



**Perfect your process**

# 02

## Introduction



### Perfect your process

Providing expert solutions to a worldwide customer base over three decades, Gencoa is among the world leaders in the design and manufacture of products for the vacuum coating sector. The continuous innovation has led to technology that has set industry benchmarks in magnetron and plasma deposition components and process control. But the success of the business is only realised by delivering products and process solutions that address challenges faced by customers.

With a complete package of plasma sources, process controllers and technical support, Gencoa have the know-how and experience to help get the most from a wide range of vacuum coating applications, and to help perfect your process

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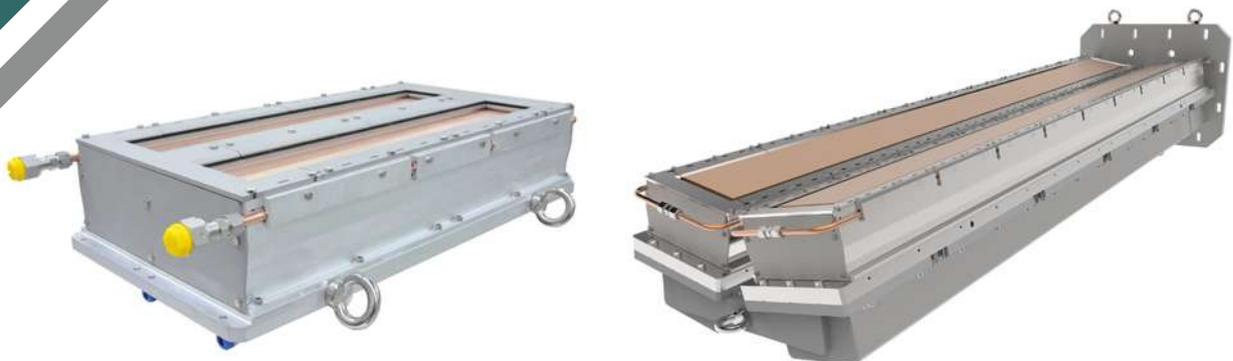
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process

# 04-05

## Rectangular

*Gencoa have given us excellent support in configuring our process layout, manufacturing the magnetrons and implementing the process on-site in our machines. This has led to a successful commercial production process for functional and low friction coatings.*

Technical Manager, Toll Coating Centre



## **Gencoa have a well-established track record of providing rectangular planar magnetrons and technology for coating of flexible substrates, architectural glass, solar cells, displays, touch screens and semiconductor wafers. In particular, the electrical insulation of our cathodes mean we are the partner of choice for any high power RF or HIPIMS application.**

Our planar rectangular magnetrons combine low ownership cost, robust design and highly-optimized magnetics to produce a reliable product delivering high performance. All Gencoa magnetic arrays are guaranteed against degradation for 10 years.

The integrated gas delivery system acts as a powerful mechanism for tuning deposition uniformity by employing single or multi-zone control. All standard cathodes are fitted with a diaphragm type cooling for high power operation without breaking a water seal during target changeover. Other cooling options are available on request.

A unique design incorporating 'zero-height' anodes prevent short circuits during processes and reduce dust and defects in the coatings. All sources incorporate rear flange plate cooling as standard and additional anode water cooling is optional.

Depending on the application, Gencoa can configure individual cathodes to meet specific process requirements and limitations. An OEM proprietary magnetron design and manufacture service is also offered, and cathode CAD dimensional data is available from Gencoa's website in 2D and 3D formats.

### **Compact Cathode**

To serve markets requiring a simpler cathode design in as small a footprint as possible, Gencoa have introduced the 'compact' range. Compact cathodes are significantly smaller than standard cathodes and have reduced features. These can be supplied with direct or indirect cooling, with or without anodes and

can be used in simpler DC and AC applications with targets typically up to 1m in length.

### **Magnetics**

**High Yield (HY)** range achieve 40% target utilization and are recommended for applications where increased machine up-time or reduced material costs are required.

**Metallizer (MZ)** range is designed for high-rate metallizing of webs, car parts and decorative applications. Using specially-designed thick profiled targets and high water flows, the MZ range can increase the machine up-time by 100%.

**Vtech (VT)** range is dedicated to ion assisted deposition processes, where the degree of plasma impact on the growing film can be automatically varied by in-situ changing of the magnetic field.

**Full Face Erosion (FFE)** magnetics are suited to processes where clean deposition and efficient target use are required, such as ITO and precious metal deposition. Target cleanliness is achieved by moving the plasma across the target surface.

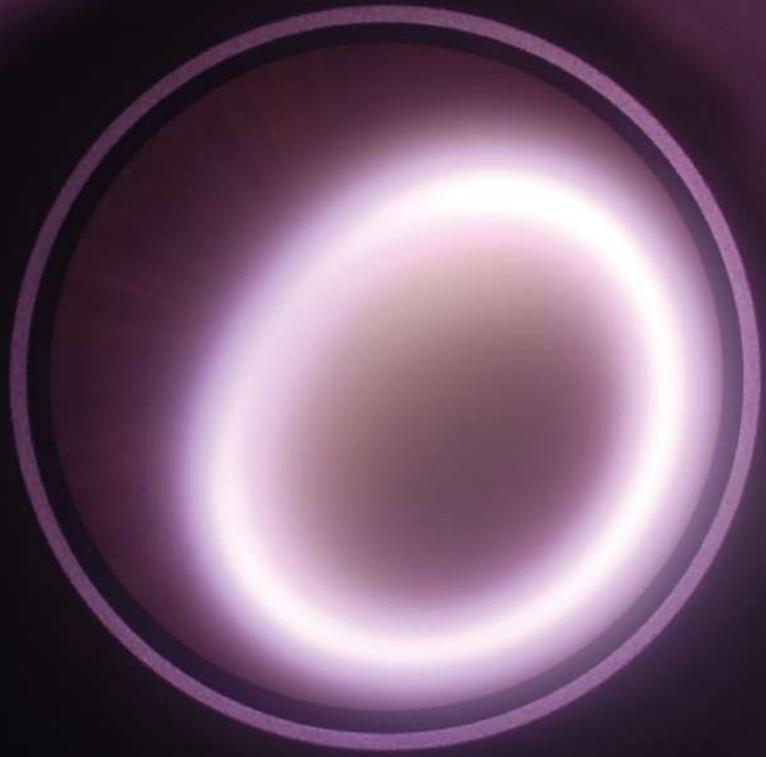
### **Mounting options**

- Externally mounted with a single or double cathode configuration
- Single and double internal with optional cantilever mounted
- Angled dual internal or external



**06-07**

Circular



## Gencoa offer a comprehensive range of circular planar magnetrons, catering for applications from R&D to semiconductor production. A large array of configurations result in solutions for the challenging demands of real processes.

Gencoa magnetron sputter sources meet vacuum requirements both in HV and UHV range. The 3G range of HV sources feature an ultra-compact low outgassing design and internal gas injection as standard, indirect or direct target water cooling, and +45 degree tilt adjustment.

The sources can be fitted with various magnetic and mechanical options, leading to performance benefits appropriate for differing applications, and are built to reliably work with DC, RF, pulsed DC and HIPIMS power supplies without any changes to the source. The 3G sources with standard magnetics work over the expanded pressure range of  $7 \times 10^{-4}$  mbar to  $1 \times 10^{-2}$  mbar.

**Conventional sputtering applications** are typically addressed using a two pole or High Yield magnetics model. The two pole sources can be fitted with various degrees of magnetic field unbalance and magnetic strength. High Yield magnetics are available for target sizes from 4", and deliver 40-50% target use.

*Applications: general sputter processes and magnetic material sputtering*

**Gencoa's VTech** range start from target diameters of 2", and allow the magnetic properties over the target surface to be changed by simple external adjustment. This can be performed during the process or between deposition runs. Changes in the magnetic properties

create different levels of strength and ion assistance to the coating process and allow rapid development of the thin film structures.

*Applications: R&D, ion assisted deposition*

**High uniformity (HU)** magnetics have two or three static plasma rings over the target surface. The combined coating flux distribution from each ring creates a uniform coating area with low source to target distance. HU sources offer high productivity by maximizing the material transfer, and can deliver  $< \pm 3\%$  uniformity over a 200mm wafer. Multi-ring sources require the use of pulsed DC.

*Applications: semiconductor, static wafer deposition*

**Full face erosion (FFE)** magnetics combine ultra-uniform films with clean target erosion by a scanning of the plasma over the target surface. The FFE magnetics cover the widest range of target sizes from 3" to 18" and have magnetic material options. The FFE magnetics ensure a clean target surface and hence improves target use and reduces defects in films. The FFE150 for example has a target use of 70% and the FFE300 can deposit layers with 1-3% uniformity onto 200mm wafers.

*Applications: wafer metallizing for semiconductor; static wafer deposition*



# 08-09

## Rotatable



**The Gencoa Rotatable System (GRS) is available in four variants, with two options of internal flange mount style, and options for horizontal cantilever and vertical mounted rotatable magnetrons. The Gencoa GRS technology offers the ultimate in performance and flexibility by focusing on five key areas: a variety of end-blocks for different target weights; higher power delivery and cooling capacity; target diameters from 75 to 180 mm; a wide range of magnetic designs; Active Anodes for improved plasma control and film density.**

### **GRS**

GRS brings rotatable cathode technology in a very small space by incorporating innovative design elements based upon our patented in-vacuum rotation method. The GRS is designed to be convenient way to upgrade planar magnetrons without a loss of film uniformity.

### **GRS-C**

The cantilever mounted version is an external end-block for insertion through the vacuum wall into the chamber. It combines high load bearing with a high power capacity and a high water flow. Changes to the angle of the magnetic array is possible as standard by an external manual lever or optional stepper motor. Typical uses of the GRS-C are web coating.



*The active anode concept has enabled us to increase power output from 16kw to 40kw without damaging our web material.*

Nick Butcher (Coating Segment Manager, Emerson & Renwick)

### GRS-V

The GRS-V is a purpose designed vertical source and enables motor or manual adjustment of the race track angular position for target pre-cleaning or uniformity control. The GRS-V is aimed at reducing the cost of ownership for display coaters with in-line or static glass, batch coaters for decorative and hard coating, and high power metallizing of plastic parts. The high current handling also makes it ideal to operate as an arc source.

### GRS-M

Developed as a high capacity drop in rotatable for target diameters of 152mm or greater, the GRS-M can be fitted with targets of up to 2m in length, in a vertical or horizontal orientation. The compact size of the GRS-M end-block is ideally suited for vertical display coaters or horizontal in-line coating systems.

## Magnetic Bar Options

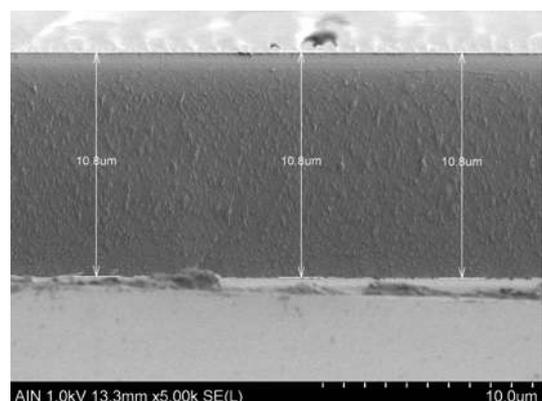
Genco have a wide range of magnetic designs for all diameters of rotatable targets for use with GRS products or other manufacturers' end-blocks. For sputtering applications, there are five different strength options available to optimize process performance and also unbalanced designs for higher ion assistance. As with all Genco magnetic designs, in-built features and build / field accuracy ensure high target use and uniformity. Field strength variations of either  $\pm 3$  or 1.5% are available and magnetic bars are scanned prior to despatch.

## Active Anodes

Genco have developed and patented a unique anode solutions for all rotatable magnetron arrangements. These active magnetically-guided anodes offer process stability and control of plasma and heat interactions with the substrate. The active anodes work with DC, pulsed or AC power modes and are water cooled and at earth potential for easy integration and can optionally deliver argon gas. The Active anodes have a profound effect on the coating structure by increasing film density and reducing defect at the same time as dropping the internal film stress (active anodes provide both negative and positive species of film bombardment).

Genco's range of gas bars, sensors and Speedflo feedback control options means a full package of process implementation can be performed at a customer's site anywhere around the globe with local support staff in the EU, USA and China.

Genco also supply a full range of targets and precision backing tubes for the GRS range of products.



# 10-11

## Plasma Sources



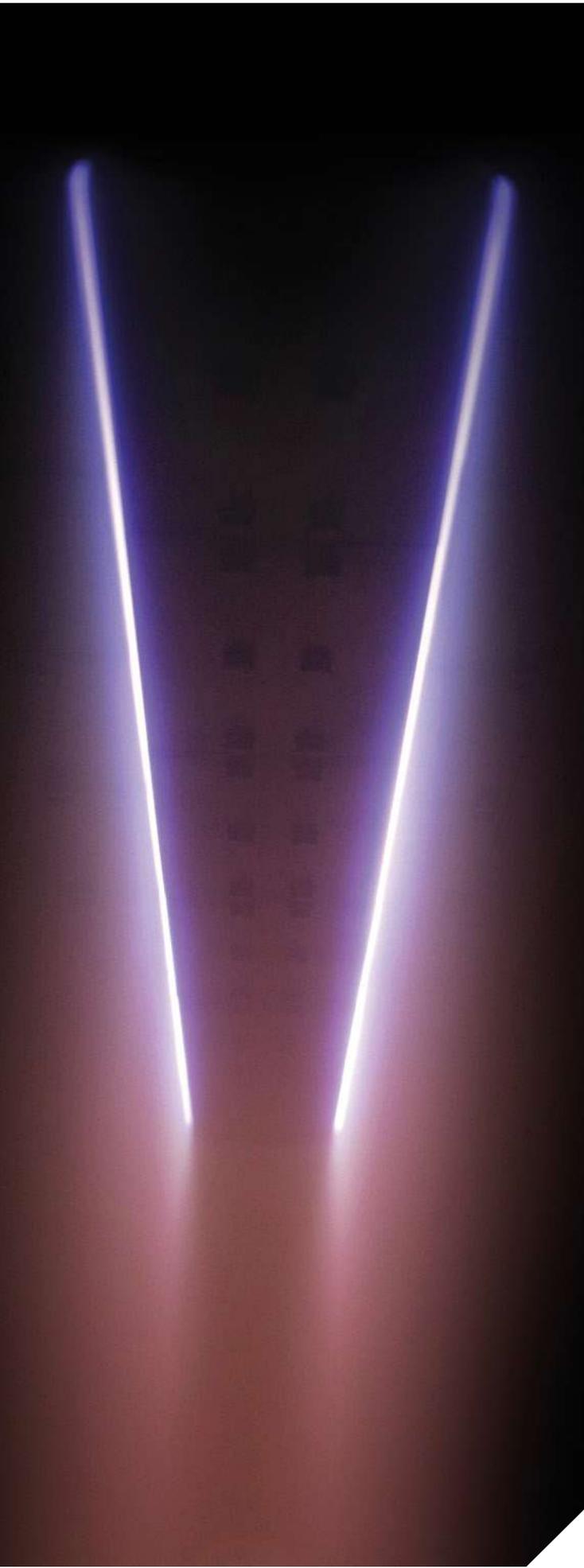
**Genco provide a range of plasma source technology based upon DC, AC and HIPIMS power modes. The DC sources are either inverted magnetron type ion sources, or magnetron based DC/pulsed DC tuned to operate at high pressures. AC types of plasma sources are dual electron switching devices that can generate higher plasma densities and rapid surface activation of fast moving substrates. HIPIMS-based plasma generation are the HipV+ sources that produce highly ionized beams of plasma to etch or modify films and surfaces.**

Linear ion sources offer a low-cost, robust and flexible means of modifying or pre-cleaning large area polymer and glass substrates prior to thin film deposition, burning off hydrocarbons and activating the surface to promote adhesion of the deposited film. The sources are packaged with the im300 or im3000 power supplies with an automatic gas feedback feature for very simple source operation.

The sources are designed to operate at standard sputtering pressures and may be used simultaneously with sputter sources during film deposition. The ion beam distribution can be easily set up for straight or focussed configuration.

Genco's ion sources are assembled with a graphite anode and cathode, protecting the substrate from contamination and reducing the erosion of source to low levels.

Genco's IMC75 circular ion source marks a new generation of neutralized plasma sources for R&D. Its flexible plasma beam is suitable for many applications, including substrate pre-clean, ion assist and CVD deposition.



## Applications

- Nanotexturing
- Coating removal
- ITO and silver deposition crystallinity control
- Etching prior to deposition – avoid RF bias cleaning of dielectrics
- Ion beam deposition
- PACVD and DLC deposition

**DC magnetron based plasma pre-treaters** are modified versions of planar magnetrons to typically run at higher pressures within unwind chambers of vacuum web-coating tools. These devices can run at high powers and with the addition of plasma emission monitoring, can change the power to automatically adjust to the nature of the web material and environmental conditions.

**AC plasma pre-treatment sources** utilize a higher voltage sine wave power delivered alternately to opposing electrodes. This type of plasma generation imparts most of the energy to the gas phase and generating high plasma densities. AC pre-treaters are highly effective to pre-treat surfaces and liberate moisture from surfaces quickly. The switching of each electrode from negative to positive provides a stable long term anode and runs stably in the presence of oxygen or moisture rich environments.

**HipV+ plasma etchers** are a unique Gencoa embodiment of HIPIMS type power technology that can deliver uniquely high levels of surface etch and modification. These sources use a high voltage HIPIMS type positive power to the electrode. The positive pulse accelerates positive gas ions away from the source to impact a surface. The etch rate and energy density is the highest of all plasma sources.



# 12-13

Speedflo –  
Process  
Control

*Switching to Gencoa's High Yield magnetrons doubled our target utilization and campaign lengths.*

*Speedflo enabled us to implement reactive sputtering in an electrically noisy industrial environment with no vacuum system modifications. With Speedflo, control of a reactive sputtering within a very tight process window was rapidly demonstrated.*

Senior Process Engineer,  
Major PV manufacturer



speedflo™



SENSOR



SENSOR 5

Perfect your reactive processes with Speedflo, an advanced reactive feedback control system delivering improvements to deposition rates, coating properties and process reliability. Speedflo is designed around the demands of real processes and has been proven on hundreds of different industrial plasma-based deposition machines – each with varying demands. With two options available – offering a choice of 8 channels for Speedflo, or 3 channels for Speedflo Mini – Speedflo has the flexibility to benefit a wide range of reactive processes, from magnetron sputtering to PECVD and electron beam deposition.

### Speedflo auto-tune

Achieving high performance control of your system is a quick and easy process using Speedflo. A proprietary, state-of-the-art automatic controller tuning procedure provides optimum controller parameters for your process at the click of a button. The auto-tuning procedure is fast and effective – and works within any system or sensor configuration.

After performing an integrated system calibration and identification procedure, the auto-tuner instantly generates the optimum controller parameters for your process by using advanced inverse dynamics algorithms to analyse the collected data.

The whole procedure takes a couple of minutes and is perfectly suited to the demands of actual processes.

### Support & Technology

Gencoa can provide remote or on-site assistance to help optimize your processes, with local support available in USA, China and Taiwan. The level of support and process know-how complements Gencoa's complete reactive gas and process control set-up that includes magnetrons, gas bars, and controllers.

### Sensors

Speedflo and Speedflo Mini can each be configured with a combination of sensor options from a selection of available sensors:

- Target voltage
- P.E.M in-situ
- P.E.M ex-situ (Penning)
- Lambda for O<sup>2</sup> only

### P.E.M Options

There are two plasma emission monitoring options: a narrow bandpass optical filter in-front of a photomultiplier tube (PMT) or wide range UV to visible light spectrometer. The PMT option is the usual choice for industrial process control as the speed of response of the sensor is below 1msec. The spectrometer option typically needs >50msec to collect enough light signal to operate, so is not recommended for industrial control. However, for R&D and slower responding processes it is a powerful tool for monitoring multiple species in the plasma. The Gencoa spectrometer sensor has sophisticated software to control using different signals and also has automatic species recognition.

### Speedflo Simulator

Replicate the Speedflo user interface using a tool that provides a dynamic simulation of the Speedflo system. Benefitting from Gencoa's in-depth understanding of process control, the software simulates the effect of Speedflo features such as controller gains and calibration parameters, in addition to system characteristics such as gas delivery pipe length.

The simulator is a highly effective tool and can improve the system user's understanding of feedback control, as well as the operation of the Speedflo system.



# 14-15

Optix –  
Process  
Control

**Optix is a groundbreaking, multi-purpose instrument for gas sensing in any vacuum environment, functioning through a wide range of operating pressures to cater for most industrial vacuum production processes without any requirement for differential pumping.**

Optix uses a remote plasma spectroscopy concept which generates a small plasma within the sensor head, and is then analysed by its built-in spectrometer. The light spectrum is automatically interpreted to provide qualitative measurement of the presence and concentration of gas within the vacuum.

The sensor generates a plasma over a wide pressure range without the need for a differential pumping system.

The Optix spectral information and sophisticated back-end software creates a range of uses for all vacuum users within an easy to use and multi-functional interface: wide range pressure measurement; leak detection; vacuum quality monitoring; process pump-down analysis; gas and molecular analysis; condition monitoring and fault detection; end-point detection; gas flow calibration and composition ratios.

## Pressure regime advantages

- Operates directly at the most common vacuum process pressures
- No need for expensive/complex differential pumps
- No spurious readings from differential pump systems
- Direct monitoring of the vacuum instantly register any changes (m/sec response)
- Significantly less expensive than RGA and differential pump combination

## Interface

An advanced Windows user interface provides clear visualisation of the condition of the process and vacuum, and powerful tools for recording and referencing data enable easy identification of process problems.

## Software features

- Built-in spectrum database for atomic and molecular emission signatures
- Automatic spectrum interpretation
- Time plots for automatic or user defined species
- Customizable trigger set-up for end point detection or process control
- Comprehensive data recording and data referencing capability
- Vacuum quality tracker



# 16

## Pulsed Effusion Cell

**An innovative solution for difficult-to-deliver vapour types, the pulsed effusion cell, with optional cracker, is a collaborative development between Gencoa and Nano4Energy.**



The range of materials that can be used with the effusion cells include sulphur and selenium, and when these materials are combined with Speedflo and the SeS sensor, stable and highly controllable reactive sputtering or thermal evaporation can be achieved.

The low temperature pulsed effusion cell relates to delivery of monomers and low vapour pressure materials for vacuum polymerization. The ability to vary the gas delivery through the duration or frequency of valve pulse is combined with process-sensing to achieve a fast feedback control of such systems. Application areas include gas permeation barriers and OLED device creation.

# 17

## SeS Sensor



**Genco have developed a convenient sensor mounted on the vacuum chamber wall specifically to measure the level of Se or S inside a vacuum chamber. It is a chemical type sensor that provides a voltage change as the Se level varies within the chamber.**

The selenium sensor is more sensitive and reliable than a quartz crystal monitor in sensing the changes in Se delivery.

The sensor can be used for any process for feedback control of the Se content in the chamber via the Genco Speedflo controller or own PLC / heater controller.

The Speedflo controller interfaces with a PLC, OPC server or window's interface to display the signal and control the sensor functions. Feedback mode is also available via the Se delivery source to automatically regulate the Se at a certain level. The Se source used can be the Genco high speed pulsed effusion cell PEC, or through use of a valved effusion cell, or an unvalved cell through temperature feedback control – slower speed Se or S regulation.

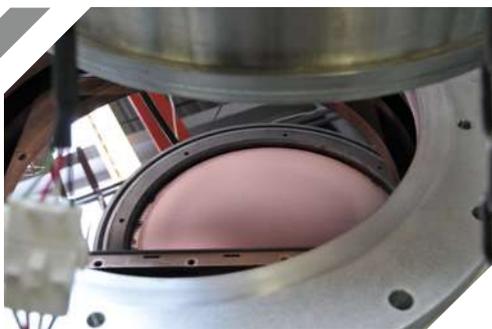
### **Advantages**

- Chemical sensor – direct measurement of chemical concentration of Selenium or Sulphur
- Lower cost as compared to other methods
- Non-obtrusive, attached to the chamber wall
- Outputs a voltage for fast feedback control of valved vapour source e.g. the Genco PEC
- Integrate sensor & feedback control package available for closed loop control

# 18

## Perfect your process

**Genco aim to exceed your expectations by applying our process understanding and product development work to address the challenges you encounter and to ever advance the field of PVD and other forms of vacuum coating. This is achieved by collaborating with our customers and investing in facilities to develop, characterize and test new layers and deposition methods. By understanding your production challenges, we are able to test and deliver solutions to 'perfect your processes'.**



Genco's core business is the production and sale of devices for use in production tools. But our collaboration runs much deeper in some cases and enables us to support our customers in using our products more effectively, as well as transferring knowledge and skills to help our customers succeed and achieve better results.

### **Performance improvement of existing products**

A common request is to replace corroded magnetic packs or to improve the target utilization or uniformity performance of cathodes. Genco can magnetically model and simulate either a direct replacement magnetic array, or fit a new high performance magnetic array which can deliver significant improvements to target usage and uniformity. Genco use both 2D and 3D magnetic modelling, target erosion simulation, magnetic field uniformity scanning and pre-delivery plasma testing. For large area glass sources we have developed a highly accurate method of measuring field uniformity. Every linear magnetron we produce undergoes a field mapping as the last stage in the production process.

### **System magnetic modelling and process optimization for hard and decorative coating**

Our staff have vast experience in working with different types of coating processes and methods to optimize and vary the level of energy within a coating process chambers. Genco can provide the optimum types of planar or rotatable sources and a complete process system layout with gas and pumping calculations for reactive processes. We can also implement the processes on-site and deliver training. The new VT-R type of variable planar magnetron is a powerful and low cost method to adjust the plasma energy within the process chamber.

### **Collaborative coating development**

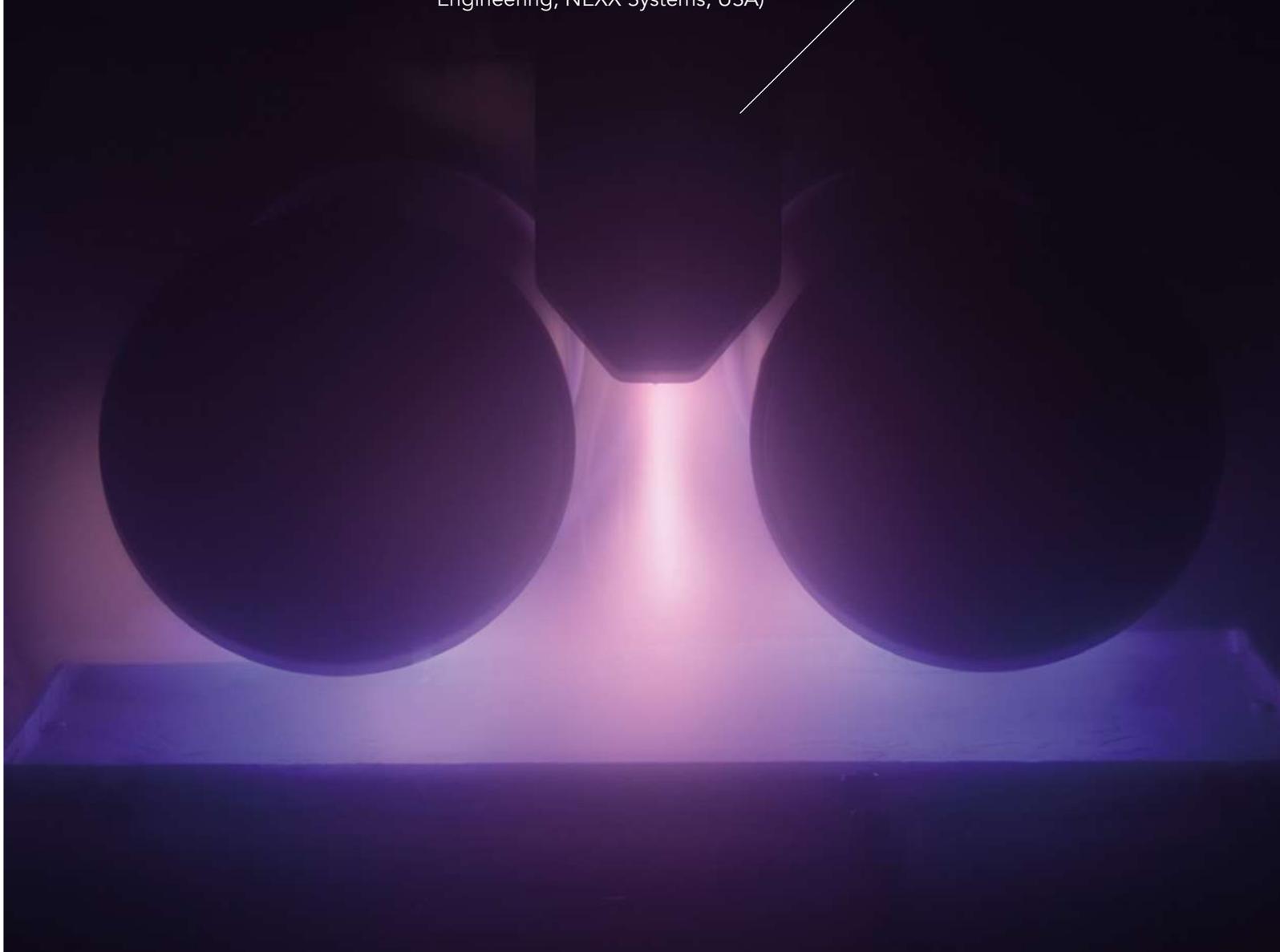
Genco have eight in-house testing and process machines for product development, with a variety of plasma and coating analysis tools and an in-house SEM. These are used for both product test and development, but also short and longer term collaborative coating development. Areas of current and historical coating activity include: hard carbon onto glass and plastic; anti-microbial coatings for medical tools and medical facilities, wound dressings, prosthetic implants; low resistivity ITO layers from rotatable magnetrons; high moisture barrier layers; PECVD of optical and dielectric layers; low stress and high adhesion oxide layers.

*Our close work with customers is something that Genco prize, and we look forward to similar opportunities to assist our customers in the future.*



*We have been impressed by the physical insight into magnetron design and operation that Gencoa provides as well as their extensive modelling and testing capability. We truly feel that we work together as a team to maintain and advance our magnetron technology.*

Steve Golovato (Manager, Dry Process Engineering, NEXX Systems, USA)



For an up-to-date list of internationally-based agents and support staff, visit [gencoa.com](http://gencoa.com)

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