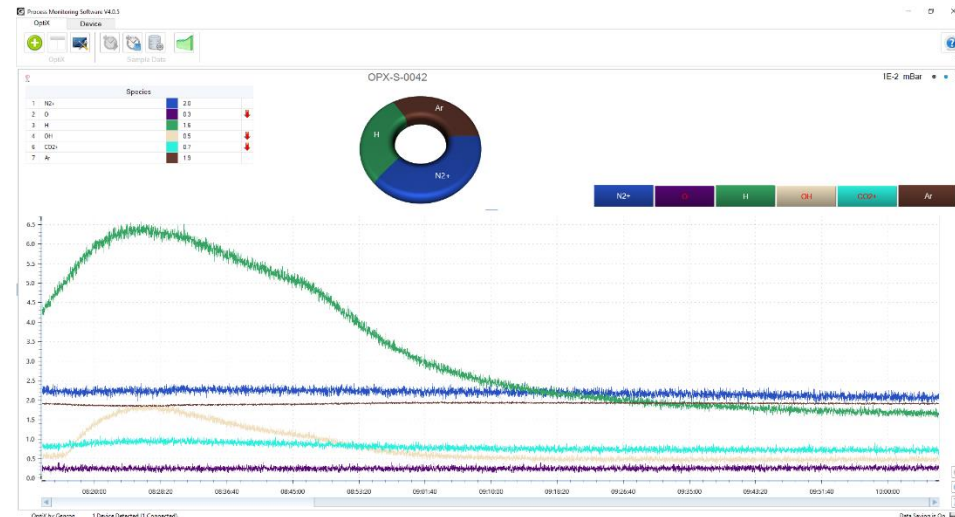
*GRSC cathodes – high power and load capacity with <10-8 mbar l/sec leak rate*

*Variable target OD and length of magnetic arrays – high target use – low substrate heating*

*Active Anode – stable uniformity – better coating – lower substrate heating – gas activation*

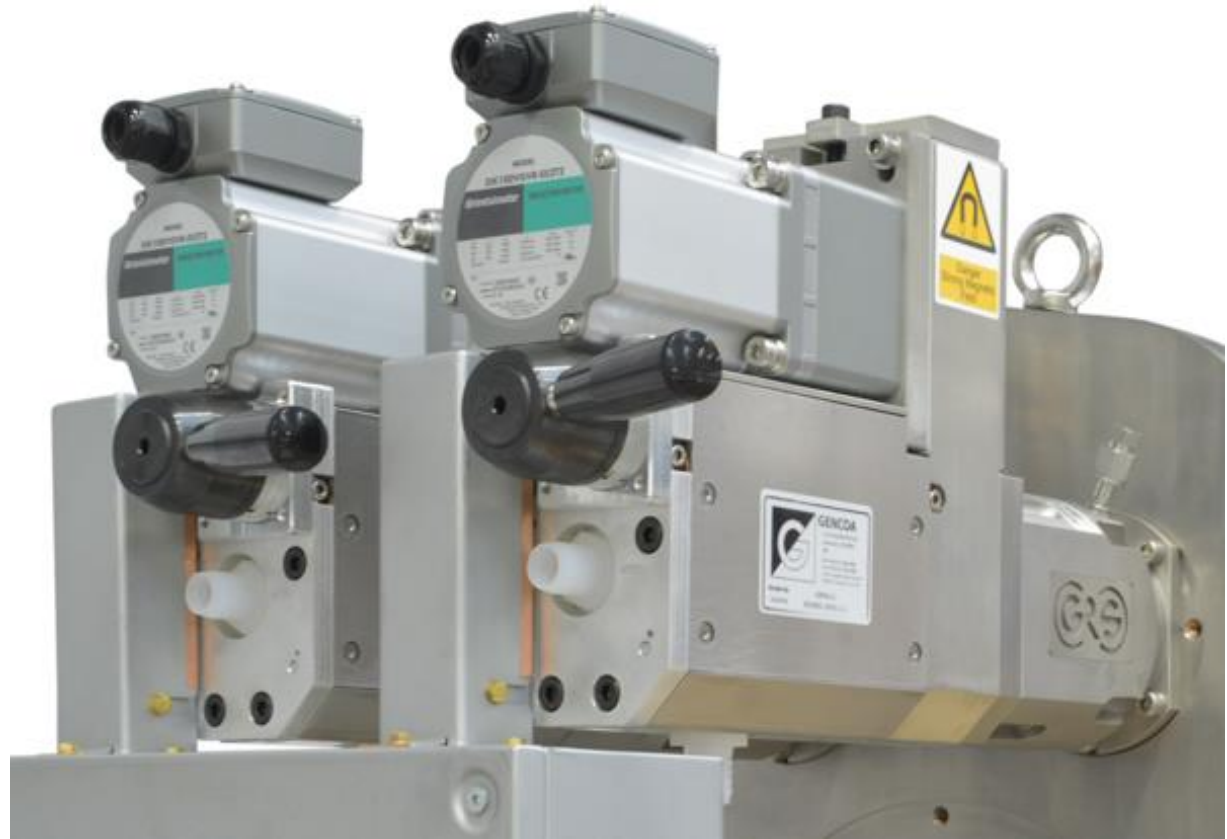


- Cantilever assembly – low deflection and contains anode and gas connections in atmosphere – can be manufactured by the OEM to Gencoa drawings. Segmented gas bars – 3 or 5 zone control of uniformity
- OPTIX for Vacuum Process Monitoring – detects process and system faults – raises alarms – can link to Speedflo
- Speedflo for reactive gas control – controls gases for high rates & long term stability

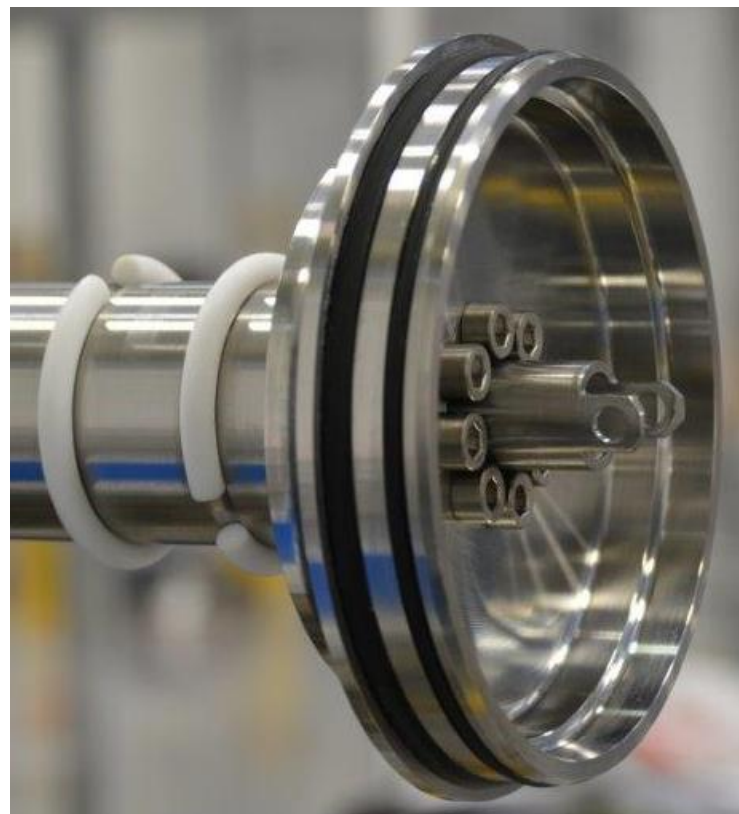
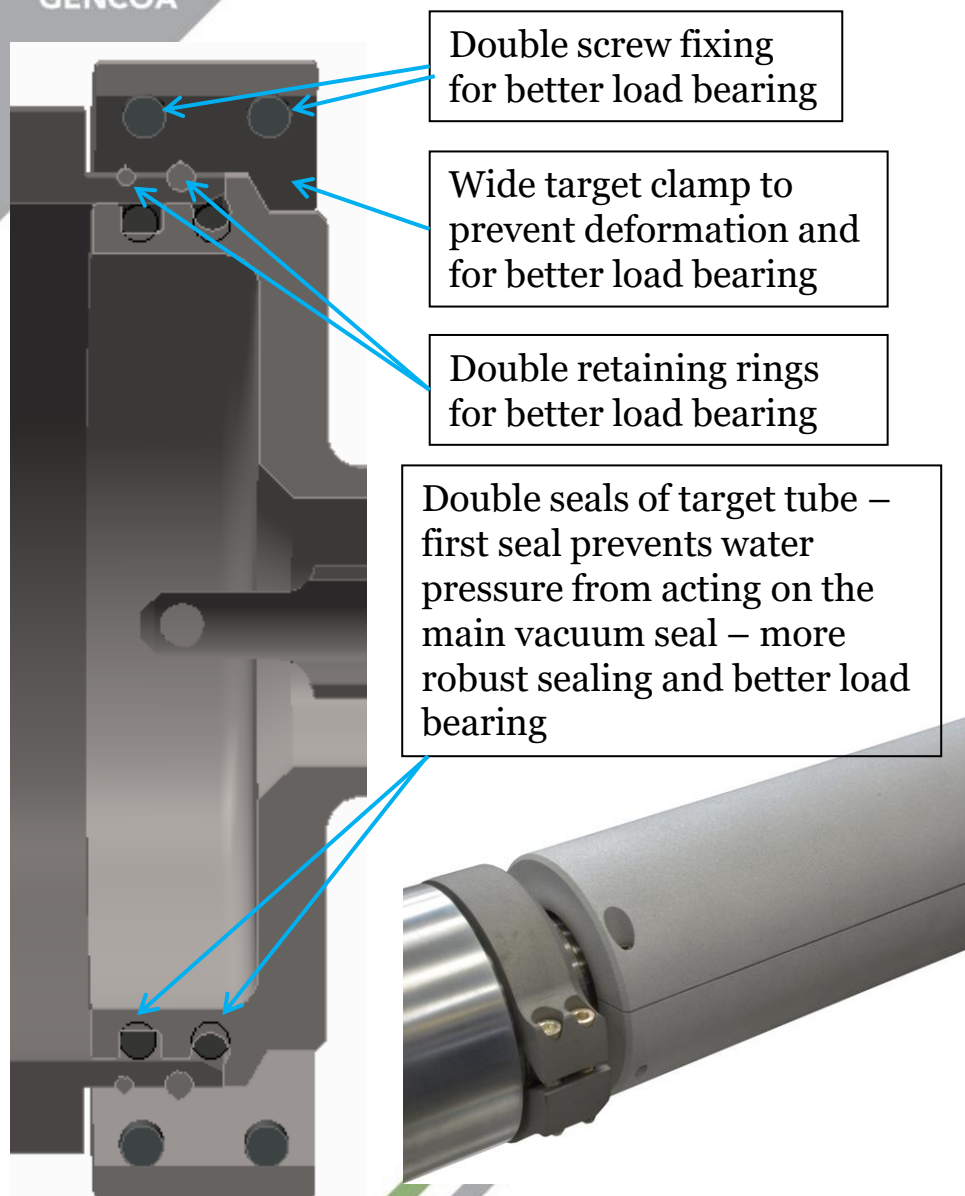




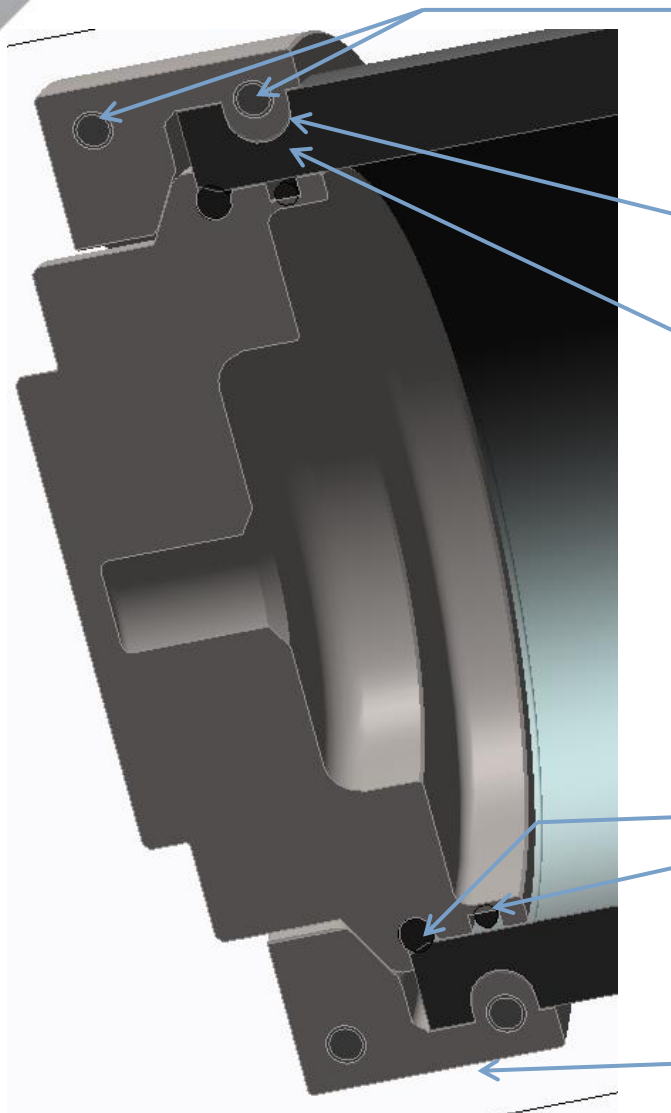
# Easy angle adjustment of the magnetic pack or stepper motor driven dynamic magnetic pack rotation / positioning



# Gencoa GRS-C, GRS-M, GRS-V standard target design double screw clamping



# Gencoa GRS, GRS-C, GRS-M, GRS-V MONOBLOCK style solid target material clamping option



Double screw fixing  
for better load bearing

Large clamping area for lower  
stress on the target to clamp  
contact point

Larger amount of target material  
under the clamp to reduce the chance  
of cracking fragile targets

Double seals of target tube –  
first seal prevents water  
pressure from acting on the  
main vacuum seal – more  
robust sealing and better load  
bearing

Wide target clamp to  
prevent deformation and  
for better load bearing



## Genco GRS, GRS-C, GRS-M, GRS-V

### Double Sealing of air to vacuum dynamic seal

The GRS-C main dynamic air to vacuum sealing is unique and has very low leak rates.

- The sealing provides Helium leak rates in the  $<5 \times 10^{-8}$  mbar l/s range under rotation and high loading
- The sealing system can be individually leak checked via a pumping port on the mounting block
- By using the leak check port to differentially pump the double seal improves leak tightness to the  $10^{-10}$  range and does not affect seal life (available with GRS C&V only)
- $1-5 \times 10^{-7}$  mbar ultimate chamber pressure range for the whole assembly

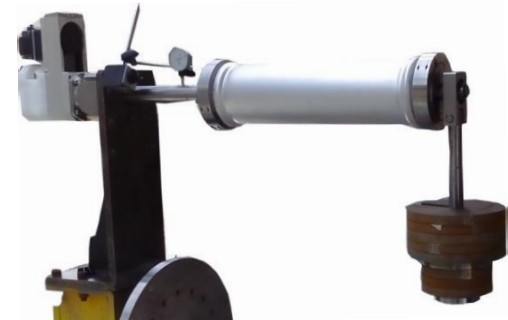
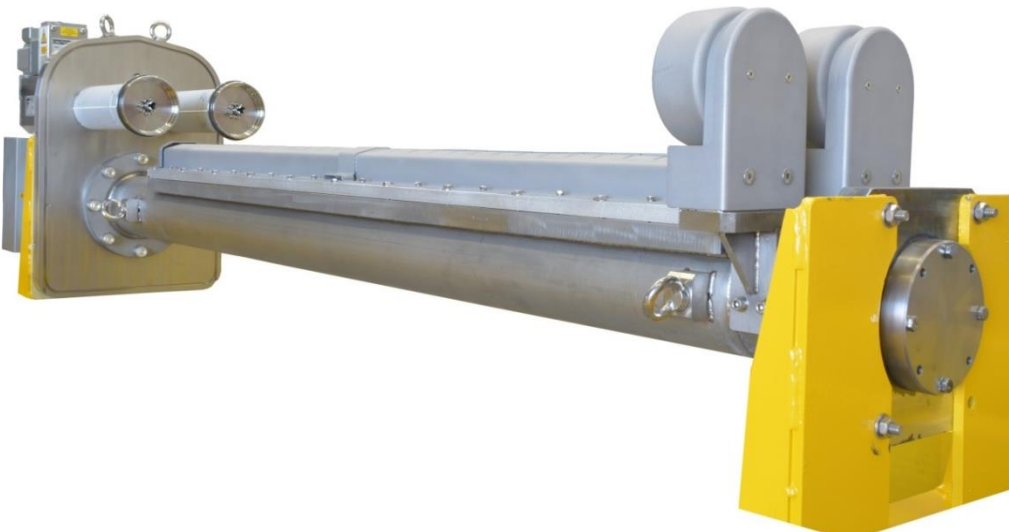
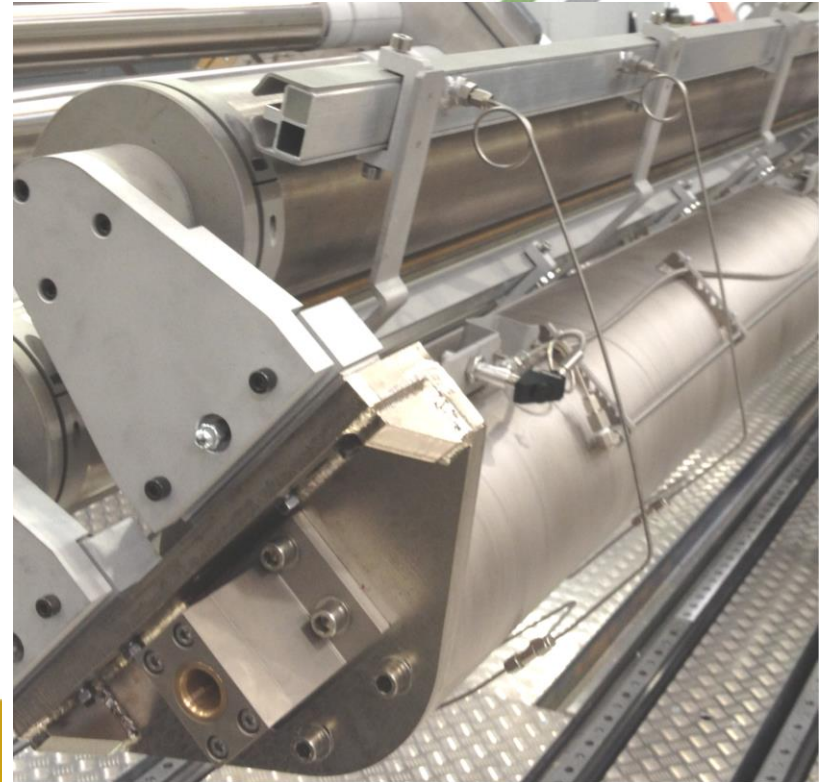
Leak check / differential pumping port



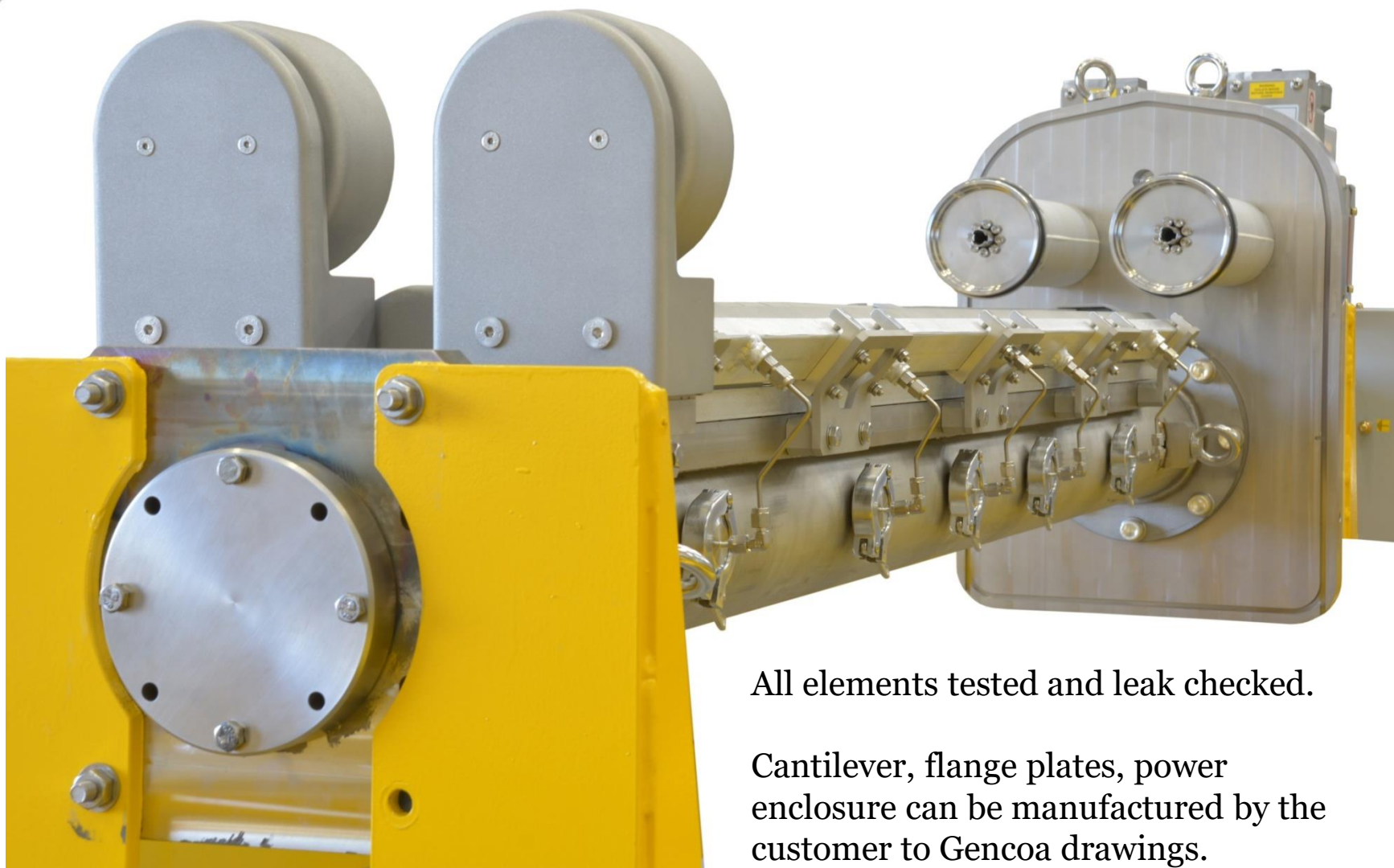


## **Gencoa GRS-C** has excellent load bearing capacity

The bearing support and high mounting tube stiffness minimizes the deflection of the target. Typically 0.8m unsupported targets or 2.4m long with outboard support.



Complete sub-assemblies can be supplied including cantilever support, active anodes & gas bars

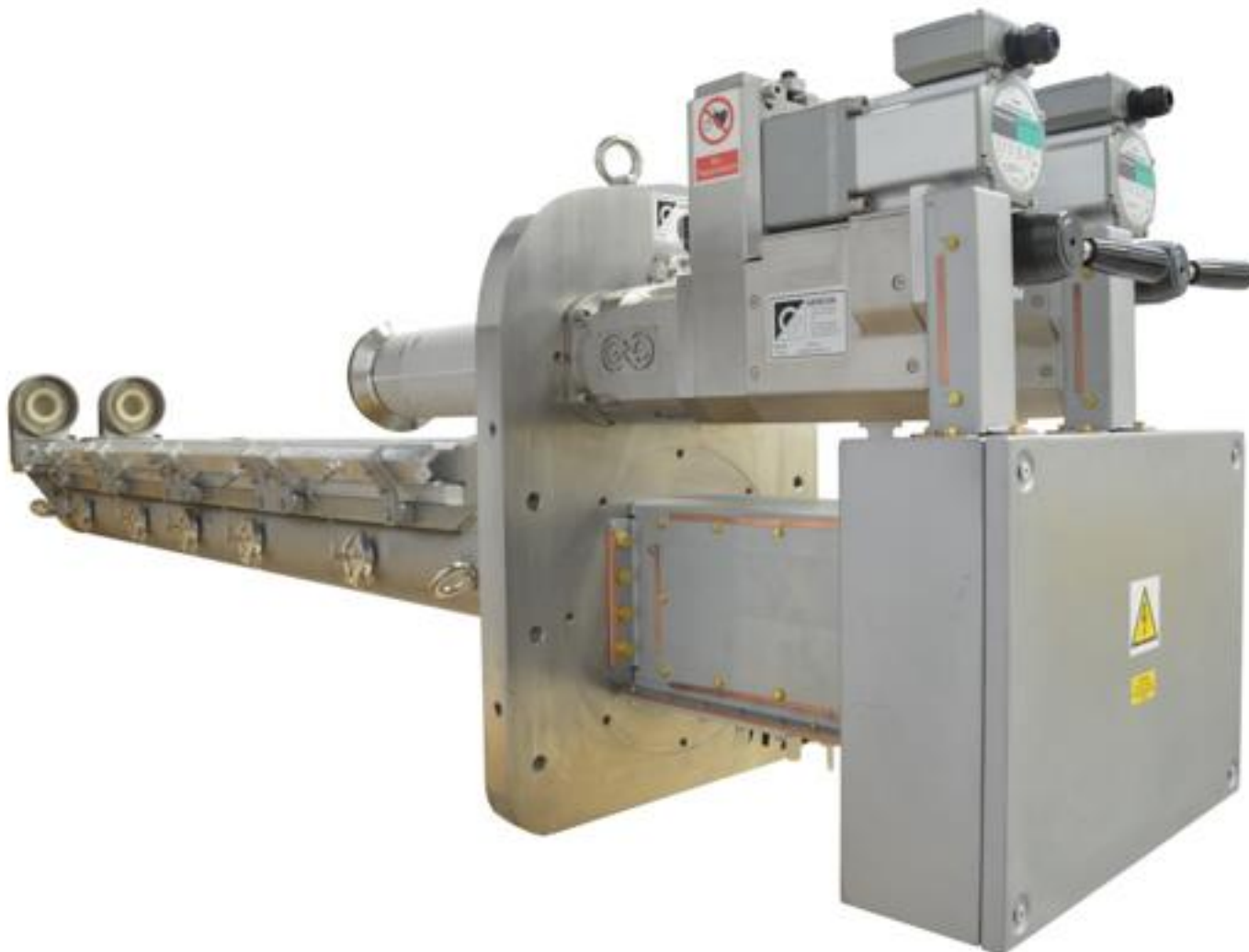


All elements tested and leak checked.

Cantilever, flange plates, power enclosure can be manufactured by the customer to Gencoia drawings.



# Electromagnetically Compatible (EMC) power enclosures to avoid stray radiation affecting system instrumentation

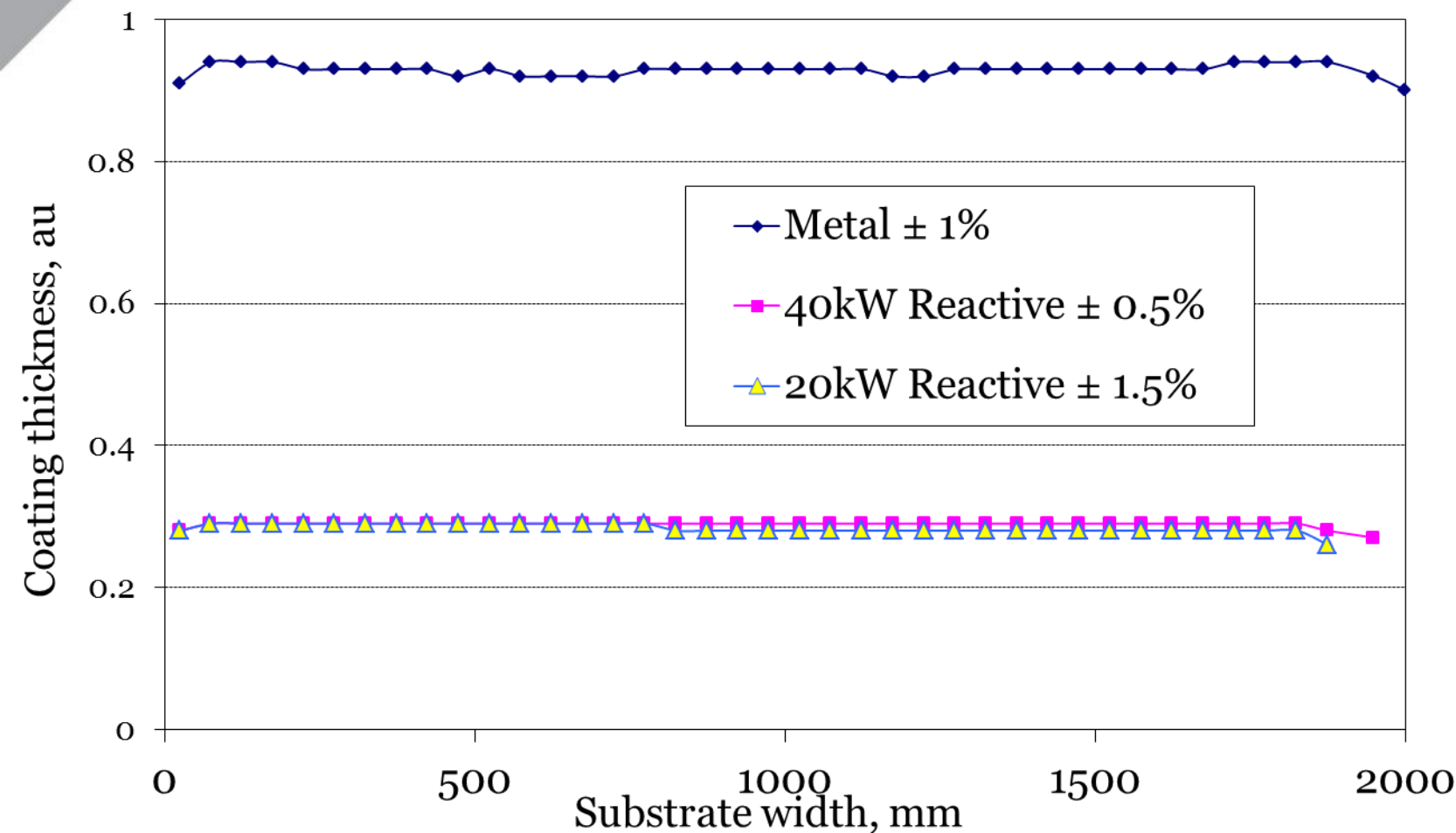


Plasma emission monitoring, gas delivery and plasma control via active anode and multi-segment gas bars for high quality layers and excellent uniformity



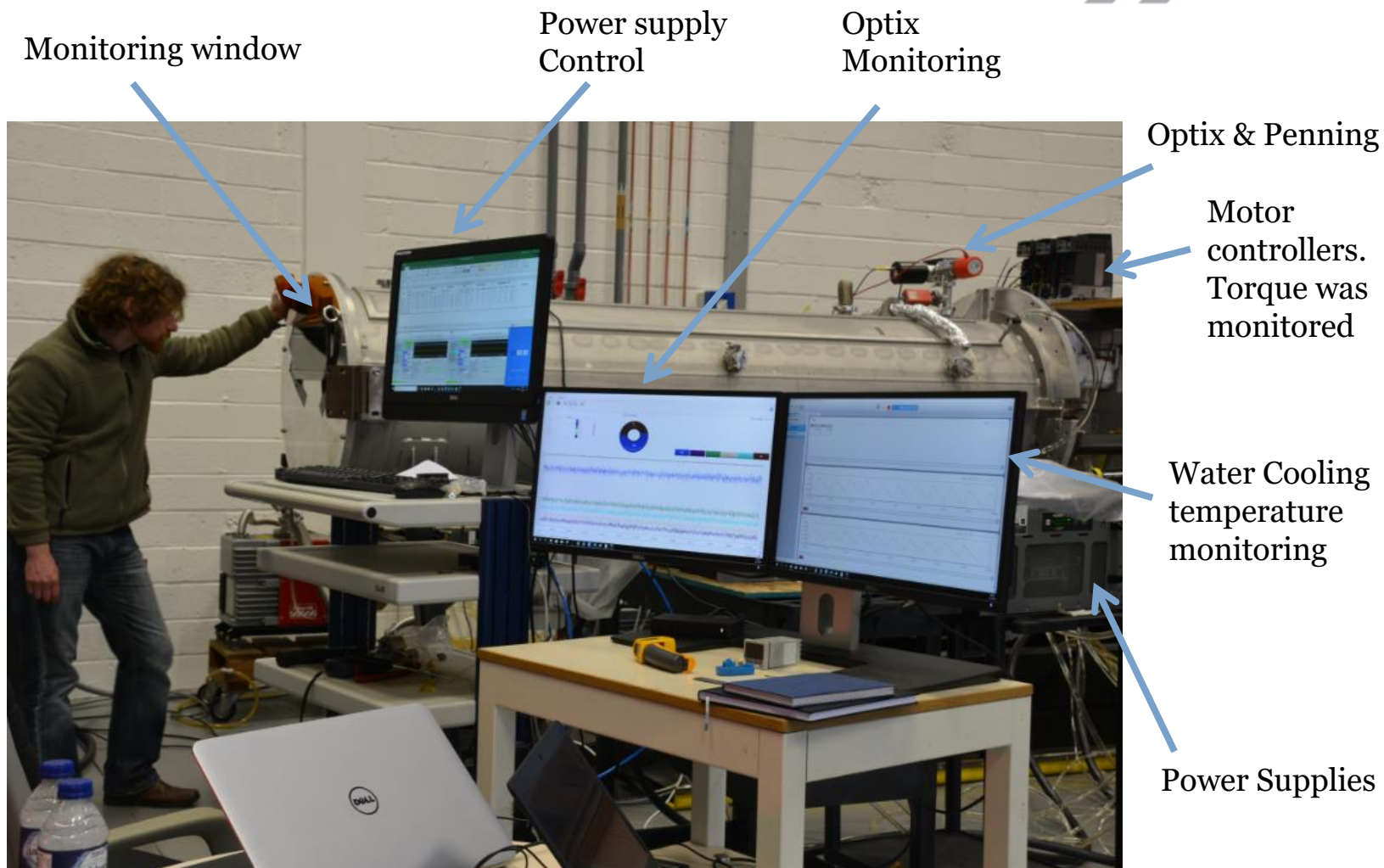
Thickness uniformity with DLIM cathodes and gas bar tuning only (no magnetic array adjustment) for  $<\pm 0.5\text{-}1.5\%$  uniformity

## Uniformity along width of substrate



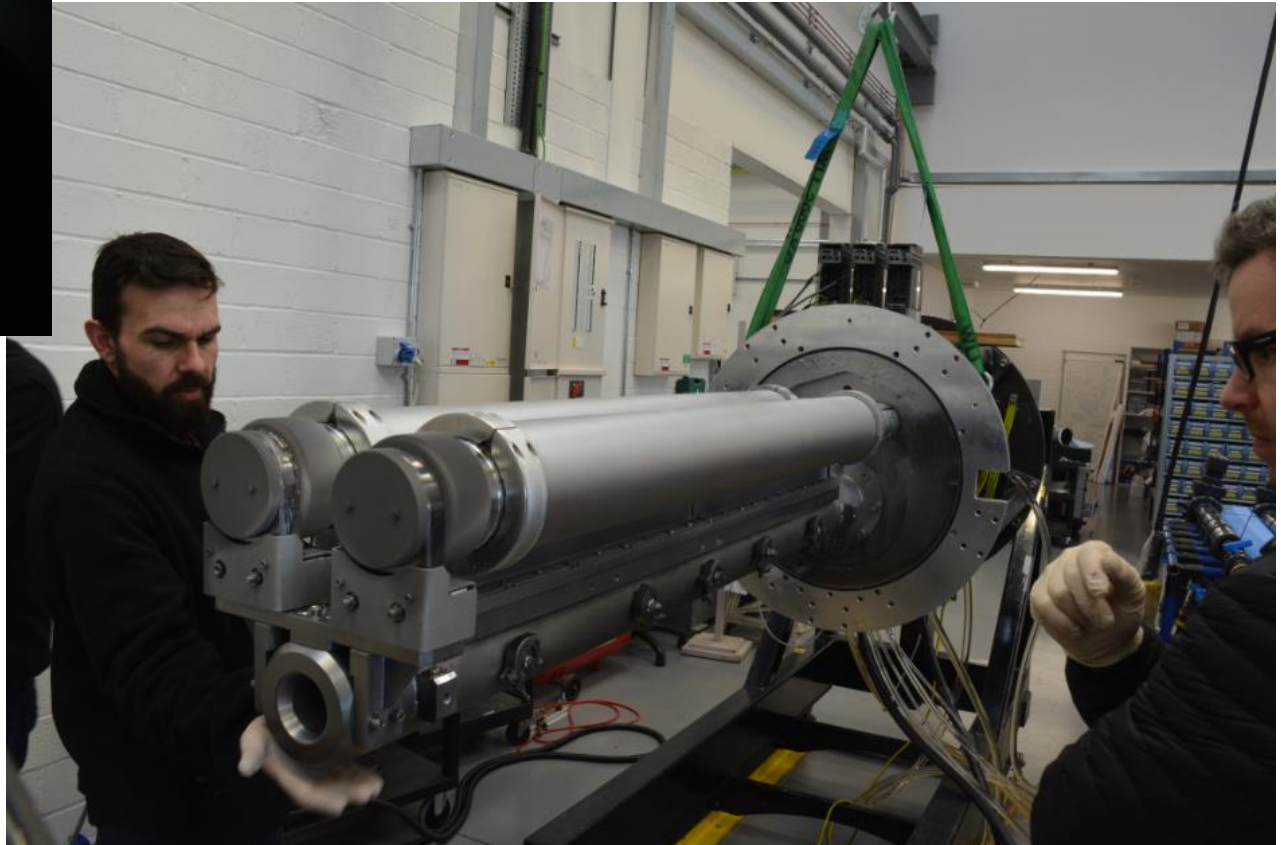
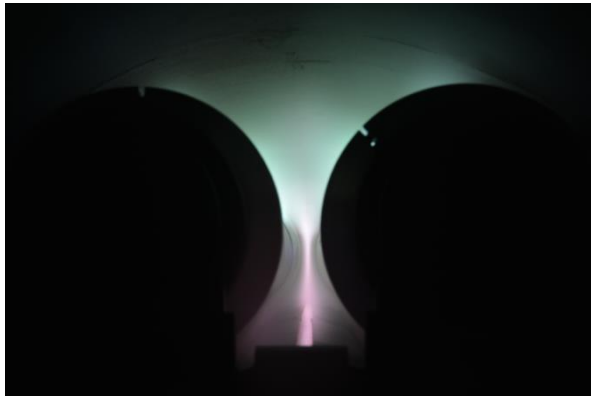


# Process and endurance testing of GRSC at GencoA



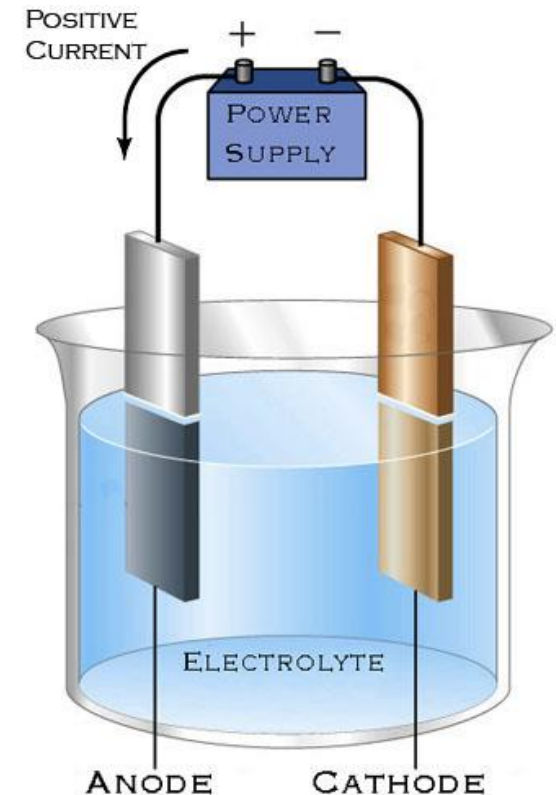
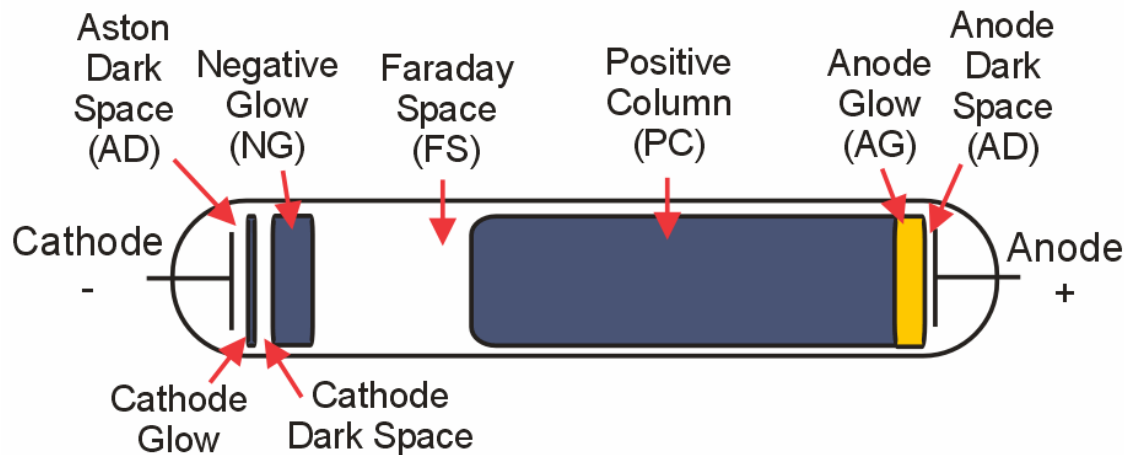
# Testing of a dual assembly with active anode, heavy targets - monoblock molybdenum at 80 kW

- Unit removed from vacuum system



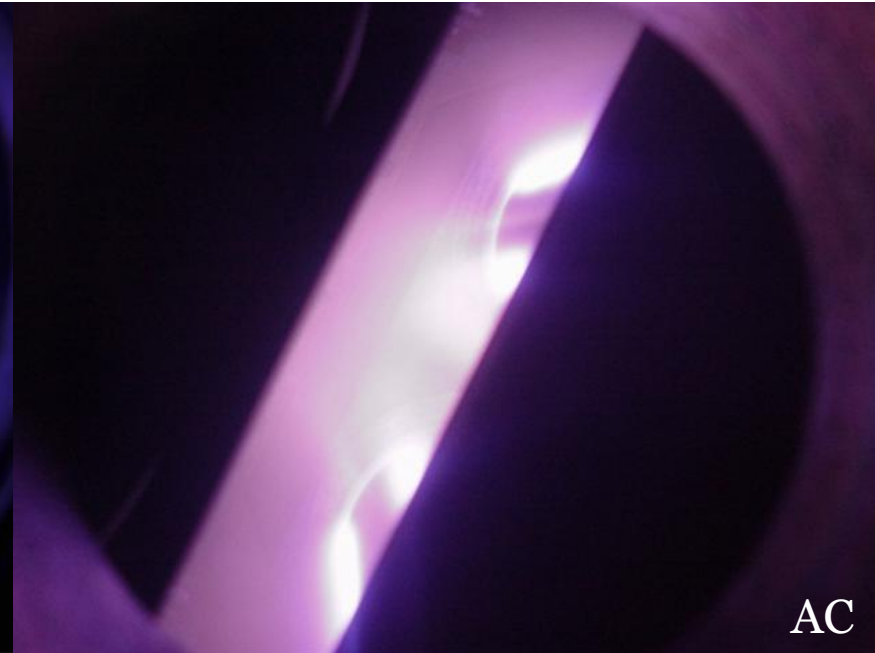
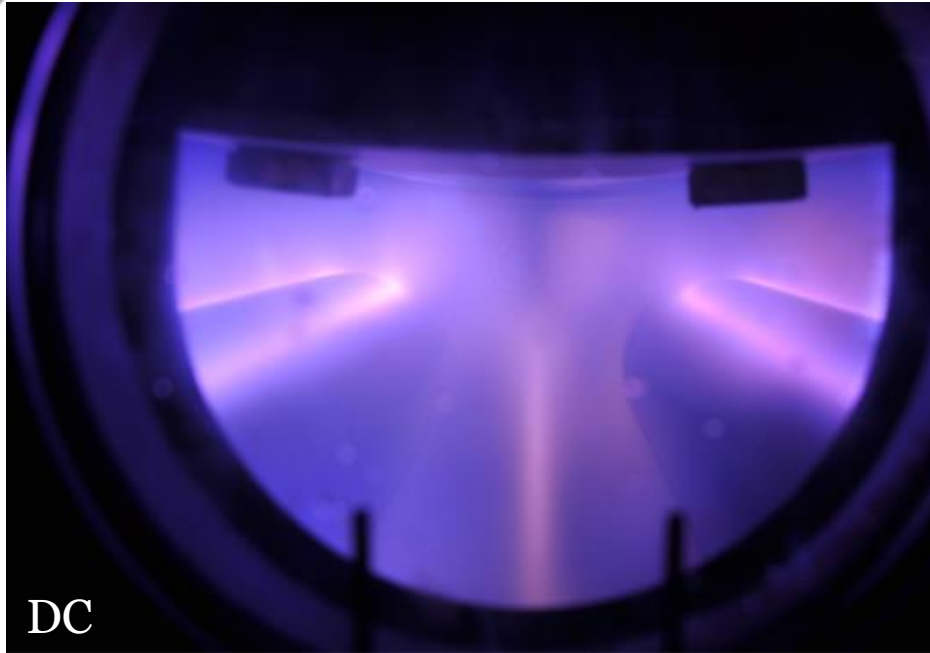
# Active Anodes for magnetron plasmas

- A plasma is effectively an electric circuit with the target a negatively biased cathode and the chamber or separate mean providing the anode for the circuit return.
- Anodes are commonly earthed, although a positive charge is also possible.
- Whilst the plasma confinement in the near target area is governed by the magnetic field, the plasma spread away from the target is primarily an anode interaction effect.





Absence of anode can be seen in a plasma spread away from the target area

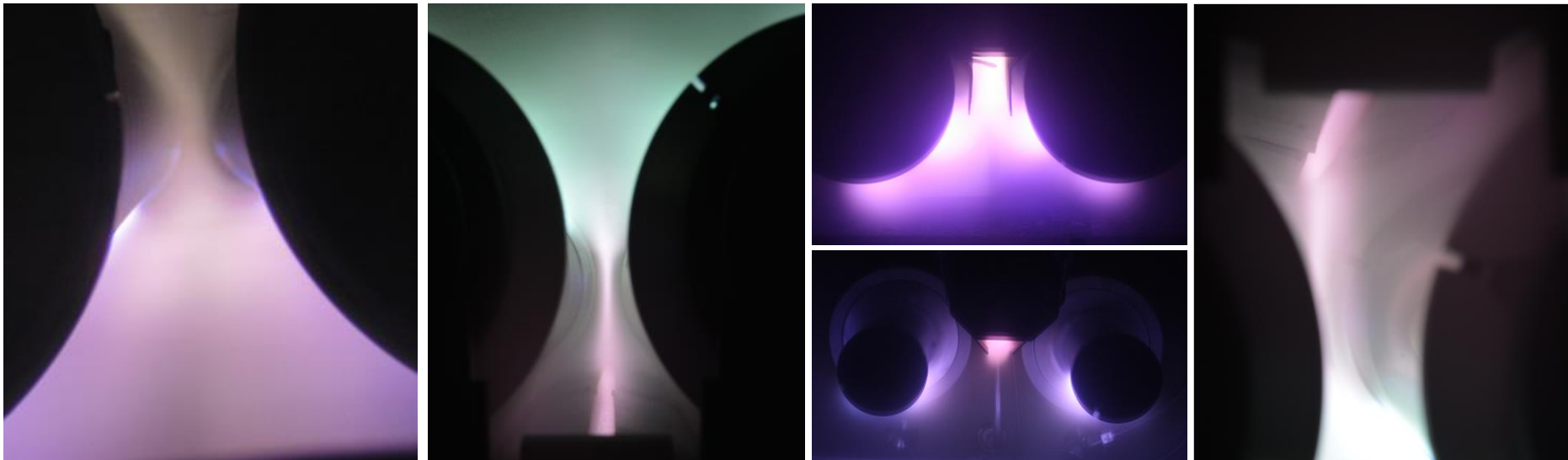


- A stable anode will prevent parasitic plasma's, process drifts / fluctuations, poor uniformity and instability.
- Anodes are most effective close to the target and intersecting with the magnetic field lines of the plasma trap (like a planar magnetron).
- Rotatables work better if no extra components are close to the target as they will become coated and products flakes and defects – this present a problem of where best to locate an anode.

Gencoa have developed and patented a method to provide an effective anode away from the coating flux that can collect all electrons escaping the plasma

The method effectively combines magnetic trapping with electrostatic attraction of electrons

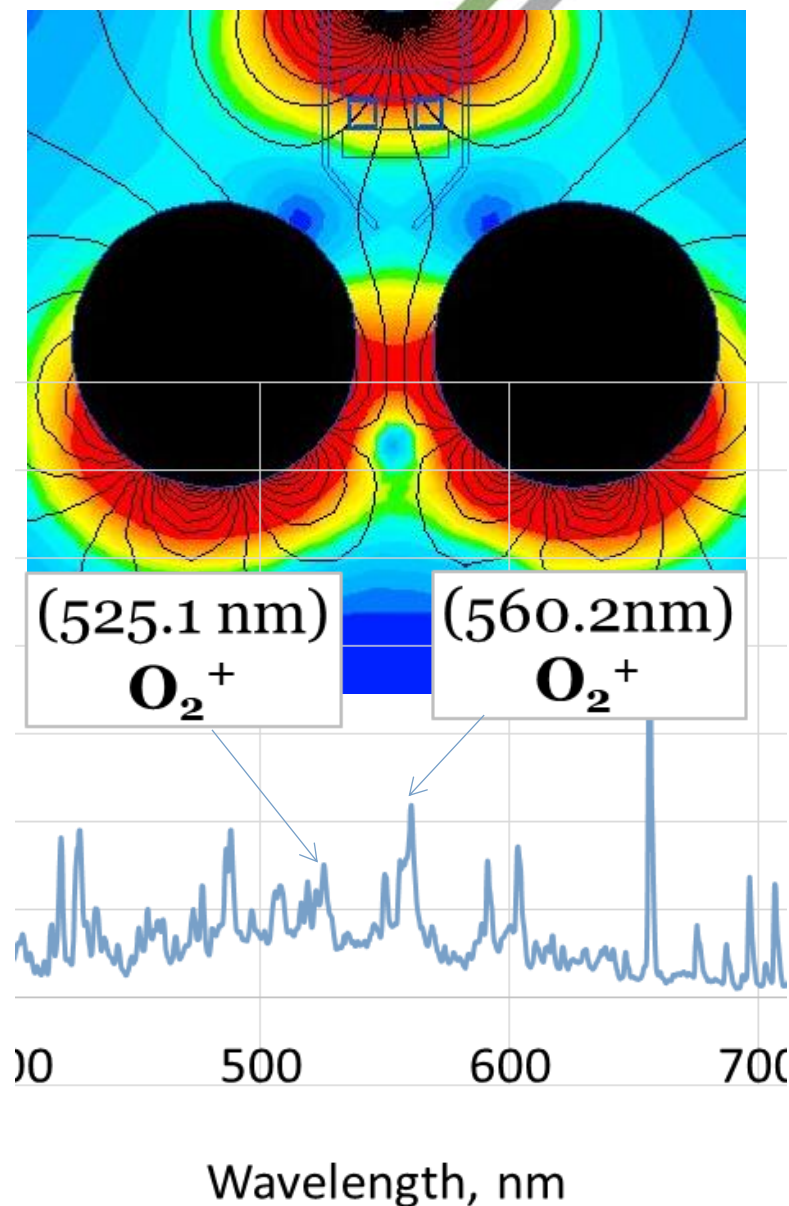
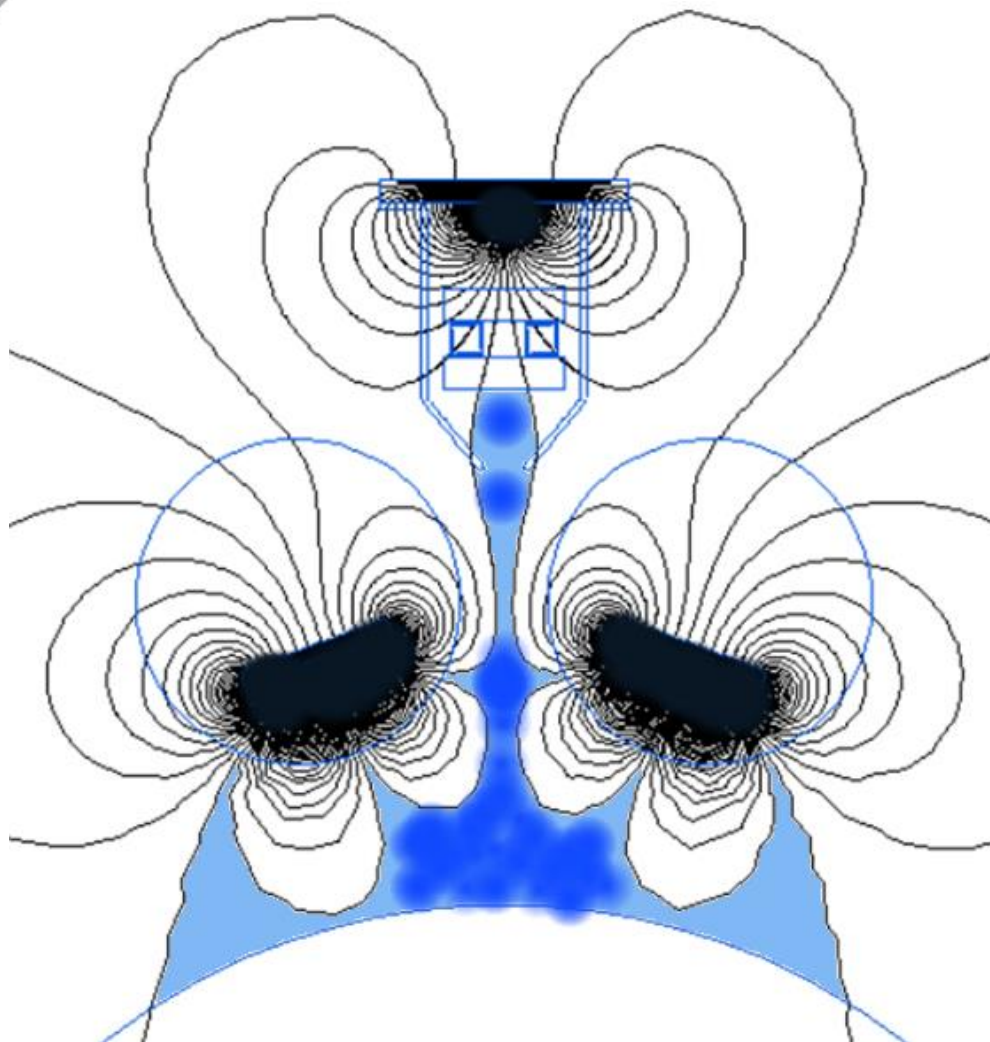
- The magnetic field from a single or double magnetron (shown) combined with the magnetic field of the anode to form a closed trap for the electrons to guide them to the anode – electrons do not possess sufficient energy pass the field lines and escape the trap.
- The anode can be at varying potentials but the most convenient and cost effective method is to have the anode at earth potential.
- For example, when used with AC power between two targets, the active anode improves process stability.



# Gencoa Active Anodes guide electrons for process stability and uniformity

## *Also ionizes the gas passing through the anode*

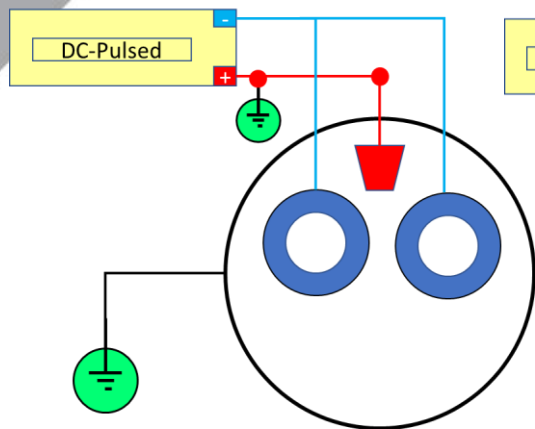
– covered by Gencoa's DLIM patent.  
Improves coating density and lowers coating stress



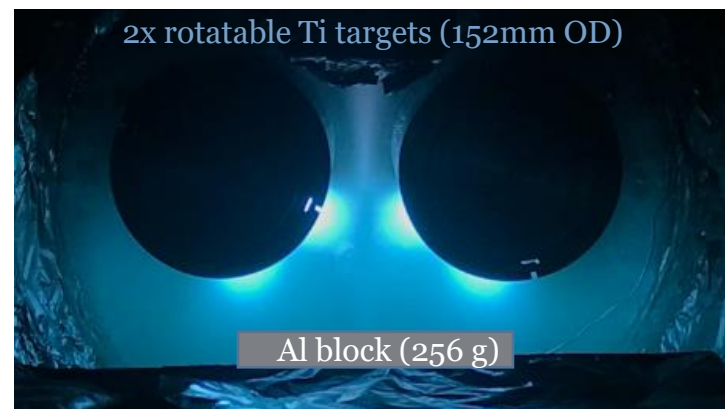
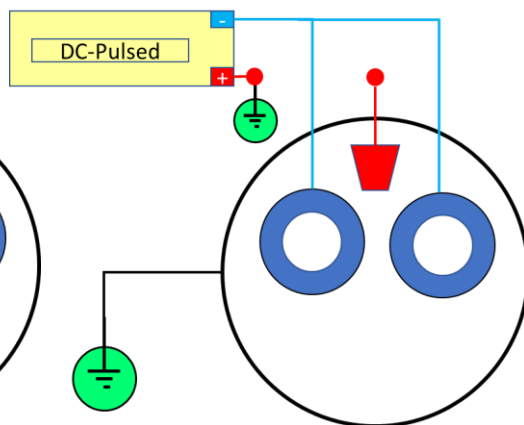


# Substrate temperature reduction for DC-Pulsed configurations

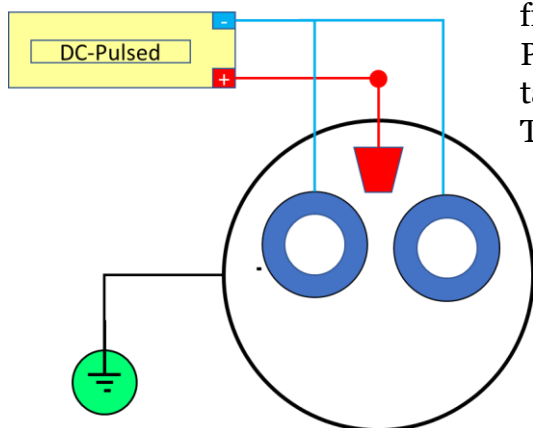
Grounded anode



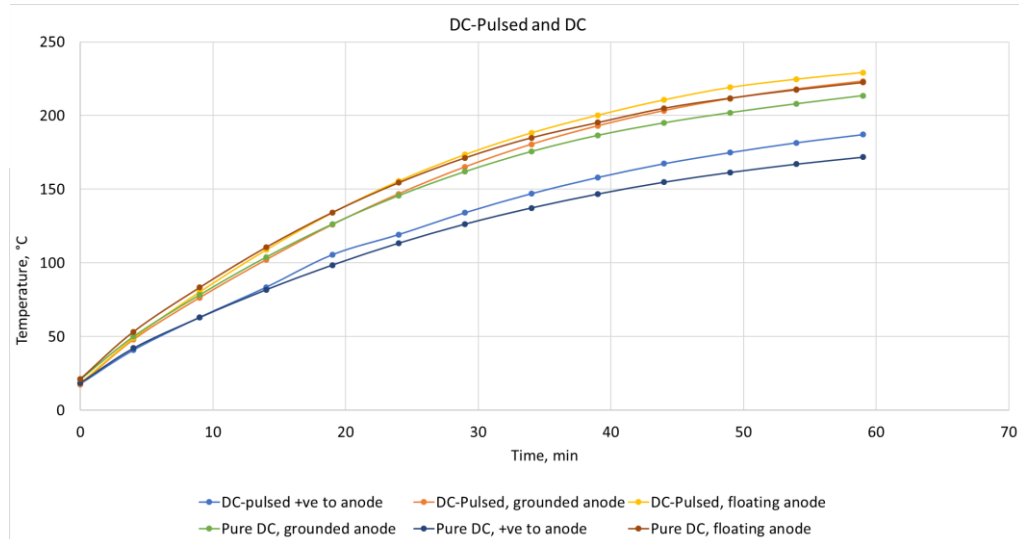
Floating anode



Positive output to anode

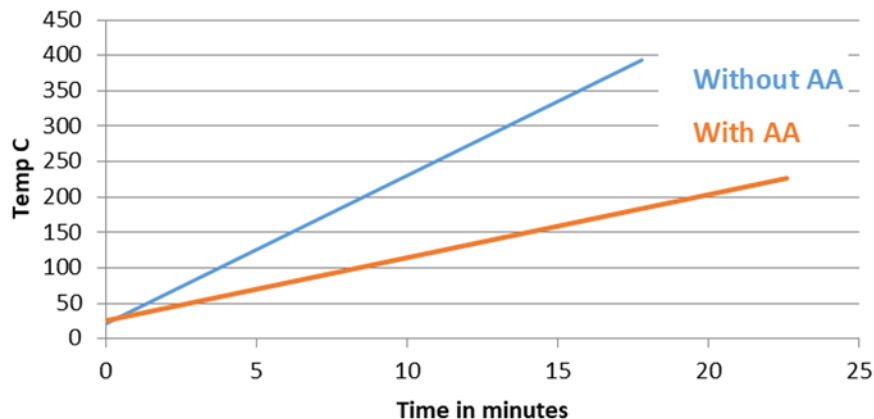


Power on (6kW)  
100 kHz pulse  
frequency  
Power split to 2  
targets  
Total time: 60 mins



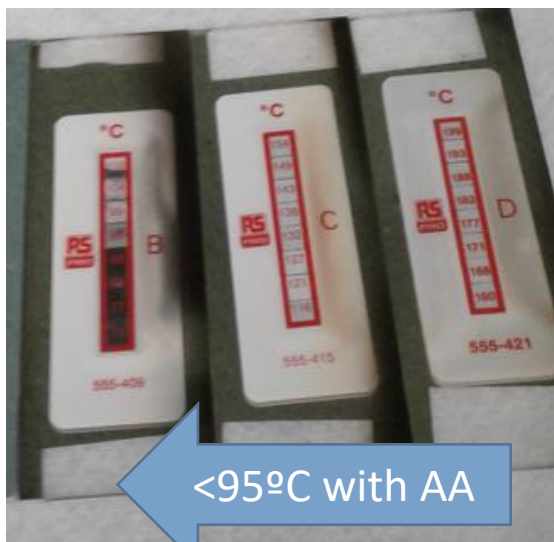
# Reduced substrate temperatures with the Active Anode and DC power modes

Comparison of static substrate temperature rise from dual rotatable with 11kW DC power on each target



With single power modes when the patented Gencoat magnetic guidance into the Active Anode is used, 100% of the plasma electrons return to the Active Anode.

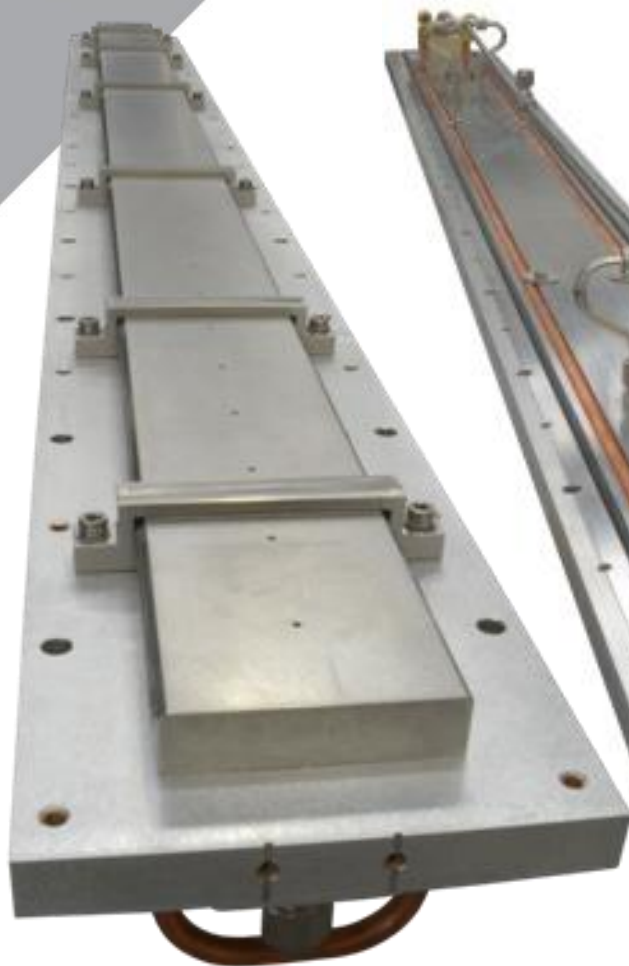
- Single cathode power modes are DC, Pulsed DC & Hipims.
- The electron heating is directed into the active anode and the substrate avoids any additional heating.
- This reduces by 50% the heating of the substrate.
- This prevents substrate damage and also enables much higher deposition rates and hence lower cost production.
- Two DC powered magnetrons can be connected to one central Active Anode.



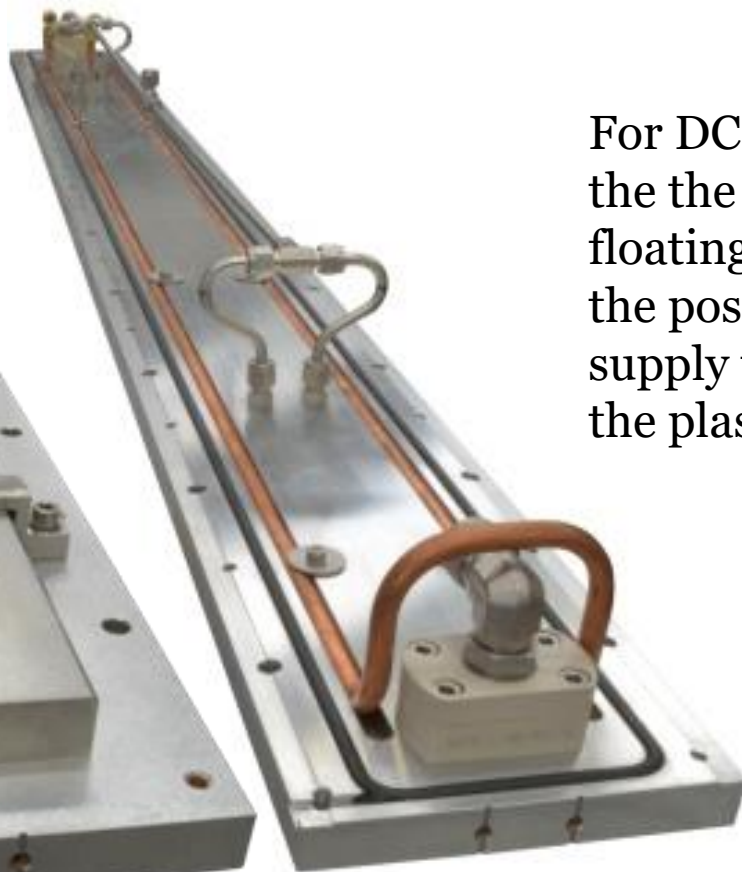
Temperature indicator strips on the rear of substrates coated with 1 micron Aluminum with and without the active anode



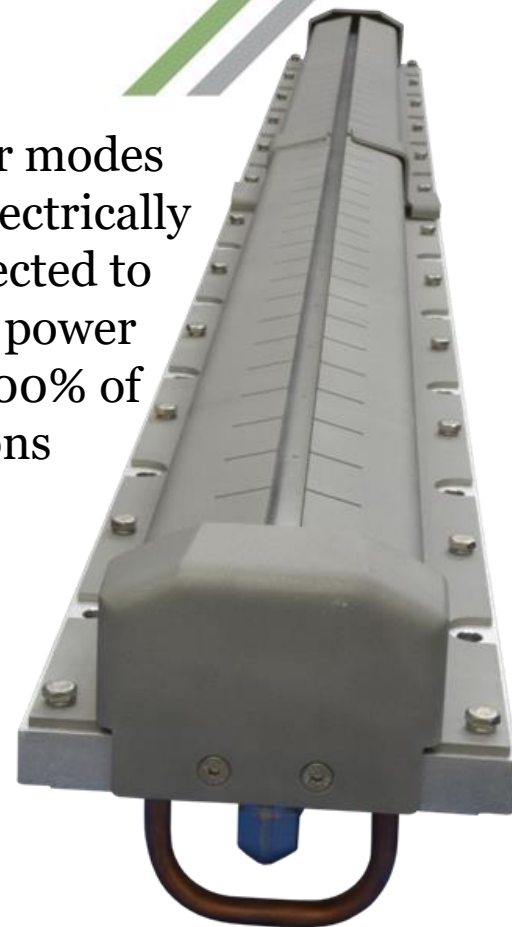
## **Gencoa Active Anodes** available in two forms for switching AC type power or DC type power modes



For switching double cathode AC power the anode is electrically earthed



For DC type power modes the the anode is electrically floating and connected to the positive of the power supply to collect 100% of the plasma electrons



High water flow to the anode structure ensures efficient heat removal and high power capability





## **Gencoa Active Anodes** reactive oxides with pulsed DC, a unique option compatible with AC and DC power modes

Gencoa's active anodes provides a long-term stable anode for rotatable magnetron operation which improves DC and pulsed DC processes from single or dual cathodes.

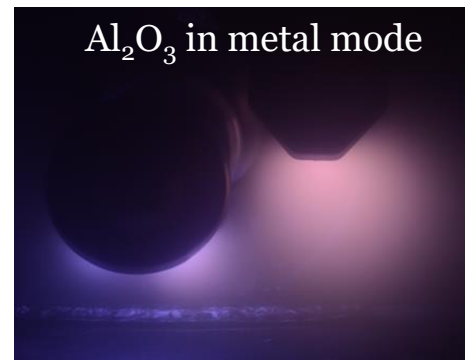


Highly insulating dielectric films can be deposited such as  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  with a single pulsed DC cathode and an active anode. This gives an alternative for dual cathodes with AC type power.

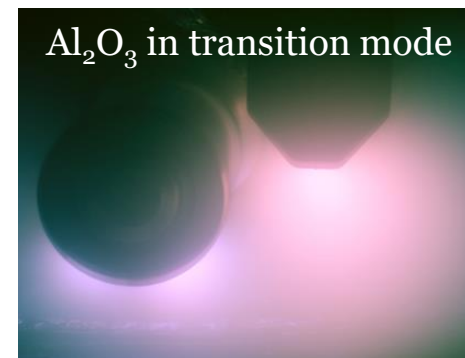
Active Anodes dramatically improves ITO layer properties from rotatable magnetrons,  $2.3 \times 10^{-4}$  resistivity at 100 C.



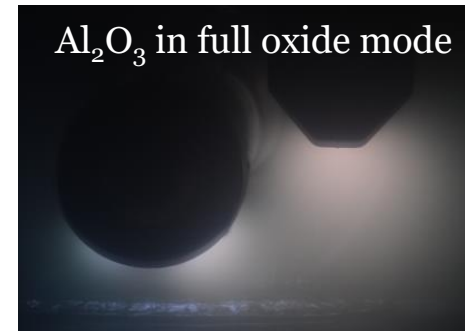
$\text{Al}_2\text{O}_3$  in metal mode



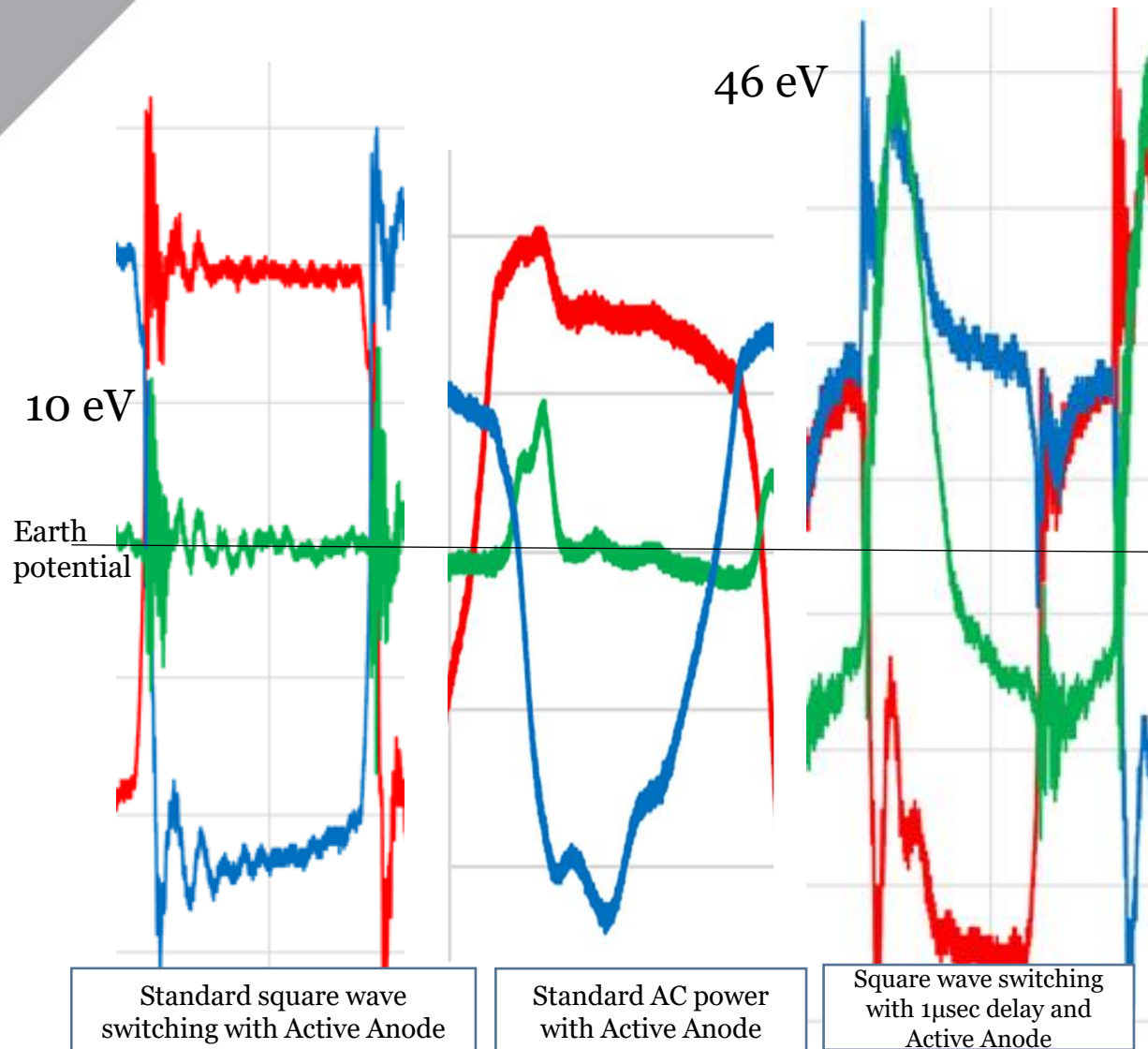
$\text{Al}_2\text{O}_3$  in transition mode



$\text{Al}_2\text{O}_3$  in full oxide mode



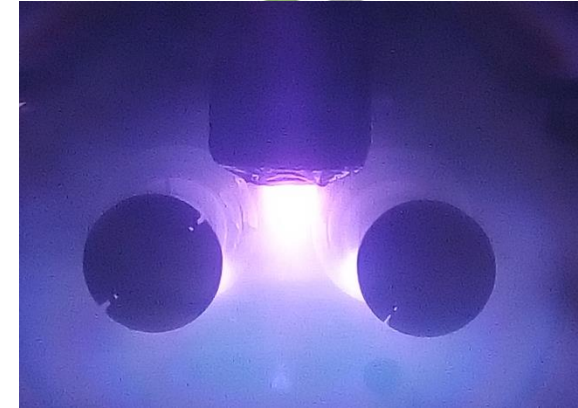
# Creation of extra energy via the use of switching power modes between 2 targets and the use of a magnetically guided earthed active anode



- By switching electrons between targets extra ionisation is created
- Active Anodes AA creates positive and negative energy bursts on the substrate (ideal for glass or plastic substrates without external bias)
- Introduction of a delay in the power switching

# Creation of extra energy via power mode and Active Anode – comparison of coating structures

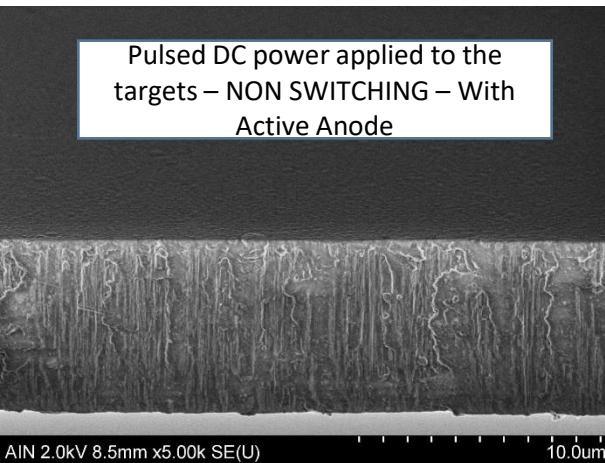
10 micron thick  $\text{AlO}_x$  deposited onto glass (floating potential – no external bias) from a dual rotatable magnetron and with active anode



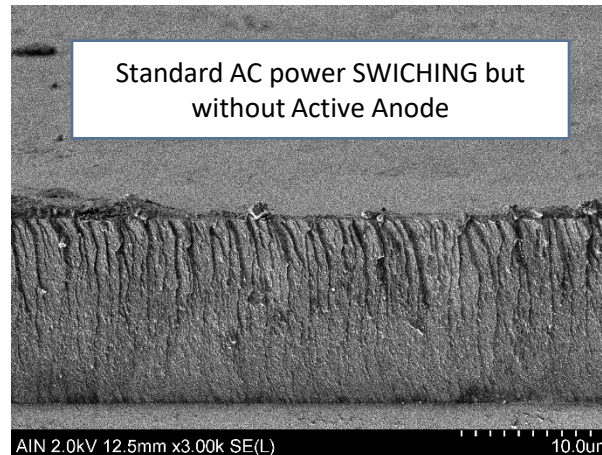
Increasing Energy Levels



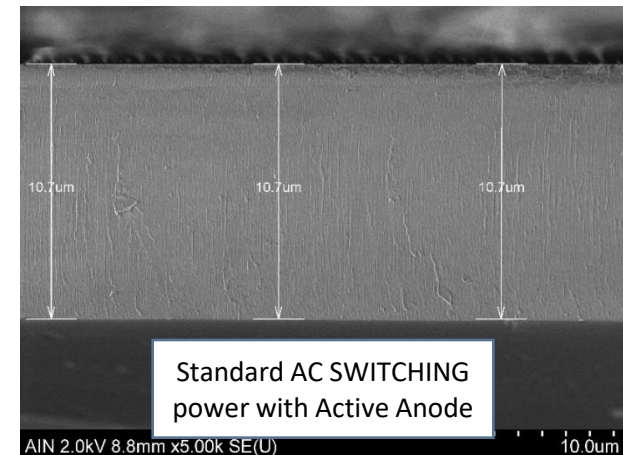
Pulsed DC power applied to the targets – NON SWITCHING – With Active Anode



Standard AC power SWITCHING but without Active Anode



Standard AC SWITCHING power with Active Anode



Columnar structures are recurrent when DC-Pulsed is used

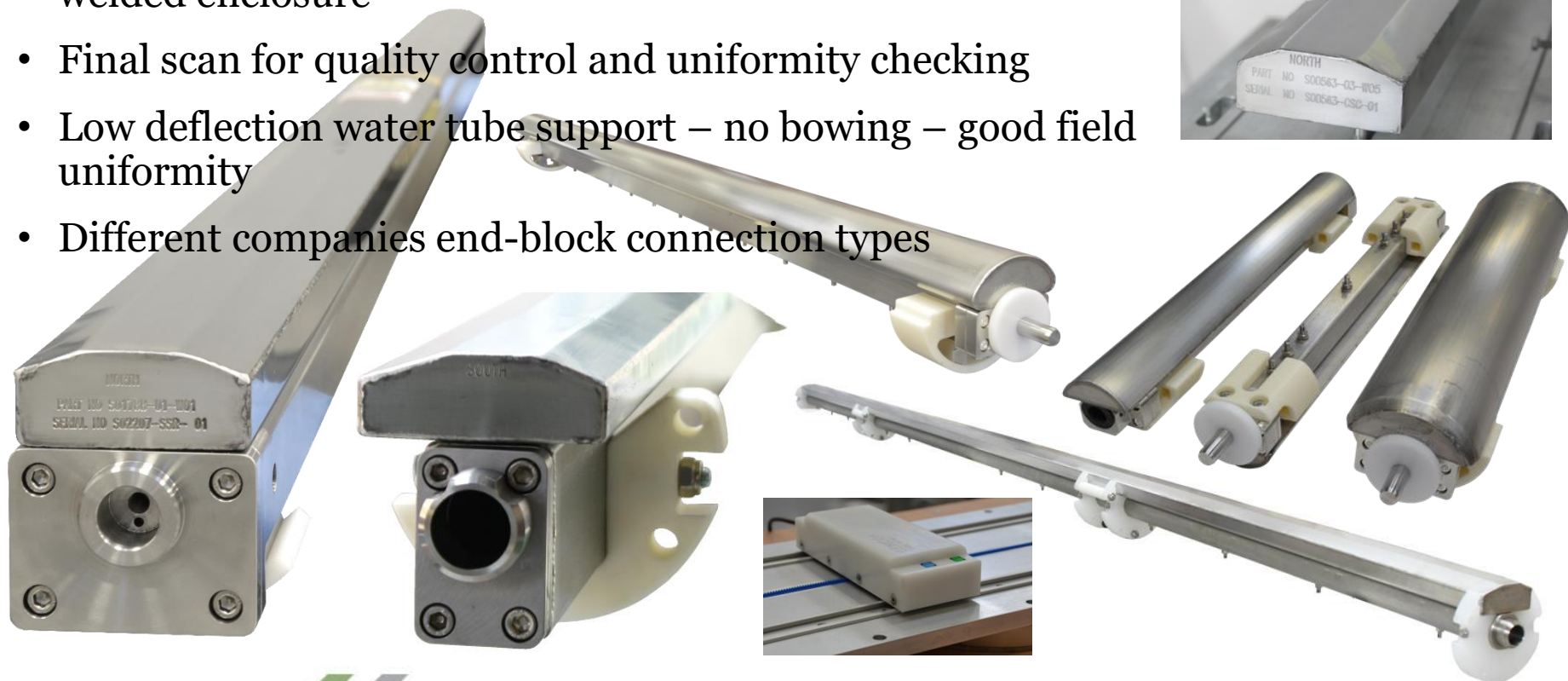
AC switching power mode has improved structure compared to pulsed DC

AC with active anode Produces highly dense structure

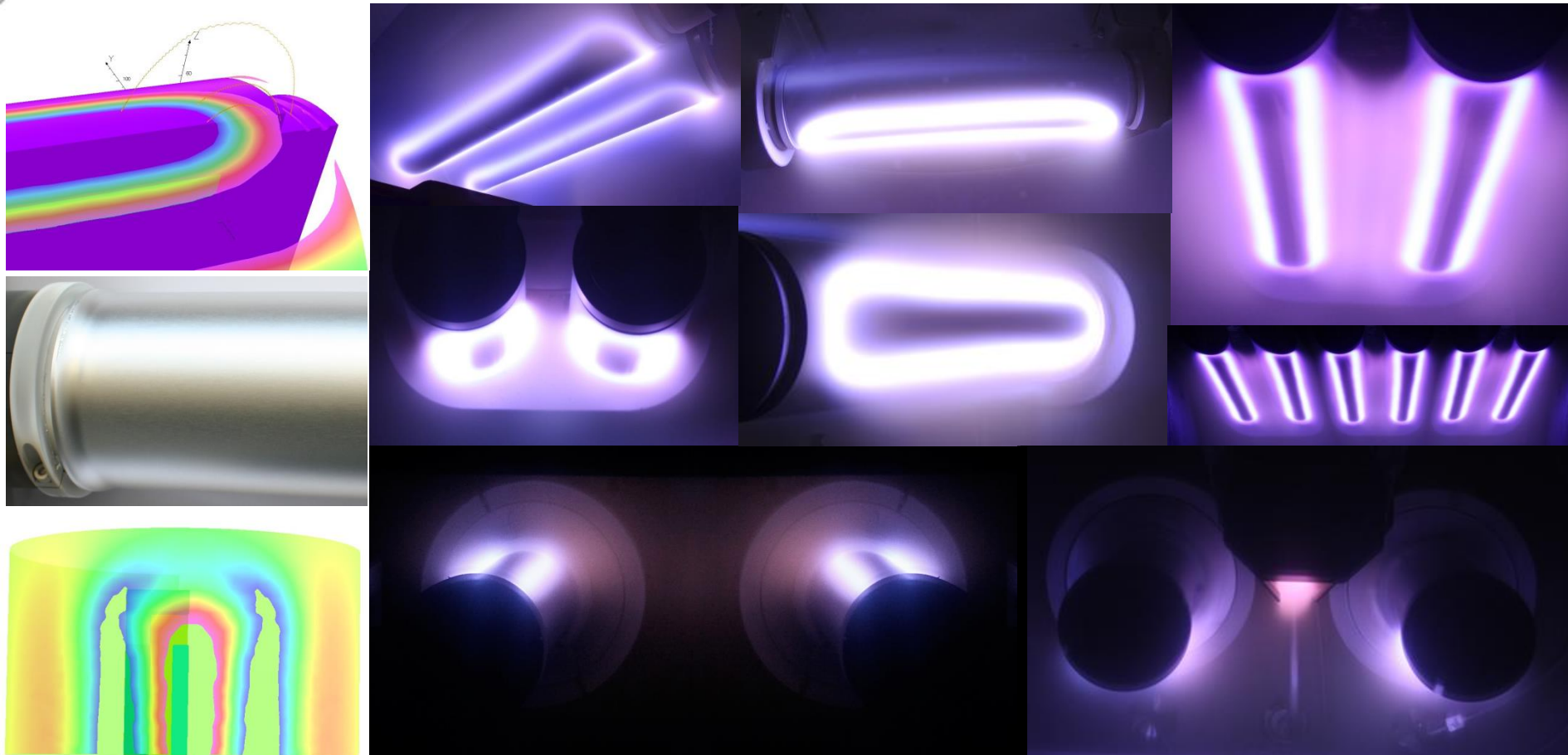


# Gencoa magnet bars with pre-tuned and scanned magnetics fit all types of end-block mounted on standard or 'free-span' HU support tubes

- Variable magnetic bar designs – 550, 750, 1000 Gauss. Unbalanced designs. Mag bars for 152 & 75 to 105mm OD
- Pre-checked magnets, precise alignment, no water contact – welded enclosure
- Final scan for quality control and uniformity checking
- Low deflection water tube support – no bowing – good field uniformity
- Different companies end-block connection types



**GRS different processes by switching the magnetic pack – DC, AC, RF/DC, PECVD available in target diameter from 75 to 160mm.**

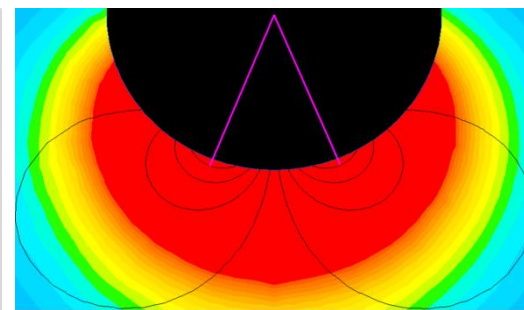
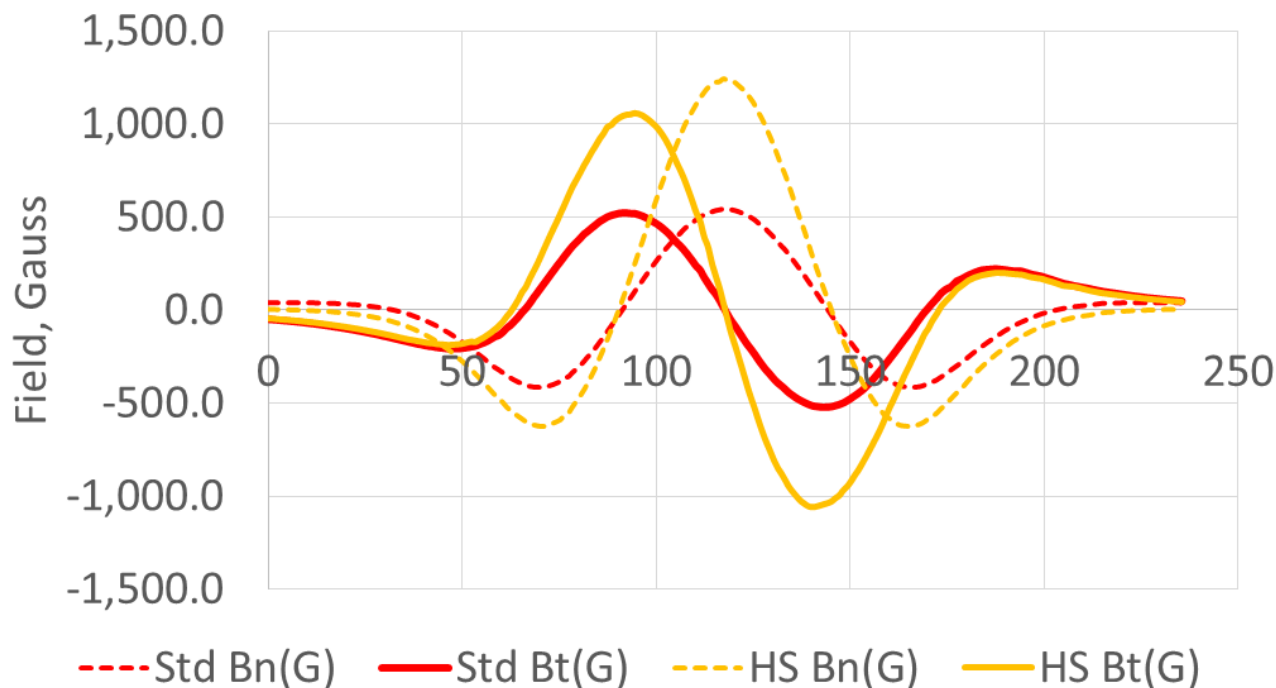


# Different magnetic and anode designs for rotatable magnetrons based upon needs

One solution does not fit all for optimum production!

Rotatable Series	150						75			100		
Array Type	HSR	HAR	SSR	SAR	PSR	PAR	GSH	GSW	GPP	GSH	GSW	GPP
Angle	$\pm 21^\circ$	$\pm 21^\circ$	$\pm 20^\circ$	$\pm 20^\circ$	$\pm 19^\circ$	$\pm 19^\circ$	$\pm 35^\circ$	$\pm 32^\circ$	$\pm 22^\circ$	$\pm 17^\circ$	$\pm 16^\circ$	$\pm 11^\circ$
Strength	1000G	1000G	540G	540G	540G	540G	700G	400G	350G	700G	400G	350G

Comparative strength

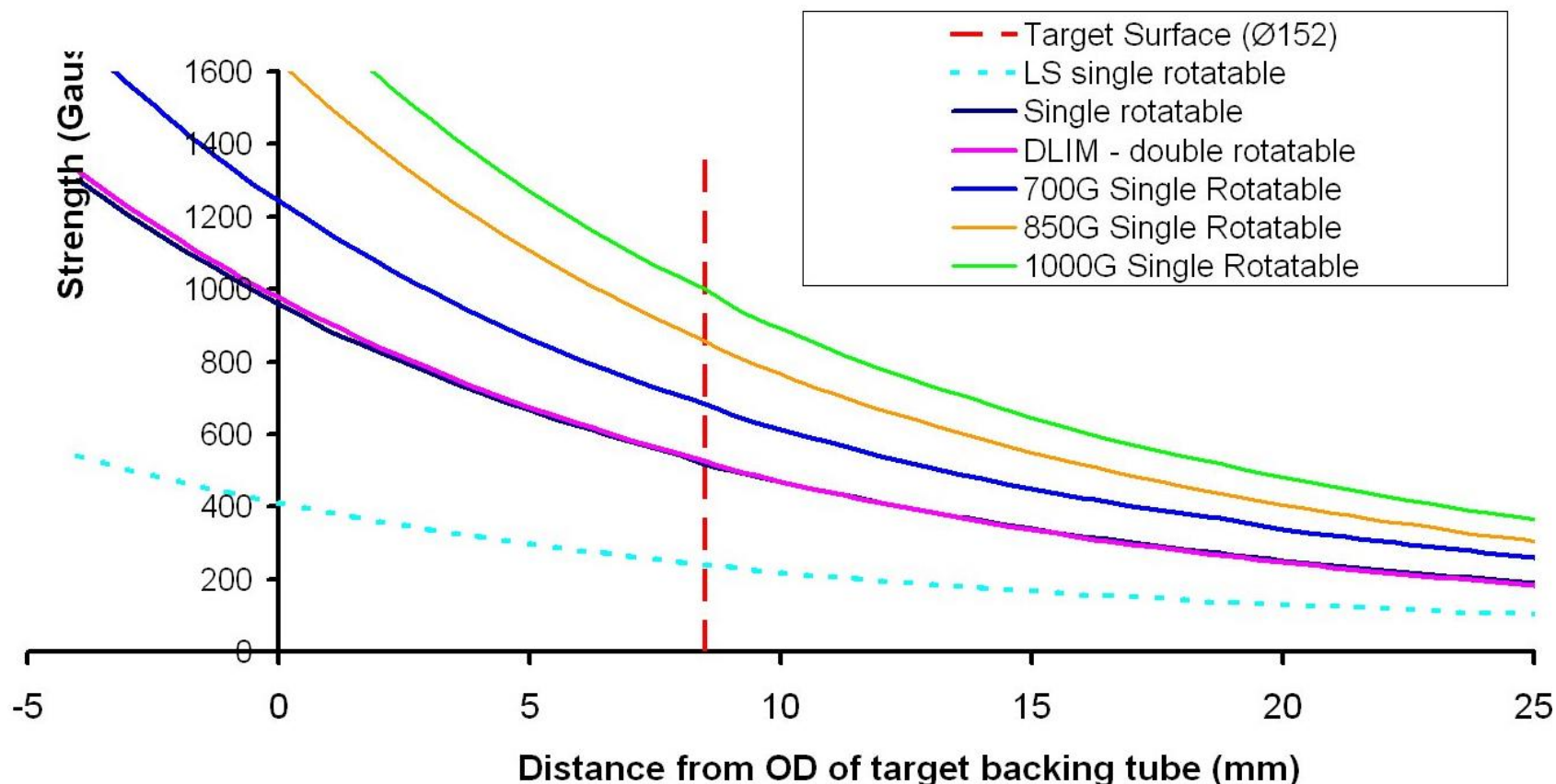


Codes	
Balanced 150	SSR
Balanced Asymmetric 150	SAR
Unbalanced 150	PSR
Unbalanced Asymmetric 150	PAR
High Strength 150	HSR
High Strength Asymmetric 150	HAR
Balanced 75, 90, 100	GSW
Unbalanced 75, 90, 101	GPP
High Strength 75, 90, 102	GSH

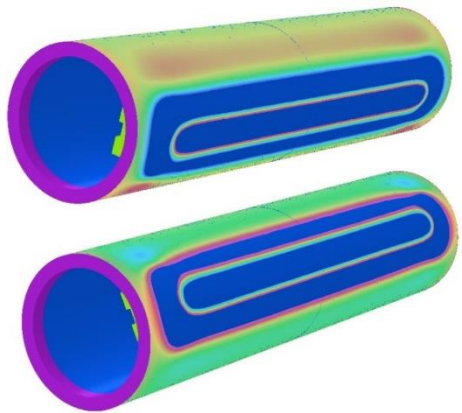


## Plot of magnetic field strength relative to distance from the target backing tube

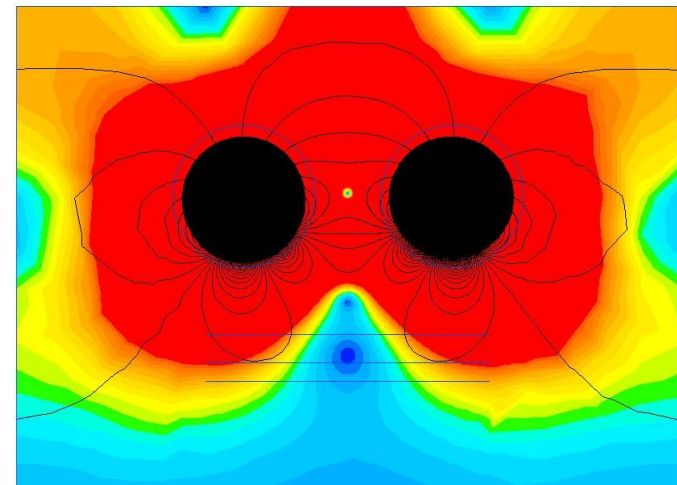
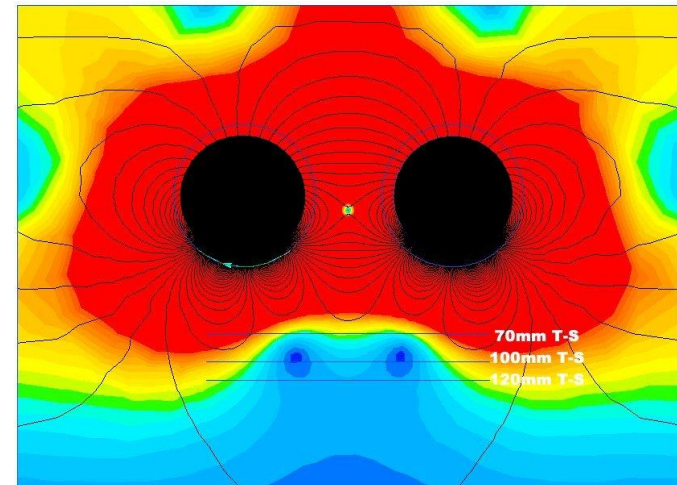
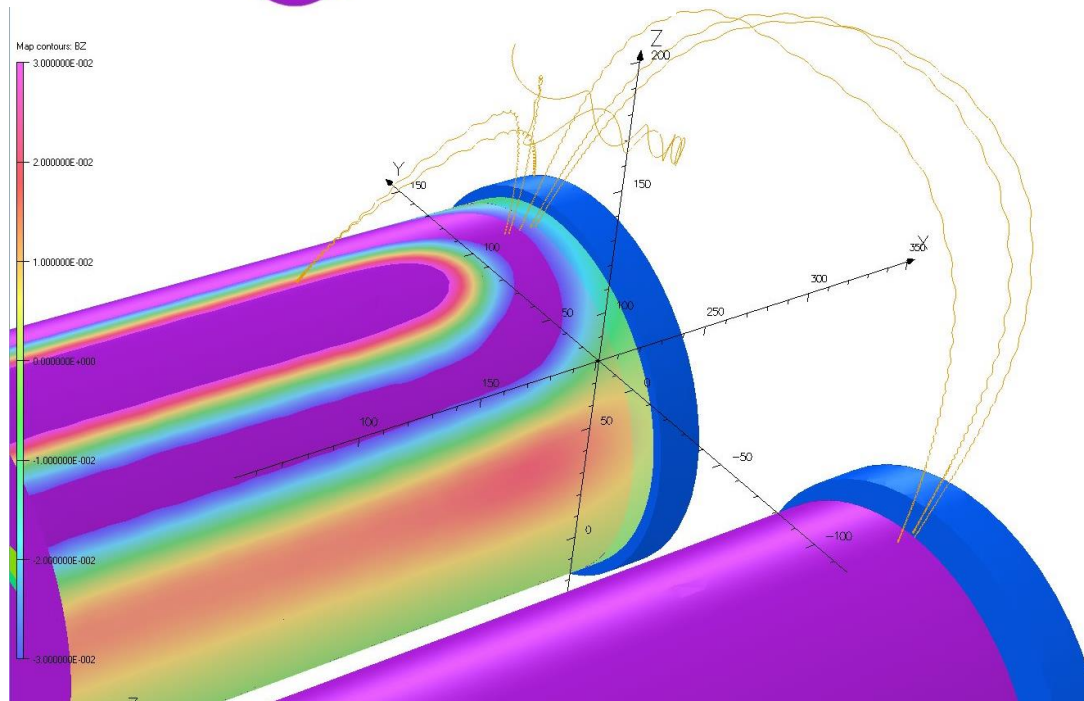
Target thickness / strength plot - parallel field component  
in the centre of the race-track



# Unbalanced (PP type) and linked magnetics are also available for substrate plasma bombardment effects

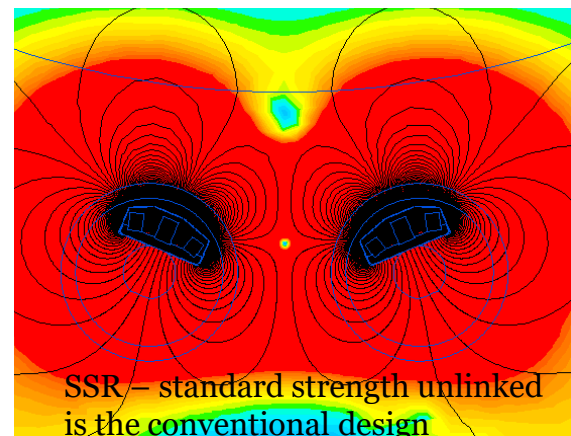
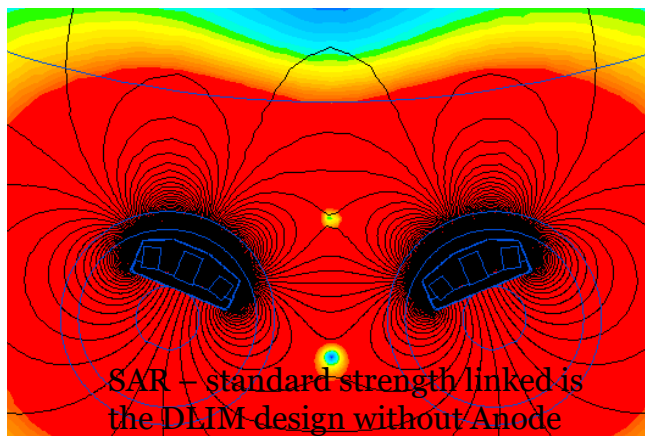
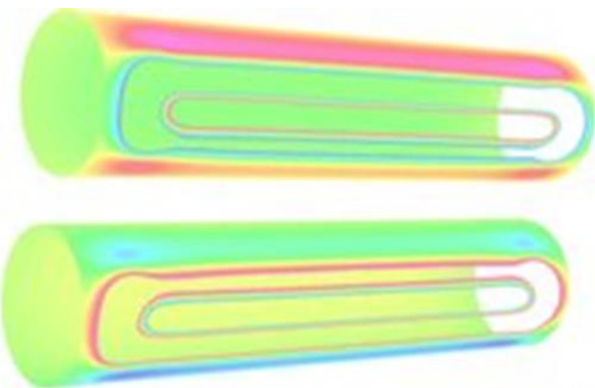


Varying the angle  
changes the  
substrate plasma  
bombardment



# Plasma control by Double Low Impedance Magnetics – DLIM no Active Anode

DLIM uses the Assymetric linked magnetic designs with an tilt angle to control electron exchange and plasma escape, product code - SAR – standard strength assymetric







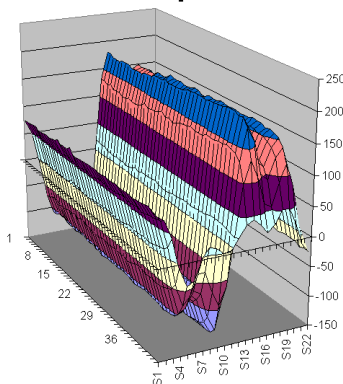
# Gencoa magnet bars with pre-tuned and scanned magnetics fit all types of end-block

Mounted on 'free-span' HU high rigidity support tubes  
Typical Magnetic Array Process Recommendations

Process Type	Magnetic Array	Active Anode
DC high rate metallizing	SSR 550 Gauss	Connected to DC +ve
DC ceramic ITO	SSR 550 or HSR 1000	Connected to DC +ve
Reactive oxides dual AC or square wave switching	SSR 550 or SAR 550	1 and per single or dual connected to earth
Reactive oxides / nitrides single or Duals DC pulse	SSR 550 or SAR 550	1 and per single or dual connected to DC +ve
Magnetic Materials	HSR 1000 or HAR 1000	Connected to DC +ve

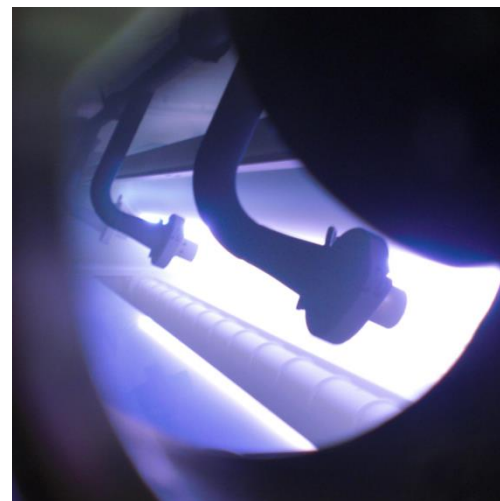
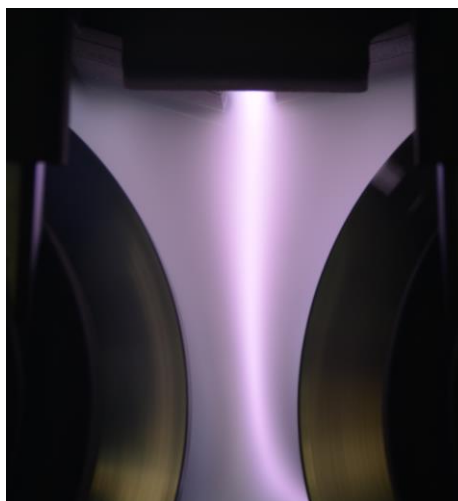
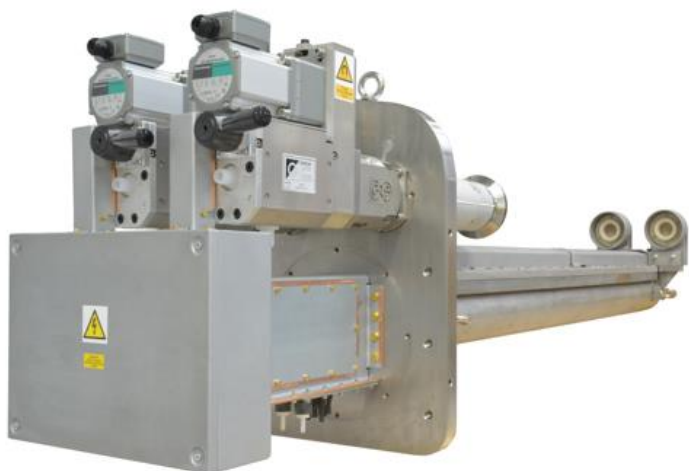


Codes	
Balanced 150	SSR
Balanced Asymmetric 150	SAR
Unbalanced 150	PSR
Unbalanced Asymmetric 150	PAR
High Strength 150	HSR
High Strength Asymmetric 150	HAR
Balanced 75, 90, 100	GSW
Unbalanced 75, 90, 101	GPP
High Strength 75, 90, 102	GSH



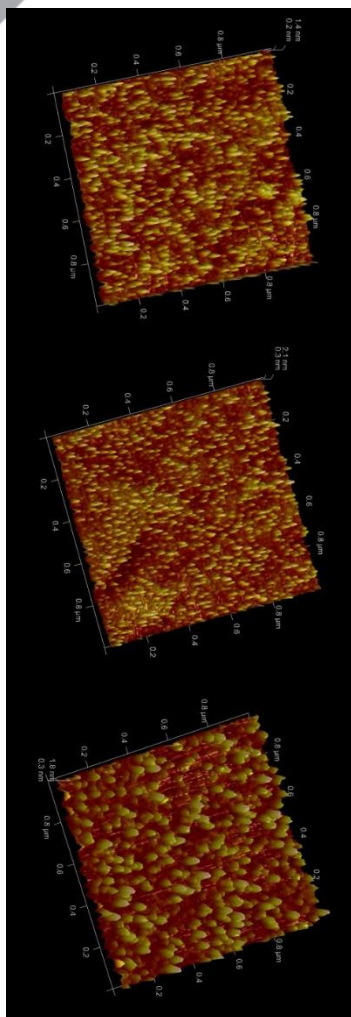


**Gencoa Process Support** provide complete sub-systems and process set-up support worldwide, process staff in the US, China and Taiwan





**Gencoa** is actively combining technologies and  
developing ways to enhance thin film devices



Thank You for your attention.

Visit [www.gencoa.com](http://www.gencoa.com) for more  
information or speak with your local  
sales representative

