thin film and pv solutions

gencoag

components for sputter deposition, process control and plasma treatment
Gencoa offer the following range of products & process technology for the thin film industry developed over the last 20 years:

- Planar Magnetrons
- Rotatable Magnetrons
- Pulsed Effusion Cells
- Active Anodes
- S & Se Sensor
- Remote Plasma Gas Sensing
- Reactive Gas Controllers
- Plasma Pre-Treaters
**Key Advantages**

- **GENCOA** inverted magnetron type linear ion source provides the best pre-cleaning solution combined with highly robust components:
  - Optimized magnetic fields to produce a collimated plasma beam at standard sputtering pressures.
  - Graphite anode and cathode to protect the substrate from contamination and provide long-life components.
  - RF standard electrical insulation on all ion sources.
  - In-direct cooling of anode and cathode – quick switching of parts – no breaking of water deals.
  - Easy switching of parts to provide multiple magnetic traps for lower voltage operation, or a focused beam.
  - 300 & 3000 Watt, regulated power supplies with gas adjustment feedback to maintain same current at all times.
  - Optional front side beam neutralizing.
  - Optional secondary front side gas injection system.
A plasma jet is generated by the combined closed magnetic trap, high voltage between anode and cathode, and correct pressure – gas flow through the magnetic trap.
Typically the sources operate at up to 1 Amp per meter length and at up to 100 sccm per meter length.

Gas consumption: ~ 25 to 100 sccm argon per metre length.
Lengths from 200 to 5000mm beams and internal / external mounting

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External mounting **im**300 with carbon cathode

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Internal mounting *im*400 with metal cathode and cantilever mounting

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Internal mounting **im600** with carbon cathode and end support mounting

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Internal mounting *im*800 with metal cathode and end support mounting
Internal mounting **im**800 & 250 with carbon cathode and rear support mounting
Internal mounting *im1000* with carbon cathode and end support mounting

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External mounting *im1500* with carbon cathode

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Internal mounting $im^{2500}$

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Internal mounting *im*4700 worlds longest linear ion source

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External mounting **im1500** connection and utility details

**gencoa: perfect your process**

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**Graphite Anode**

*Please do not put weight on this component.*

**Lifting Eyes**

*Will be supplied as shown (to ensure no damage during transit)*

*Can be unscrewed and placed facing atmosphere direction.*

**Support Pillar**

*Can be removed and placed on opposite side of seal plate.*

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**1/4'' SwageLock Tube Connection (Flange Cooling)**

**1/4'' Hose Barb Connection (Main Water Cooling)**

**1/4'' SwageLock VCR Connection (Gas Connection)**

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**Flange Socket with Soldered PTFE Pink Cable by Gencoa. Plug to be soldered to customers power supply cable.**

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**Dimensions:**

- **1610**
- **1650**
- **250**
- **1711**
- **430**
- **83.5**
- **207**
- **307**
- **280**
- **102**
- **28 x 218 - (1680)**

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**Notes:**

- Use M10 screws for assembly.

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Adaptors available to convert to existing port designs – MRC type shown
Standard straight beam arrangement

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Standard straight and focused beam arrangement

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im1500 External
**Typical operating parameters IM800**

**IM800 - Ion Source - Anode Voltage vs Current # graphite on**

- **Ar: 13.4 sccm**
- **Ar: 27.8 sccm**
- **Ar: 41.4 sccm**
- **Ar: 48.4 sccm**
- **Ar: 55.6 sccm**
IM400 V vs I plot for Ar flow rate (%)

- 14.7 sccm
- 21 sccm
- 28 sccm
- 34.7 sccm
- 41 sccm
- 48.5 sccm

Typical operating parameters IM400

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Linear ion sources are typically used to pre-treat before sputter coating scalable robust devices based upon DC power.

The Gencoa range of linear ion sources are a powerful means to liberate moisture and burn-off hydrocarbons before the sputter coating of the flexible web. The linear ions sources work at sputtering pressures and with web speeds of <5m/min. For higher speed webs, magnetron based plasma treaters are recommended. The 3 or 0.3 kW ion source power supply has a unique automatic gas adjustment feature to make operation of the ion source very simple.
The Gencoa im300 and im3000 power supplies automatically regulate the beam energy by automatically adjusting gas flow.

Voltage / Current Curve with power for automatic gas feedback mode for beam voltage regulation.

- 1500V Setpoint V
- 2000V Setpoint V
- 2500V Setpoint V
- 1500V Setpoint P
- 2000V Setpoint P
- 2500V Setpoint P
Comparison of wetability of un-treated and treated PET film – 1 pass.

Untreated

Treated

Comparison of wetability of un-treated and treated Polyimide PI film – 1 pass.

Untreated

Contact angle: 101°

Treated

Contact angle: 31°
Plasma surface treatment of glass with single pass at 1 m/min in front of an argon ion beam with 40 sccm gas flow.

Comparison of voltage with power and water contact angle on glass after IM1850 linear ion source 1 pass.

![Graph showing voltage vs power and contact angle](image-url)
### Typical etch rates for different materials

**Oxide etch rates:**
- Gas: Ar
- IM600, 300 mA beam @ +1.6 kV
- Example of oxide: SiOx
- Etching rate: 5 nm/min static (over 8 mm diameter substrate, total time 23 mins)

<table>
<thead>
<tr>
<th>Polymer etch rates:</th>
<th>Oxide etch rates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas: O2</td>
<td>Gas Ar</td>
</tr>
<tr>
<td>IM400: 200 mA beam @ +1.5 kV</td>
<td>IM600, 300 mA beam @ +1.6 kV</td>
</tr>
<tr>
<td>Substrate in rotation at equivalent 600mm/min linear speed (80 passes)</td>
<td>Example of oxide: SiOx</td>
</tr>
<tr>
<td>Example of polymer: silicone</td>
<td>Etching rate: 5 nm/min static (over 8 mm diameter substrate, total time 23 mins)</td>
</tr>
<tr>
<td>Etching rate ~ 20 A/pass</td>
<td>Example of polymer: acrylic</td>
</tr>
<tr>
<td>Example of polymer: acrylic</td>
<td>Etching rate ~ 38 A/pass</td>
</tr>
</tbody>
</table>

**Example of metal Ti:**
- Etching rates: 0.5-1 A/pass (170 mA @ +1.82 kV)
Ion pre-treatment is a powerful means to improve coating adhesion and device performance.

Elcometer abrasion test (ISO 11998)
• Abrasion resistance of coatings
• Rubbing in wet conditions
• Load: 100 gr.
• No. Cycles: 500
• Comparative results of coating with and without ion beam pre-treatment

Results of single pass plasma pre-treat

Sample without ion-beam pretreatment | Sample treated by ion beam
Parallel on-axis in-lens secondary electron detection

Sample not treated by ion beam

Samples without ion beam pretreatment show a hazy reflection.
Due to small bubbles (5 mm) in the coating.

Sample with ion-beam pre-treatment

After the tempering process no visible defects were detected on the coating.
SEM analysis confirm the good state of the coating.
Robust mechanical design, easy to access and connect
Long operating lifetime, very easy to service and maintain

No water or vacuum seal broken during anode / cathode change, typically 2 hours for full conversion from straight beam to focused beam mode.
Gencoa provide a unique customer built power supply that automatically regulates the gas flow for ease of operation (300 & 3000 w)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output voltage</strong></td>
<td>Up to 2500V (3000V ignition voltage)</td>
</tr>
<tr>
<td><strong>Output current</strong></td>
<td>2 A @ 2000V, short circuit 2.5A</td>
</tr>
<tr>
<td><strong>Output Power</strong></td>
<td>4000W @ 2000V</td>
</tr>
<tr>
<td><strong>Output polarity</strong></td>
<td>Positive</td>
</tr>
<tr>
<td><strong>Regulation Mode</strong></td>
<td>Current 0-2.5A</td>
</tr>
<tr>
<td><strong>Output connector</strong></td>
<td>Fischer, type 105, 10kV rating for RG213 coax cable</td>
</tr>
<tr>
<td><strong>Mains input</strong></td>
<td>3x400Vac +/- 10% 50Hz (L1,L2,L3 PE)</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>Standard Rack 19” 4U=177mm High</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>12kg</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td>Forced air cooling</td>
</tr>
<tr>
<td><strong>Working temperature</strong></td>
<td>15-35°C</td>
</tr>
</tbody>
</table>
**IM300 power supply for smaller sized linear ion sources 500mm long or lower power longer beams**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footprint</td>
<td>3U1 rack mount L=240mm H=178mm D=300mm</td>
</tr>
<tr>
<td>Supply</td>
<td>220 AC or 110 ac switch selector inside max 600va</td>
</tr>
<tr>
<td>Voltage strike</td>
<td>Greater than 3kV, positive</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>2500V – 200mA - 500Watts</td>
</tr>
<tr>
<td>Short circuit current</td>
<td>Minimum 400mA</td>
</tr>
<tr>
<td>Inverter frequency</td>
<td>36kHz</td>
</tr>
<tr>
<td>Power input connector</td>
<td>Computer type 1P + N + GND or 2P + N + GND (additional earth recommended)</td>
</tr>
<tr>
<td>Regulation mode</td>
<td>Current 0 to 400mA – 0.5 mA resolution</td>
</tr>
<tr>
<td>Analog inputs</td>
<td>AD and DA converters with 12 bits resolution</td>
</tr>
<tr>
<td>Output connector</td>
<td>Panel Mount SHV Connector</td>
</tr>
<tr>
<td>Mass flow controllers outputs</td>
<td>2 channels, analog 0 to 5V (setpoint), supply +/-15V, max supply power 10 Watts. Only to be used with Gencoa’s Speedflo to MFC cable (ready for MKS1179A type)</td>
</tr>
<tr>
<td>MFC interface</td>
<td>2x9 pin standard GENCOA pinout</td>
</tr>
<tr>
<td>Display</td>
<td>Touch screen display, 240x 128 pixel</td>
</tr>
<tr>
<td>Data entry</td>
<td>Touch screen + encoder on front panel</td>
</tr>
<tr>
<td>Interlock /remote</td>
<td>25 pin D-type interlock, remote ON/OFF, beam_good bit, output is ON bit</td>
</tr>
<tr>
<td>RS232 interface</td>
<td>9 pin female, see below for accessible data</td>
</tr>
<tr>
<td>Regulation mode</td>
<td>Internal:Constant gas flow or gas feedback (constant voltage) External:R232 or analog user port</td>
</tr>
</tbody>
</table>
Schematic of the ion source with power supply and automatic gas regulation

Removes beam variation – I & V regulated

**IMCOA:** perfect your process

Power Supply

IM-3000-BDS-VT

Power Cable

MFC cable (for MKS's MFC), D9-D15 Shielded

MKS MFC

Gencoa IM

Chamber

Pump

Gas

MFC Spec:
MKS 1179A
Db15
±15V
Schematic of the ion source with power supply and automatic gas regulation

Of more than 1 gas type – needs speedflo mini IM-3000-BDS-VT

- Chamber
- GENCOA IM
- Pump
- Gas Line
- Speedflo Cable
- High Power Cable
- Voltage feedthru cable

Gas 1
- MKS MFC1
- IM Voltage Feedback (0-10V)

Gas 2
- MKS MFC2

Gas 3
- MKS MFC3
IM600 at 300mA - gas Ar - Example of voltage tracking feature via auto control of gas

- Started in constant flow and not feedback
- Then switched to feedback control to maintain both current and voltage of the Ion Source

1.6 kV maintained by auto-gas feedback

- Sensor (V)
- SetPoint (V)
- Actuator (%)

Time, s
Any length of plasma beam is available and a variety of mounting options

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Also available as a circular ion source with 75mm diameter beam
Gencoa IM75 plasma source for Research and Development

A powerful new tool for thin film research.
Fits into the space of a typical magnetron and has head tilt adjustment.
Self neutralized plasma - no substrate surface charging.
Variable plasma energy.
Automatic gas feedback control via the IM300 power supply (any gas).
Robust design with no maintenance.
Can replace RF substrate etching.
Multiple uses - ion assistance, patterning, pre-cleaning, coating stripping, PECVD
The full range of Gencoa Plasma Generation and Pre-treatment Products

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<table>
<thead>
<tr>
<th>Plasma Treatment Product Categories:</th>
<th>Application / use</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Linear ion sources</td>
<td>Low speed web &amp; glass</td>
</tr>
<tr>
<td><em>DC magnetron based plasma treaters</em></td>
<td>Low to High speed / power</td>
</tr>
<tr>
<td><em>AC type plasma cleaning sources</em></td>
<td>Low to High speed / power</td>
</tr>
<tr>
<td><em>AC type gas activation sources – O2 plasma generation for reactive gas reactions</em></td>
<td>Low to High speed / power</td>
</tr>
<tr>
<td><em>Hipims</em>+ positive beam ion etching</td>
<td>Etching of metallic substrates</td>
</tr>
<tr>
<td><em>Positive pulsed power inverted magnetron metal strip etching source</em></td>
<td>Etching of metallic plate or web</td>
</tr>
</tbody>
</table>

DC, AC and *Hipims*+ power supplies included in plasma source packages (magnetron based PSU can be customer supplied)
DC power mode is less expensive than AC as a single cathode is used
AC power mode requires 2 electrodes and uses magnet enhancement for higher plasma density – AC better arc suppression than DC – AC better suited to environments with high ‘moisture’ content
*Hipims*+ positive ion etching technology covered by Gencoa patent application
Standard straight and focused beam arrangements

Different kinds of plasma sources from Gencoa