



# thin film and pvsolutions

gencoa

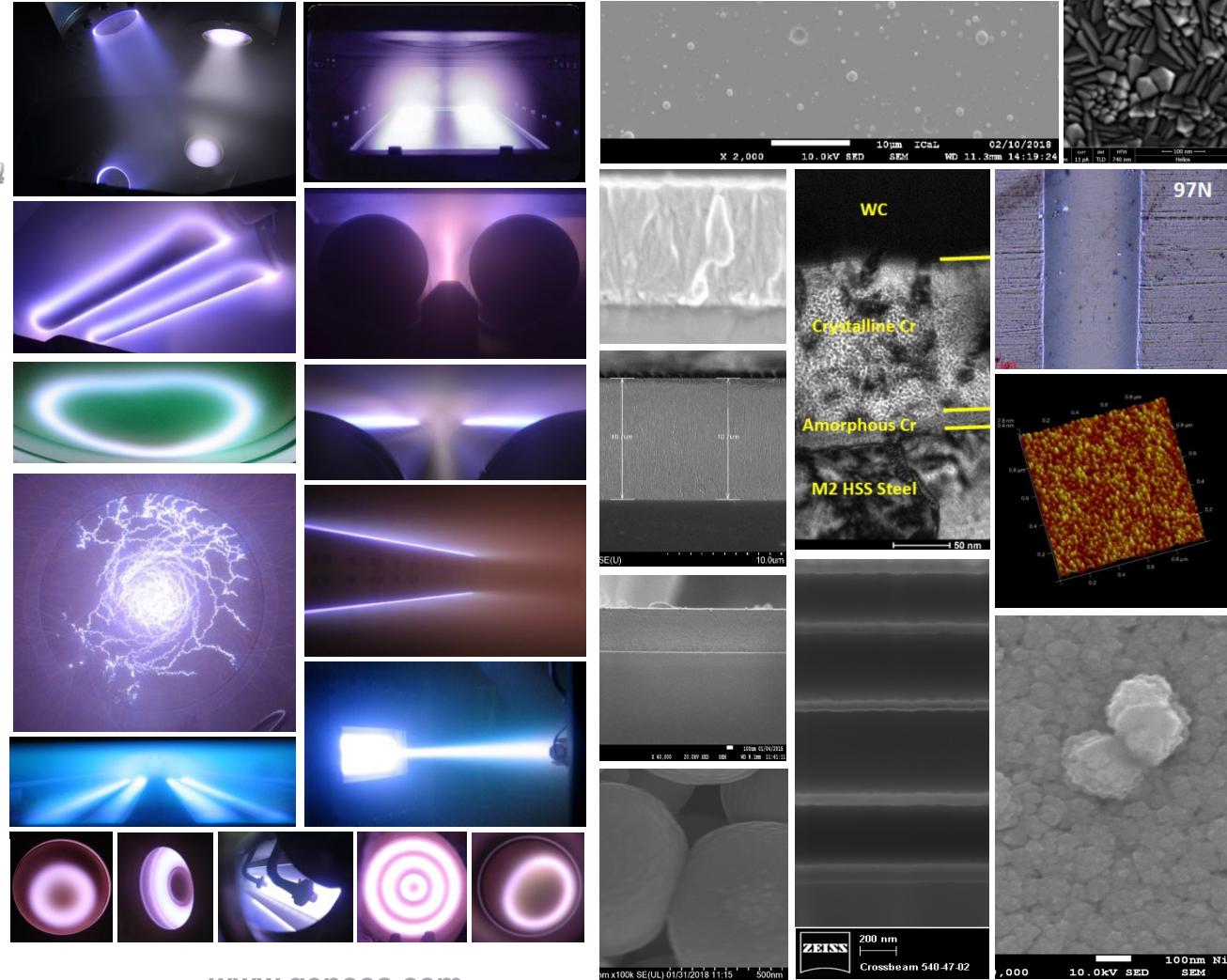
components for sputter  
deposition, process control  
and plasma treatment





# 27 Years of Products and Technology from Gencoа

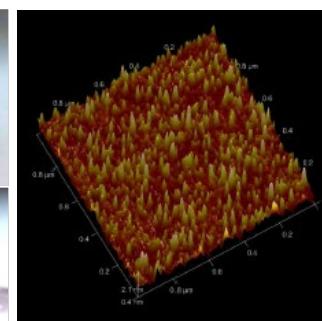
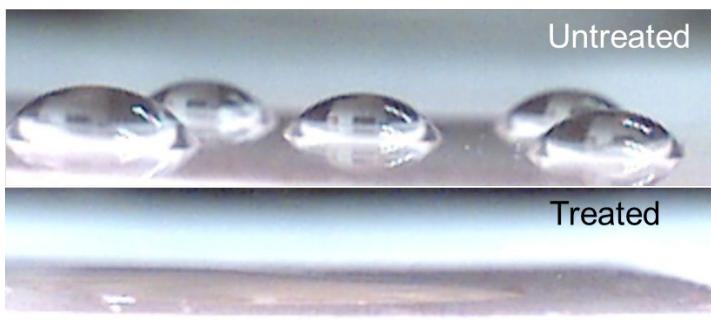
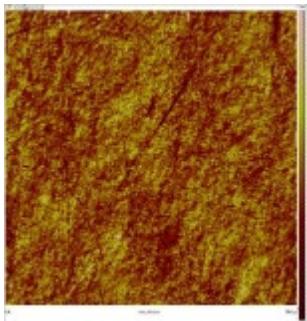
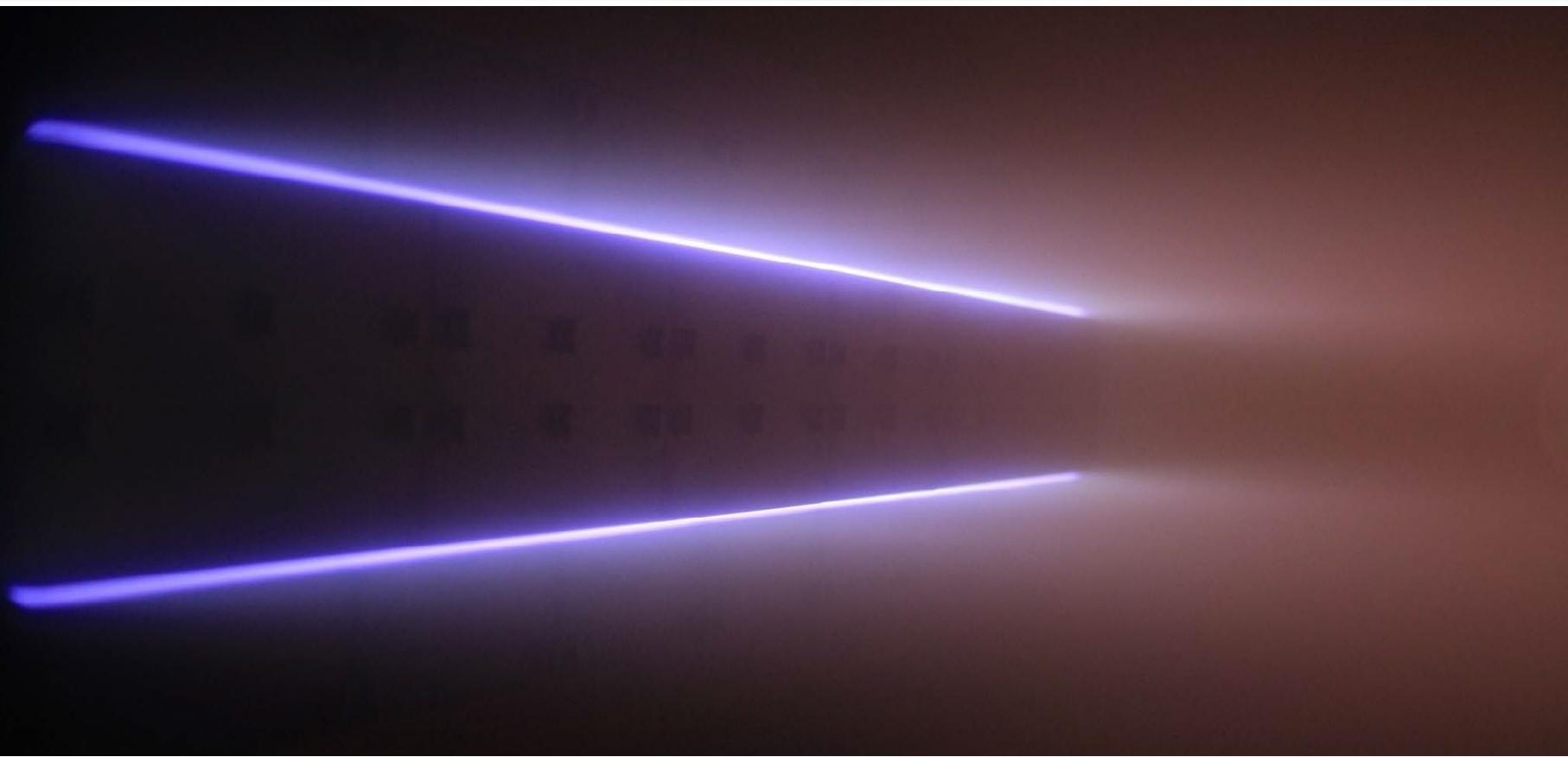
Rotatable & Planar Magnetron Sputter Cathodes • Retrofit magnetic packs • Plasma Treaters  
• Speedflo Reactive Gas Controllers • IM Ion Sources & power supplies • Arc MAX sources &  
power supplies • Active Anodes and Gas Delivery Bars • OPTIX Gas and Chemical Sensing • S  
and Se Sensor • PEC Pulsed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





Gencoa offer the following range of products & process technology for the thin film industry developed over the last 20 years

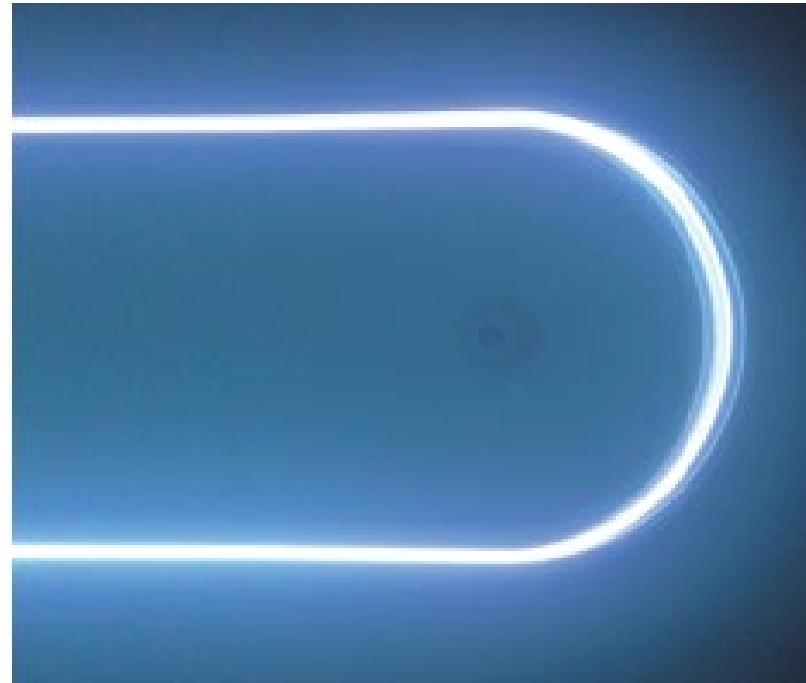
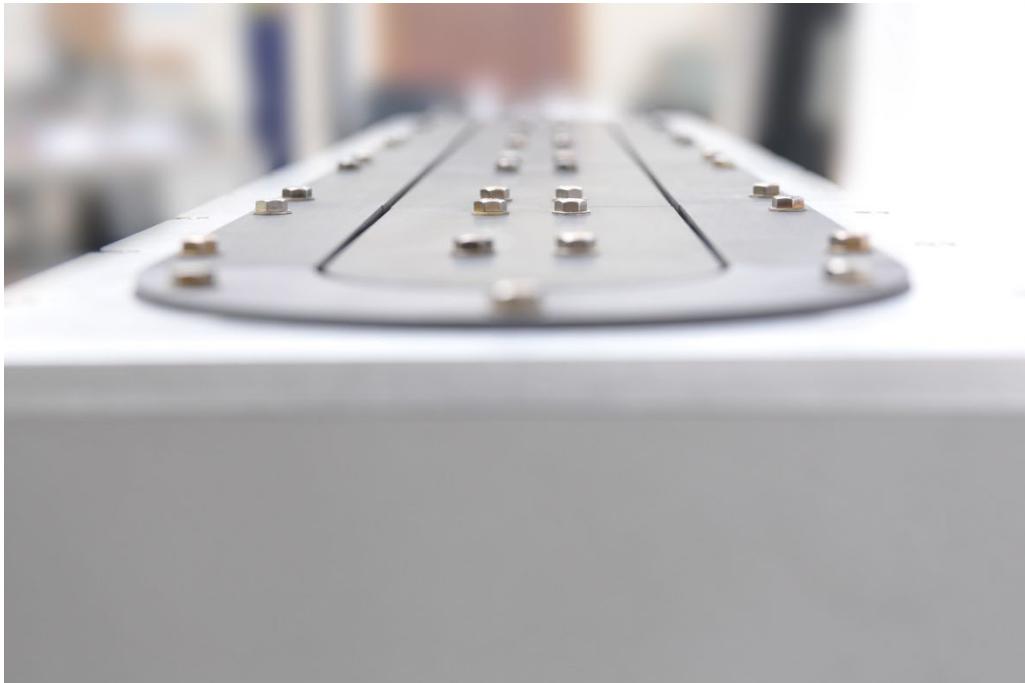






# Linear ion sources

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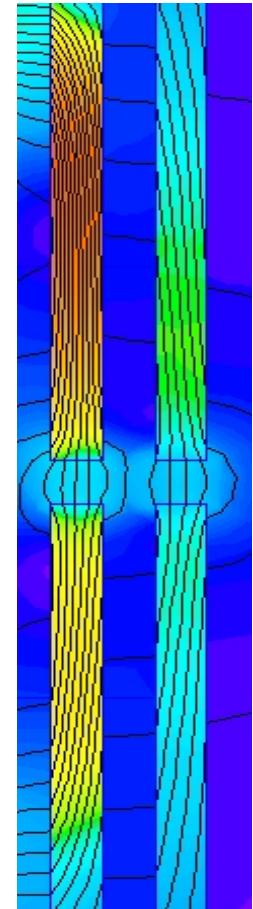


# Linear ion sources

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## 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.



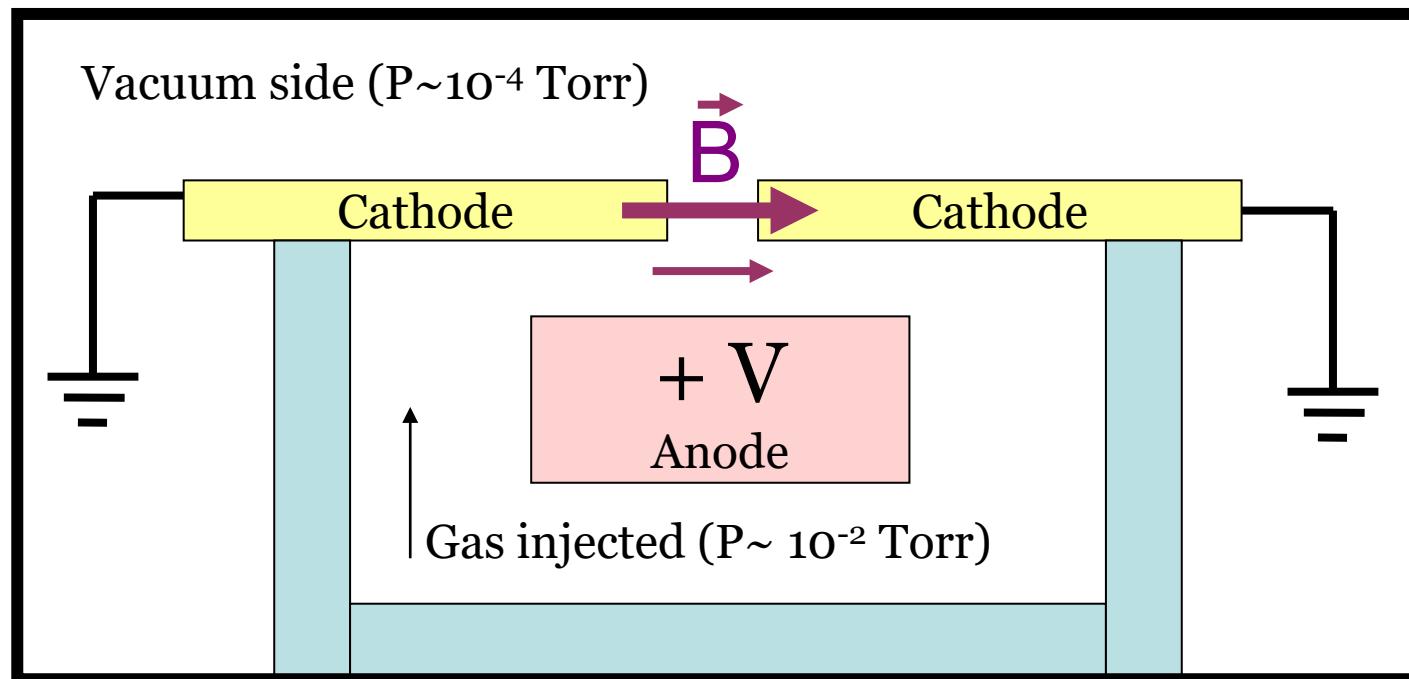
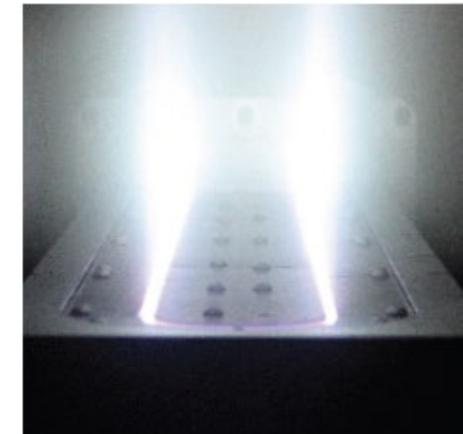
# Linear ion sources

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Concept of operation based upon space plasma

thruster devices – simplified schematic of operation

- 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.

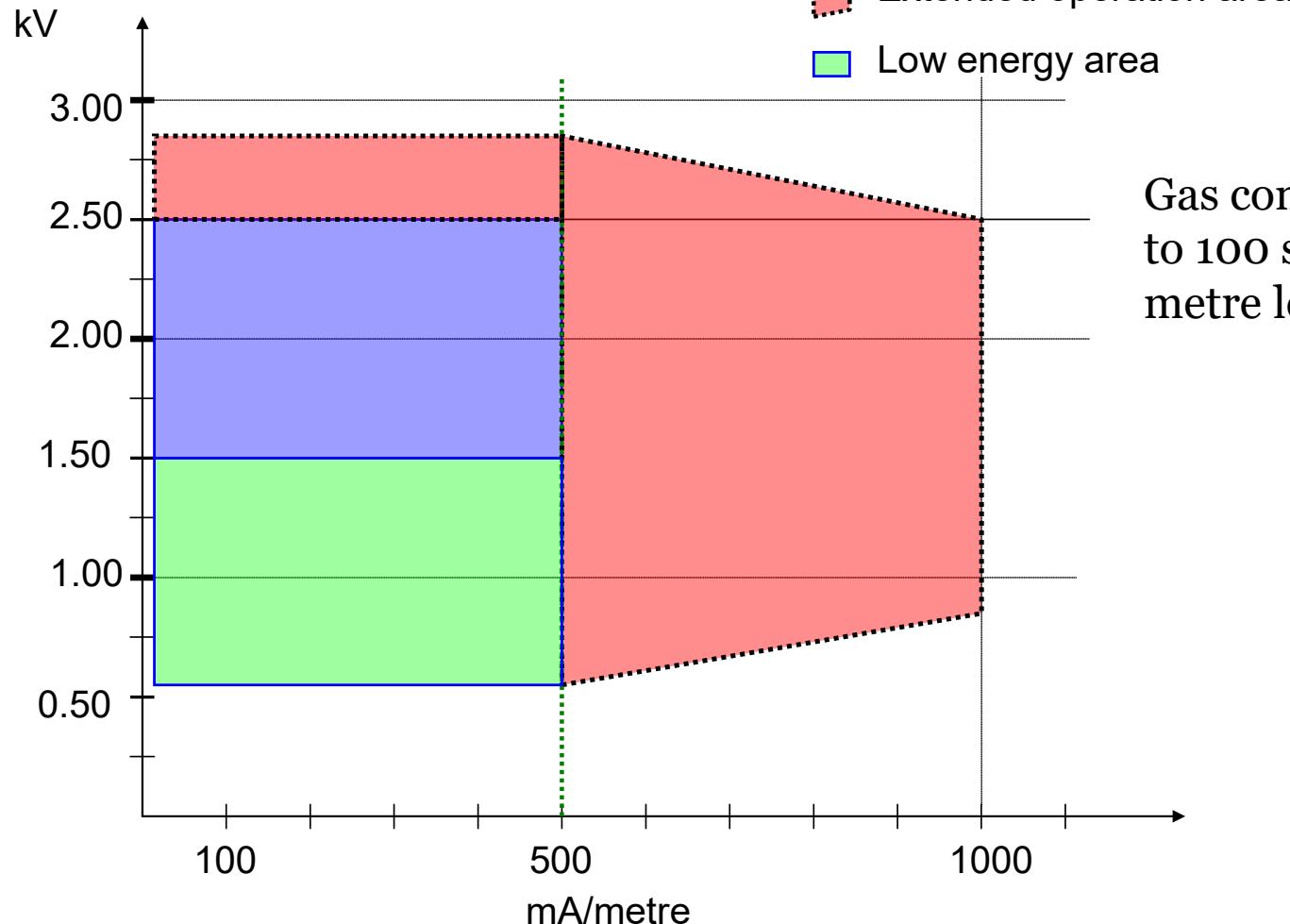


Typically the sources operate at upto 1 Amp per meter length and at upto 100 sccm

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per meter length

Operation range for the IM source



Gas consumption: ~ 25  
to 100 sccm argon per  
metre length



Lengths from 200 to 5000mm beams and internal / external mounting

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Carbon based beam generation / extraction



## Why carbon cathode and anode?

- Very low sputter yield hence long lifetime compared to metallic components
- Compatible with Oxygen gas mixtures which are the most effective in terms of pre-treatment
- Produces a neutralised beam with O<sub>2</sub> gas present – oxygen and carbon ideal partner for electron tunnelling quantum effect which is essential for beam neutrality
- Metallic parts suffer from loss of conductivity with oxygen present and hence loss of beam neutrality – arcing on substrate



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

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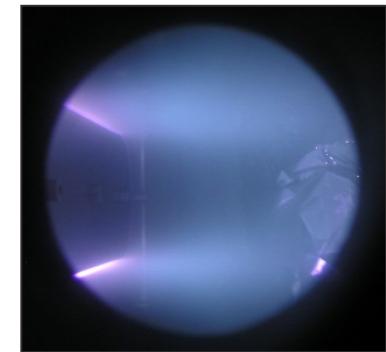
# Internal mounting **im**600 with carbon cathode and end support mounting

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# Internal mounting **im**800 with metal cathode and end support mounting

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Internal mounting **im**800 & 250 with carbon cathode and rear

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support mounting



# Internal mounting **im**1000 with carbon cathode and end support mounting

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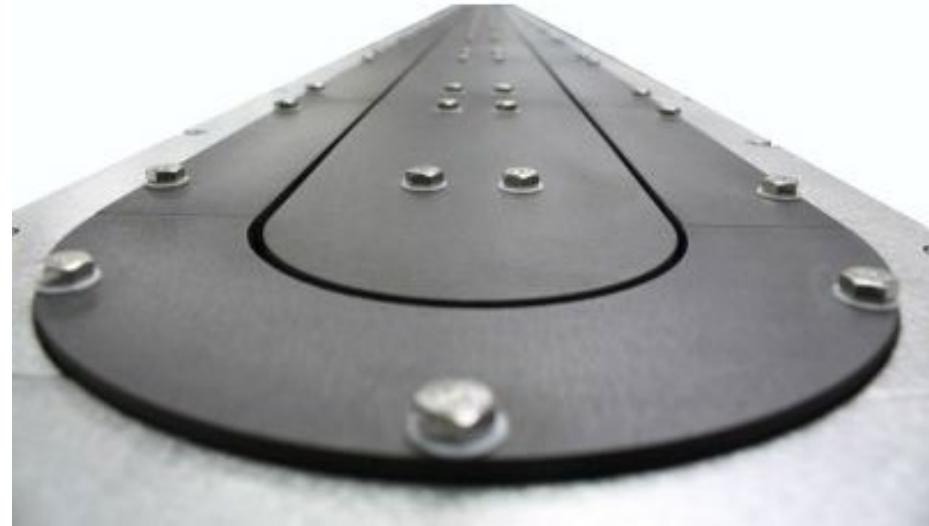
# External mounting ***im*1500** with carbon cathode

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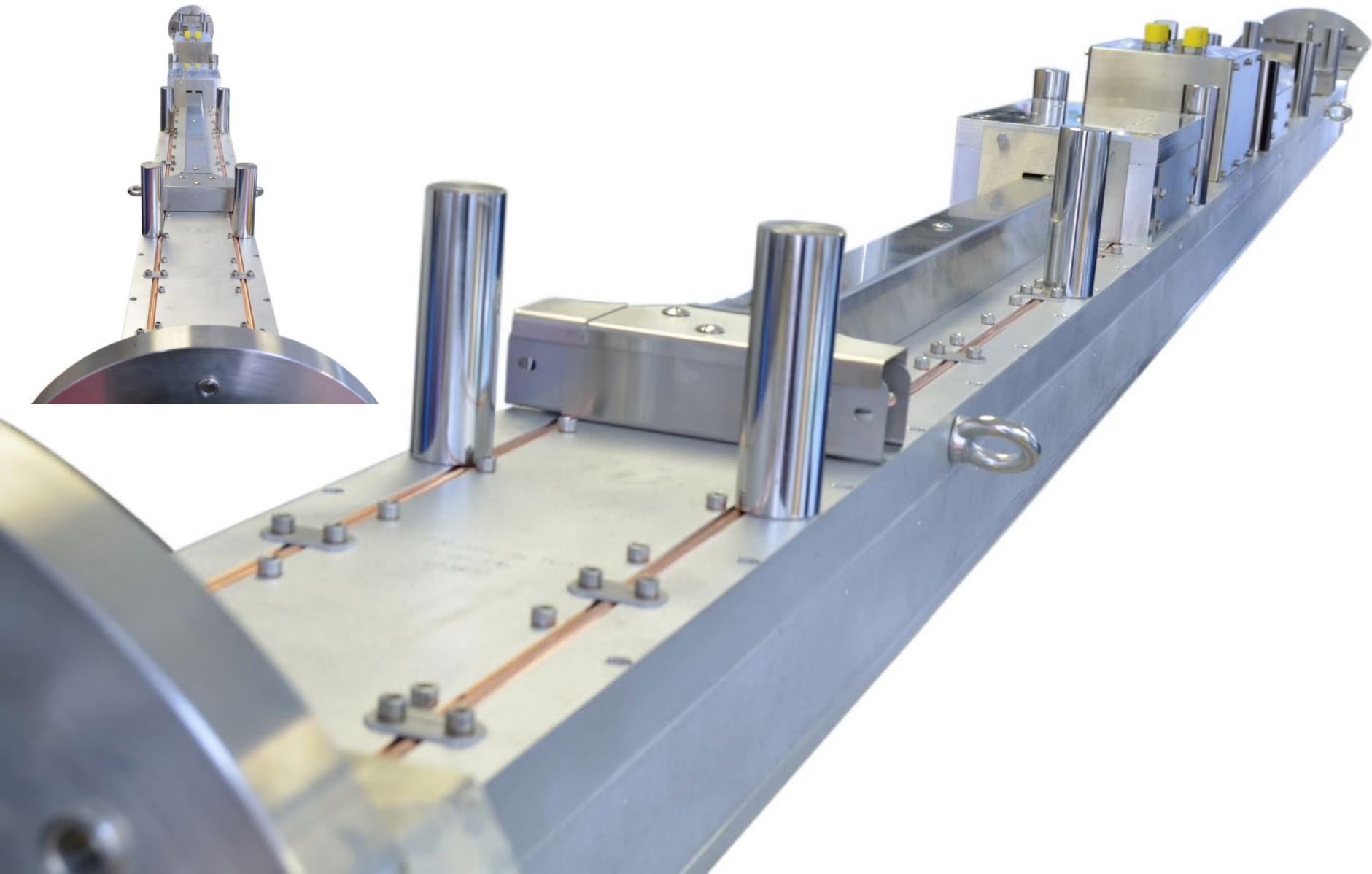
# Internal mounting **im**2500

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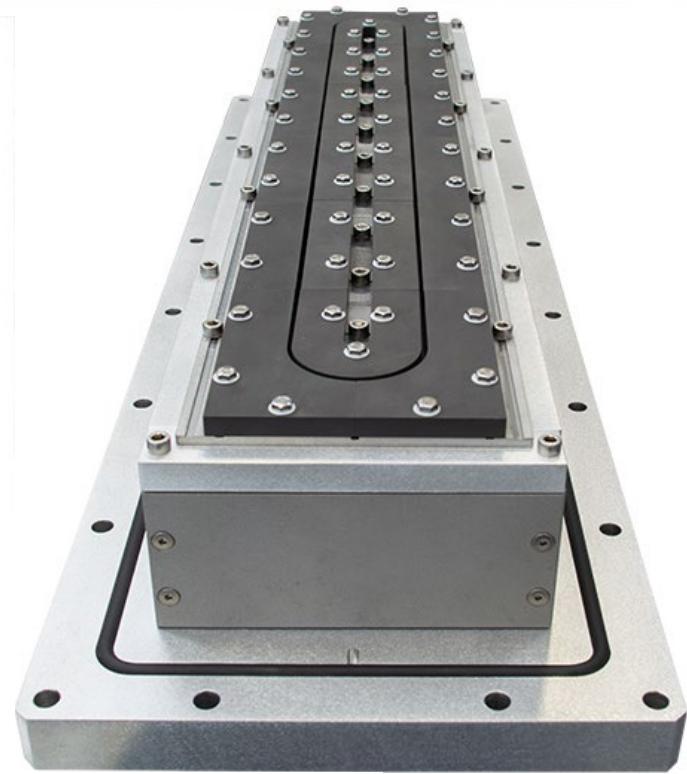
# Internal mounting **im**4700 worlds longest linear ion source

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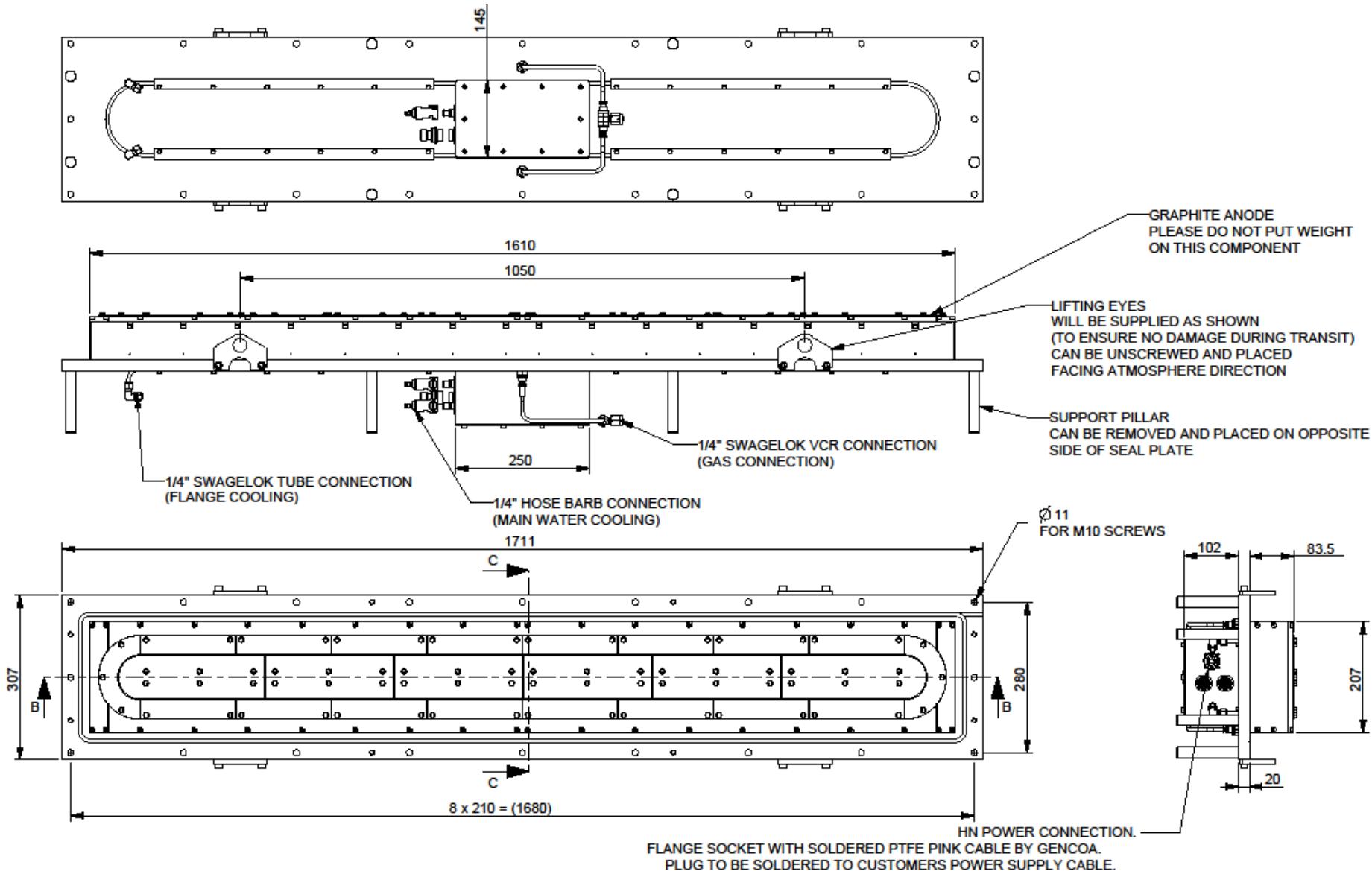
2020 onwards a more compact source design is produced

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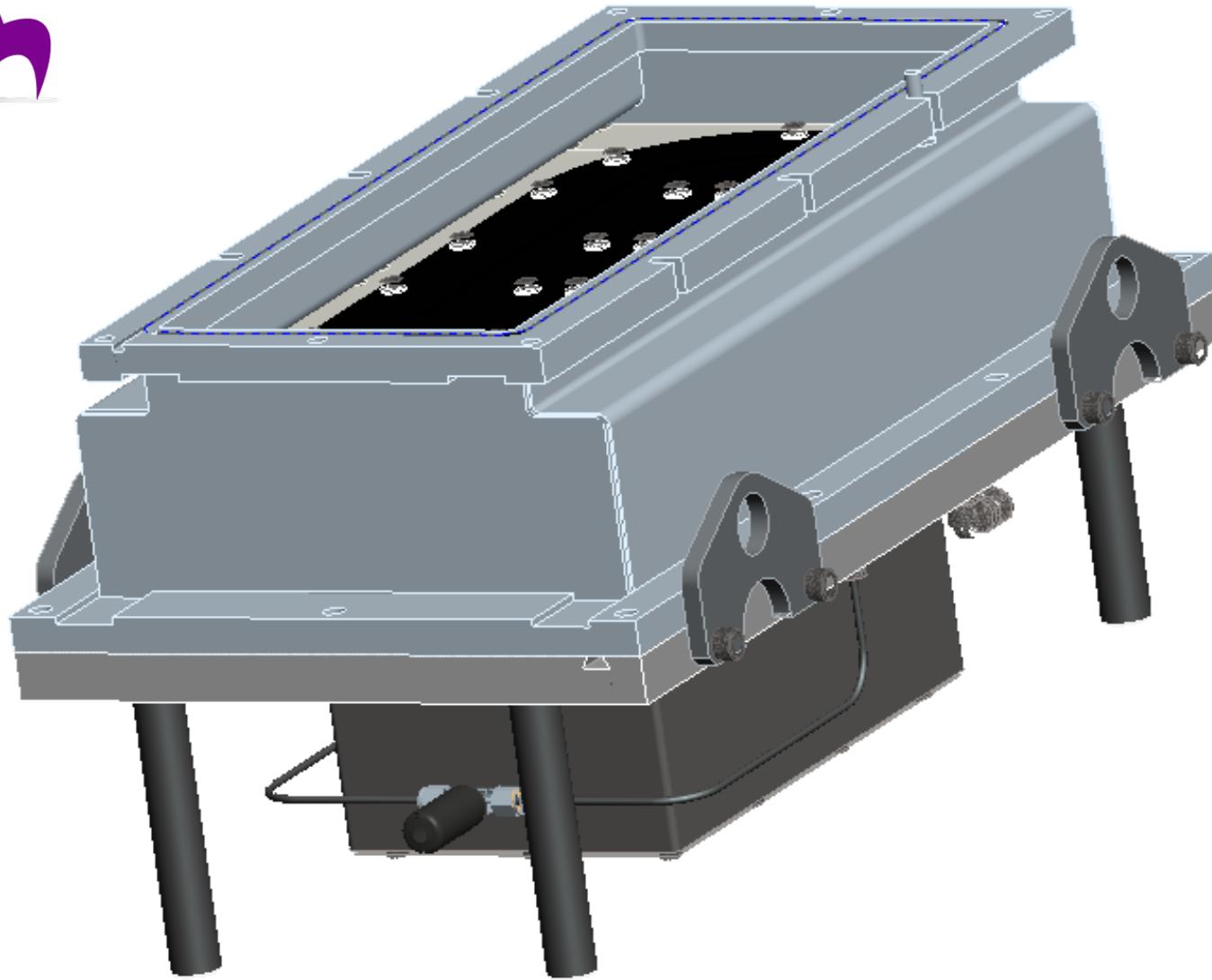
# External mounting **im**1500 connection and utility details

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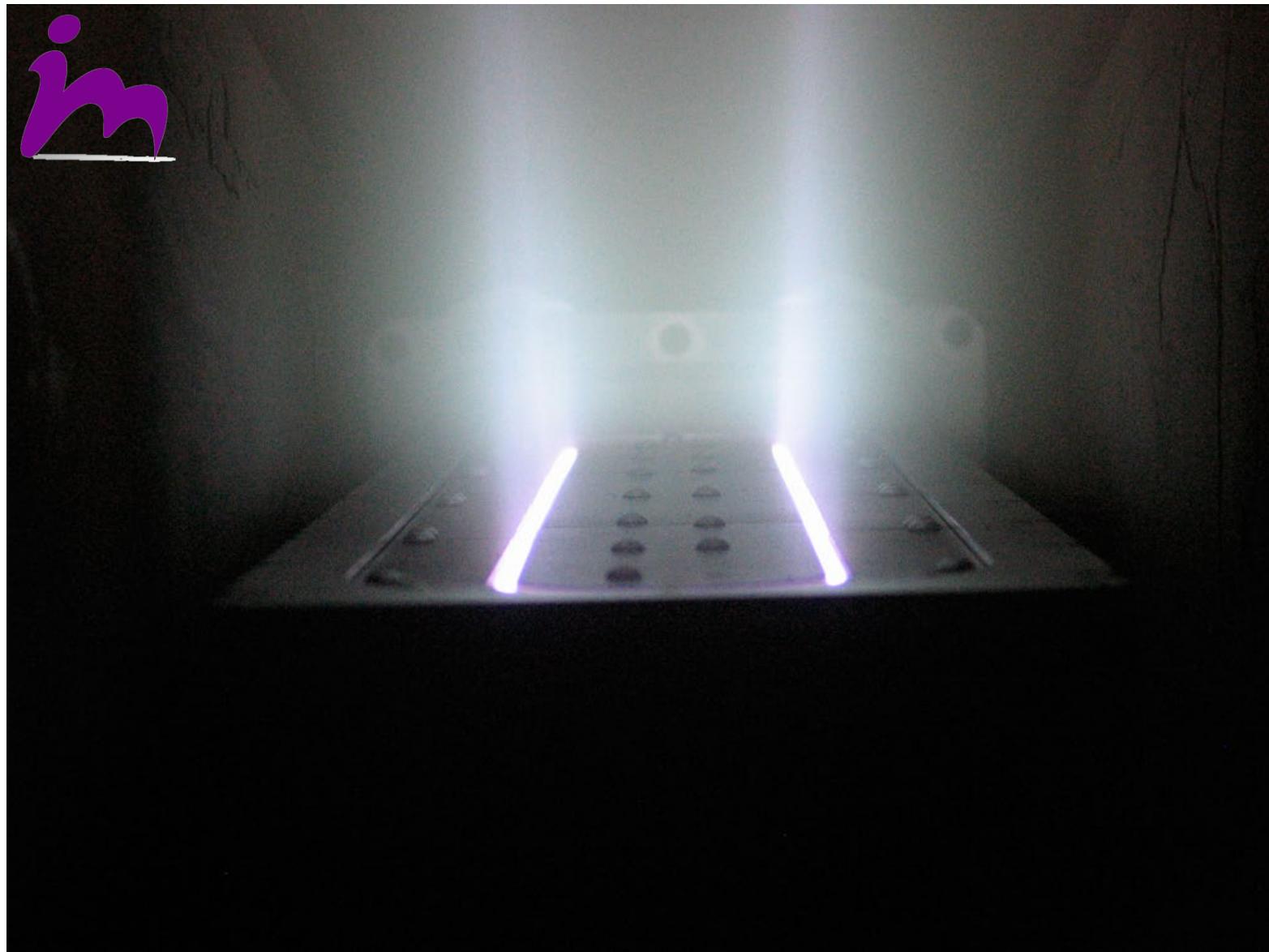
Adaptors available to convert to existing port designs – MRC type shown

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# Standard straight beam arrangement

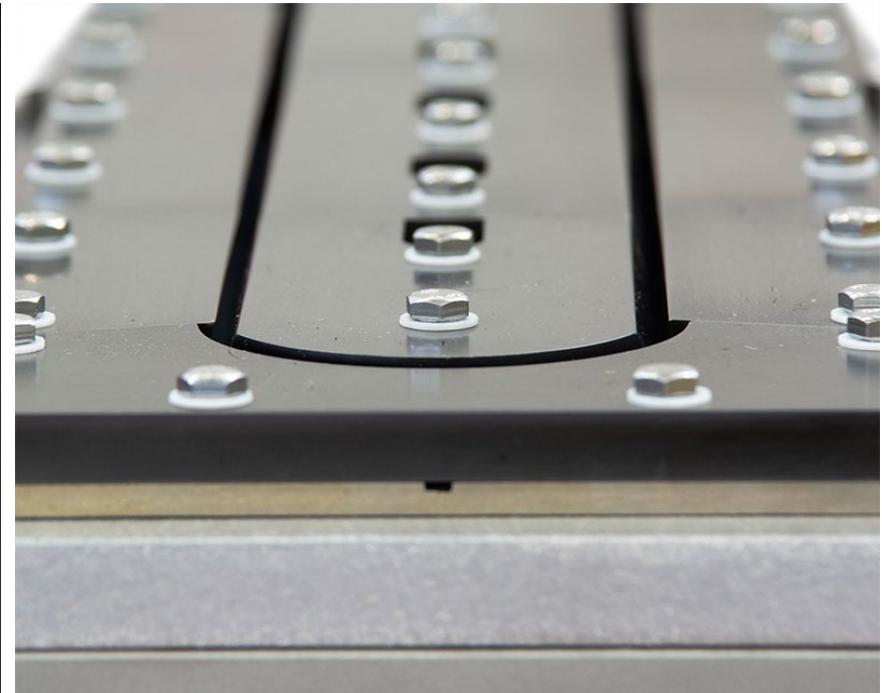
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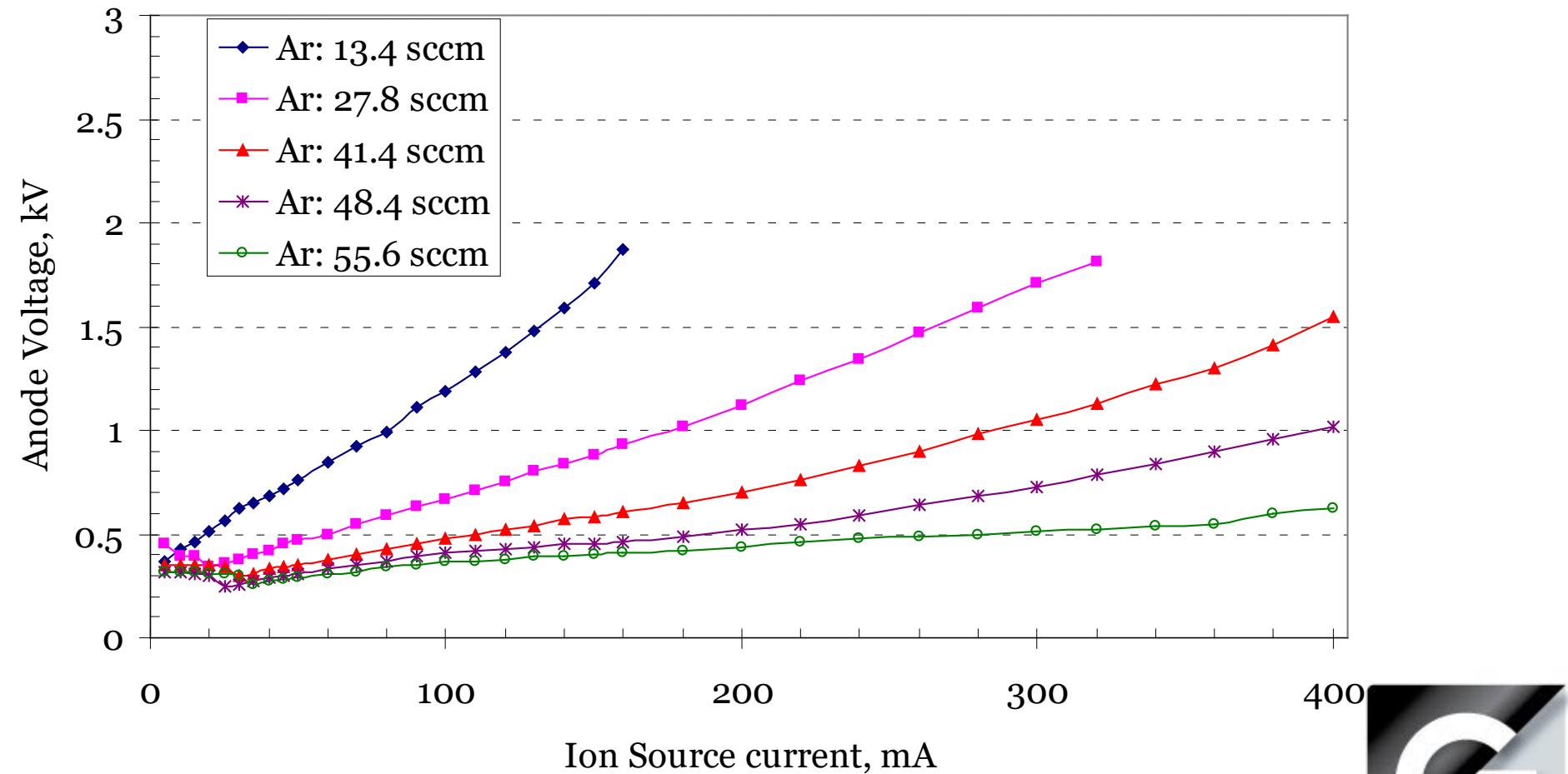
# Standard straight and focused beam arrangement

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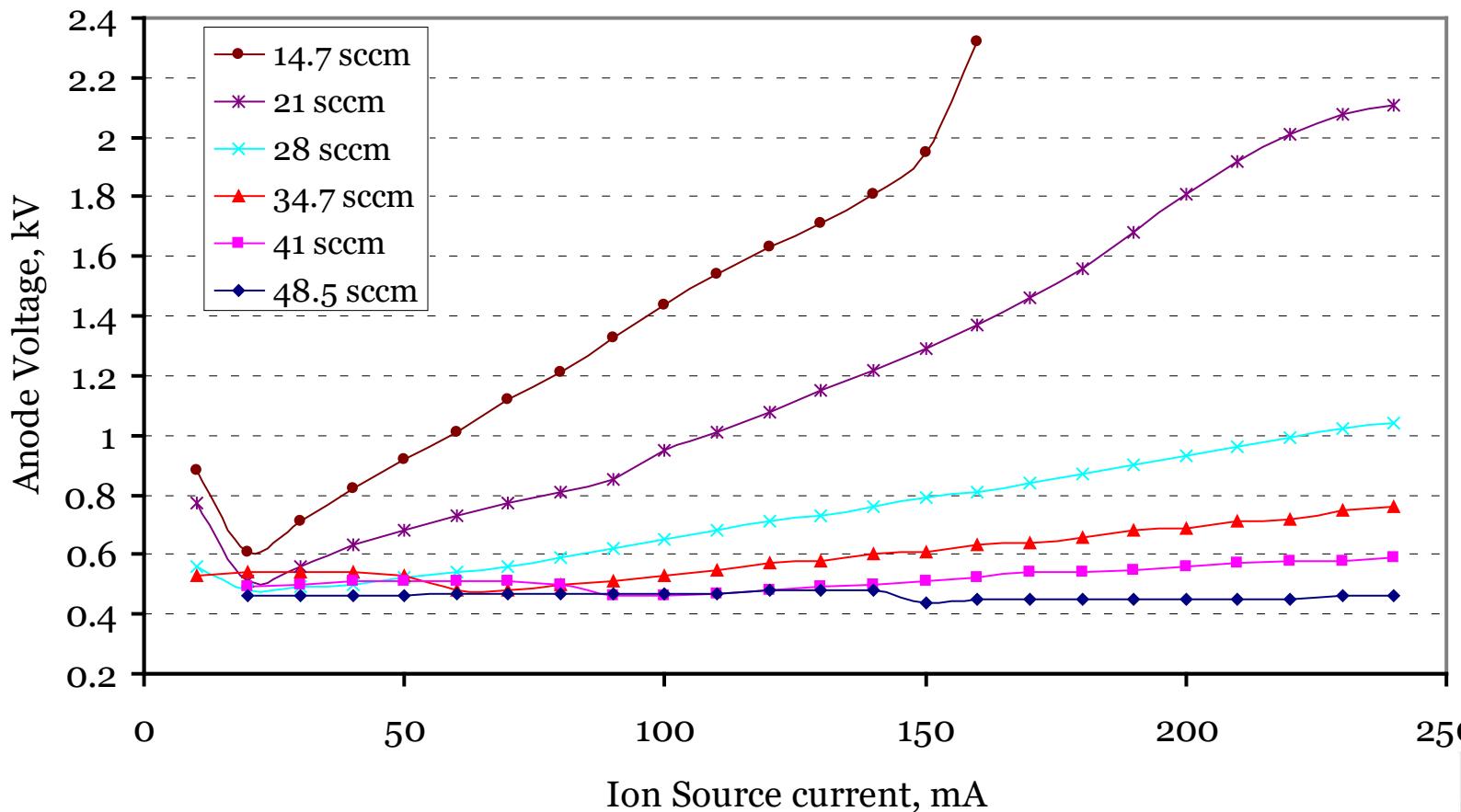
***im*1500 External**



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



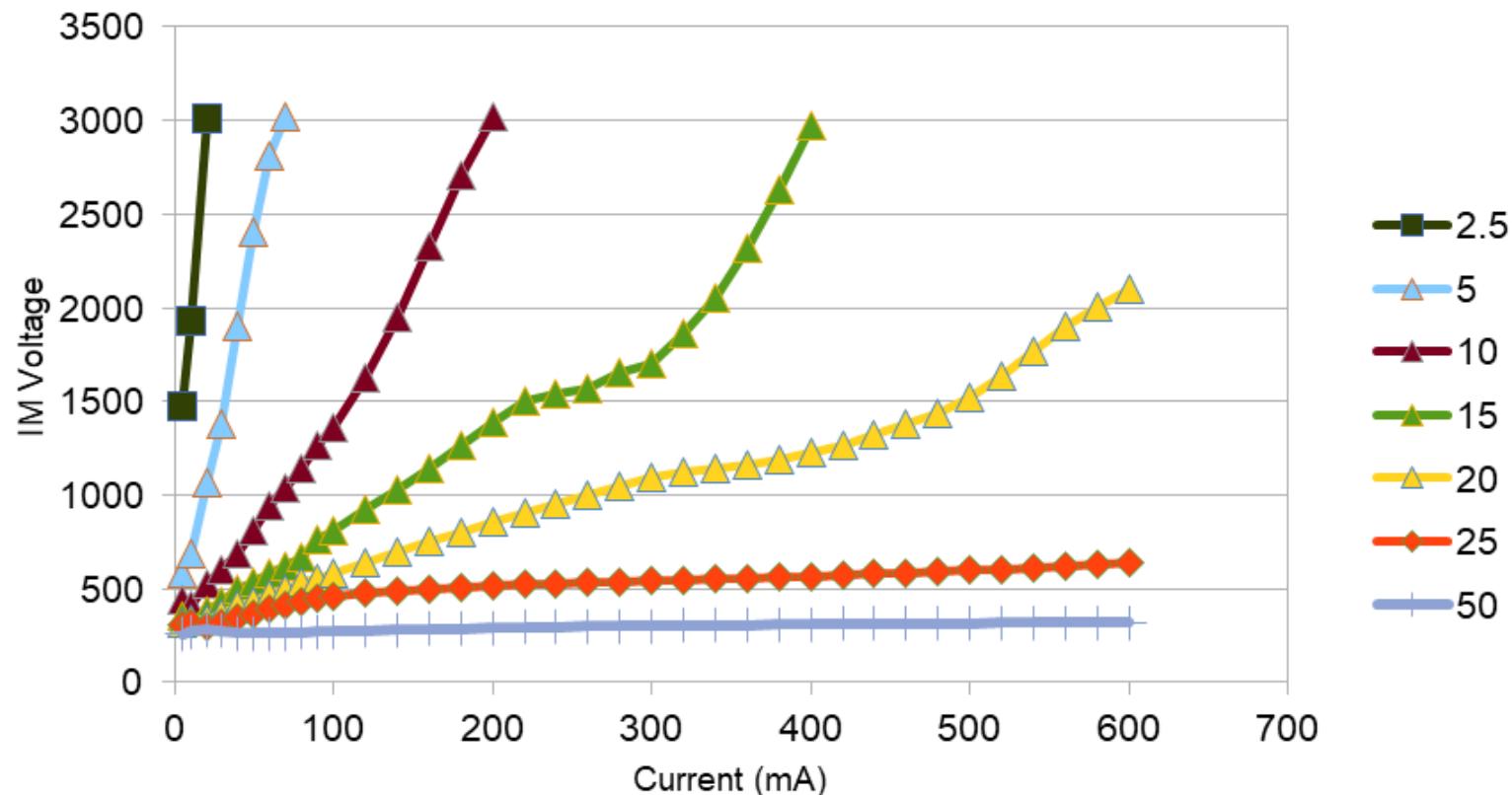
## IM400 V vs I plot for Ar flow rate (%)



Linear Ion Sources uses DC power so easy to scale and low cost. Also very flexible – can operate in high or low voltage modes to adjust the impact energy on the substrate.

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### IM900 conventional mode Ar only V vs I - for a range of Ar flow (sccm)

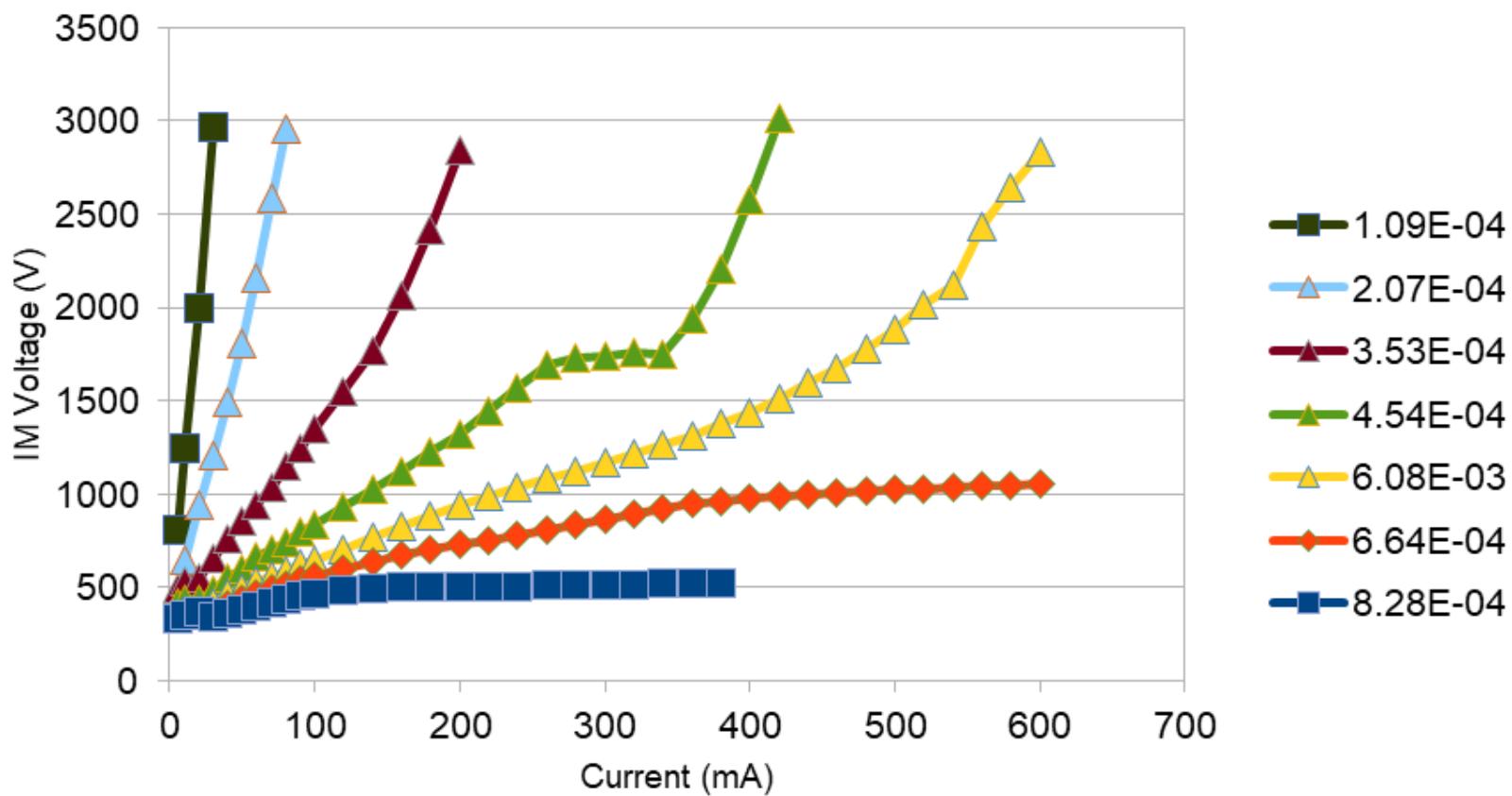


The average energy of the beam is 50% of the ion source discharge voltage as shown on the x axis, hence in low voltage mode, beam energy is only 150 volts. Please note beam is collimated over entire range.

By adding some argon to the oxygen gas the lower voltage mode is possible although 100% argon gives the lowest voltage of operation

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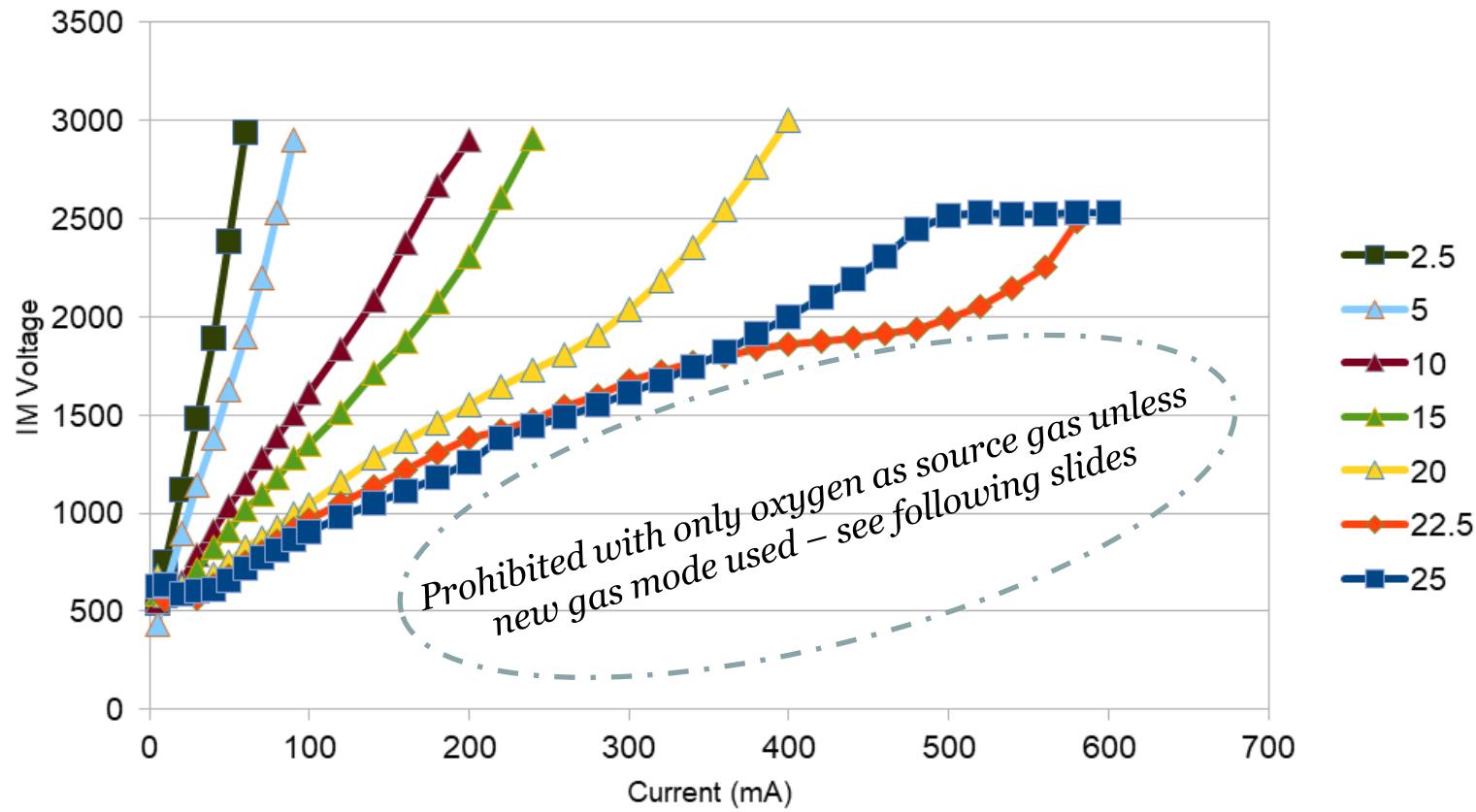
IM900 conventional mode 70% Ar + 30% O<sub>2</sub> only V vs I at across pressure range



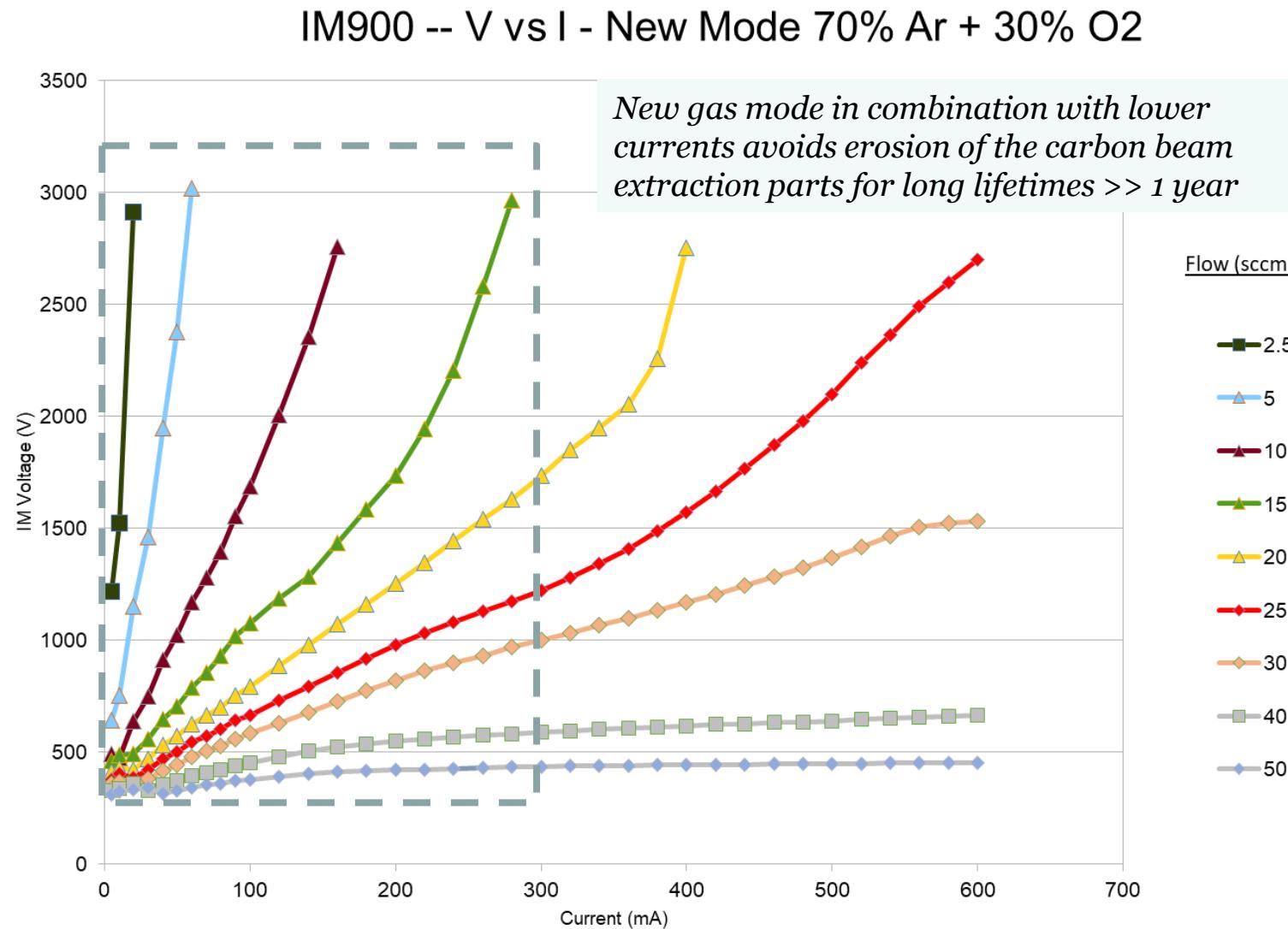
Linear Ion Sources can use any gas or mixture of gases, but with only oxygen gas the low voltage mode is prohibited

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IM900 conventional mode O<sub>2</sub> only V vs I for a range of O<sub>2</sub> flow (sccm)



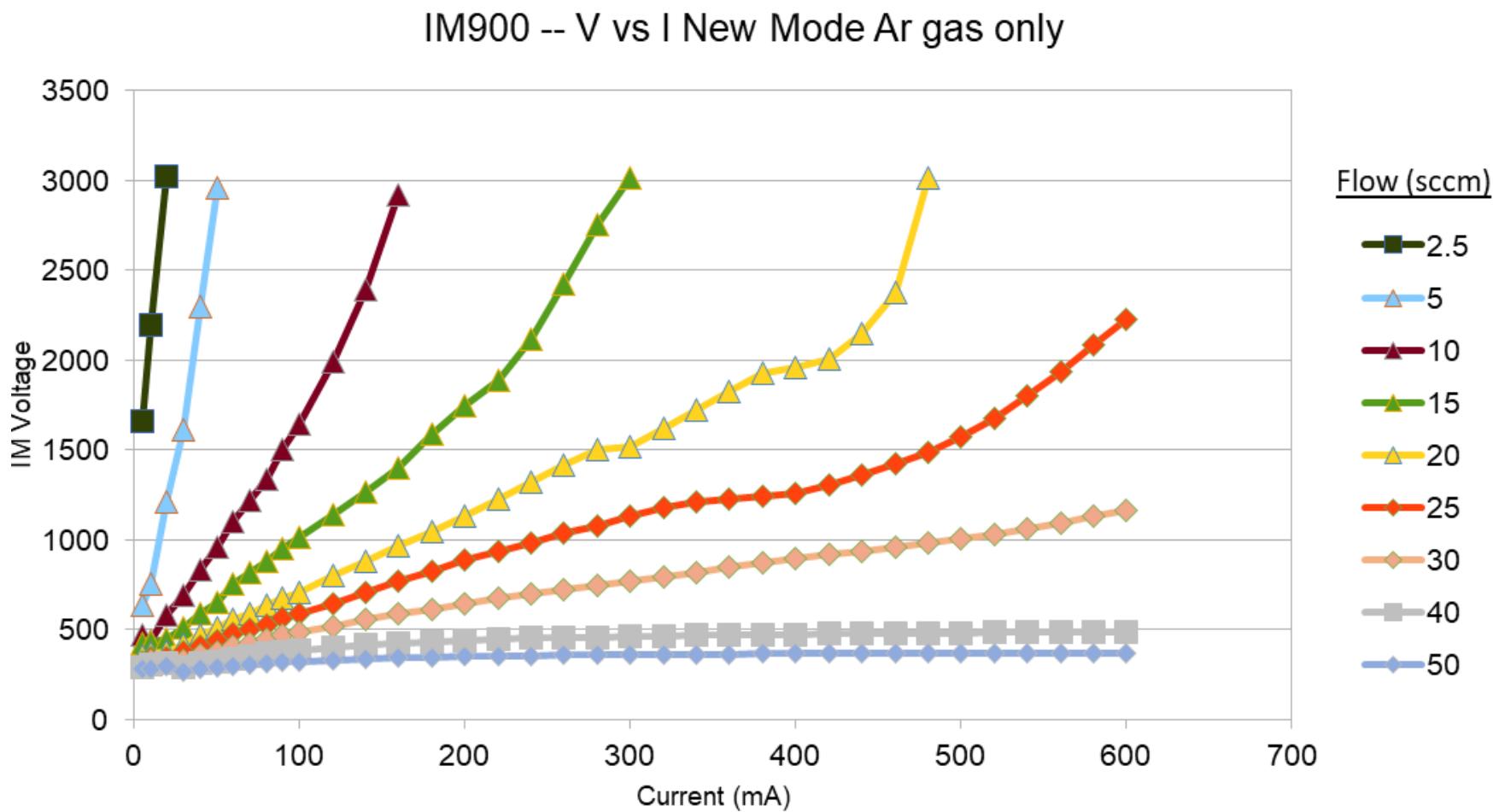
Introducing a ‘New’ gas mode of operation which largely avoids source maintenance which makes the linear ion sources very convenient to use



New mode gas delivery operates in a similar way to conventional mode and both types can be fitted to a linear ion source with low voltage mode still produces a collimated beam

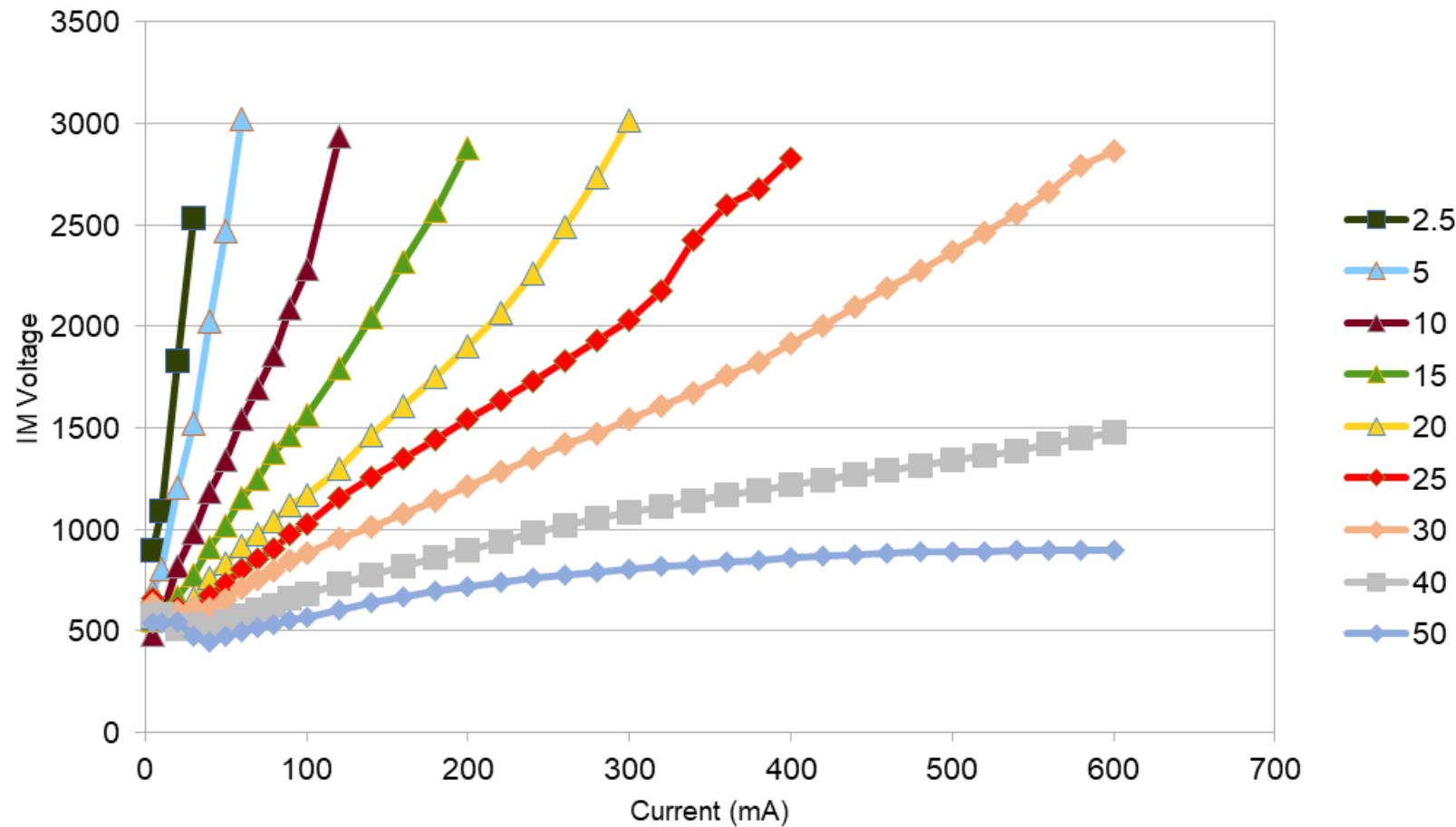
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voltage mode still produces a collimated beam



New mode gas delivery with pure oxygen runs at lower discharge voltages compared to the conventional mode, hence lower impact energies possible with pure oxygen.

IM900 New Mode O<sub>2</sub> only V vs I for a range of O<sub>2</sub> flow (sccm)



*Adding some percentage of Argon gas required for <500V*

# Linear ion sources are typically used to pre-treat before sputter coating

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## scalable robust devices based upon DC power



The Genco 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.

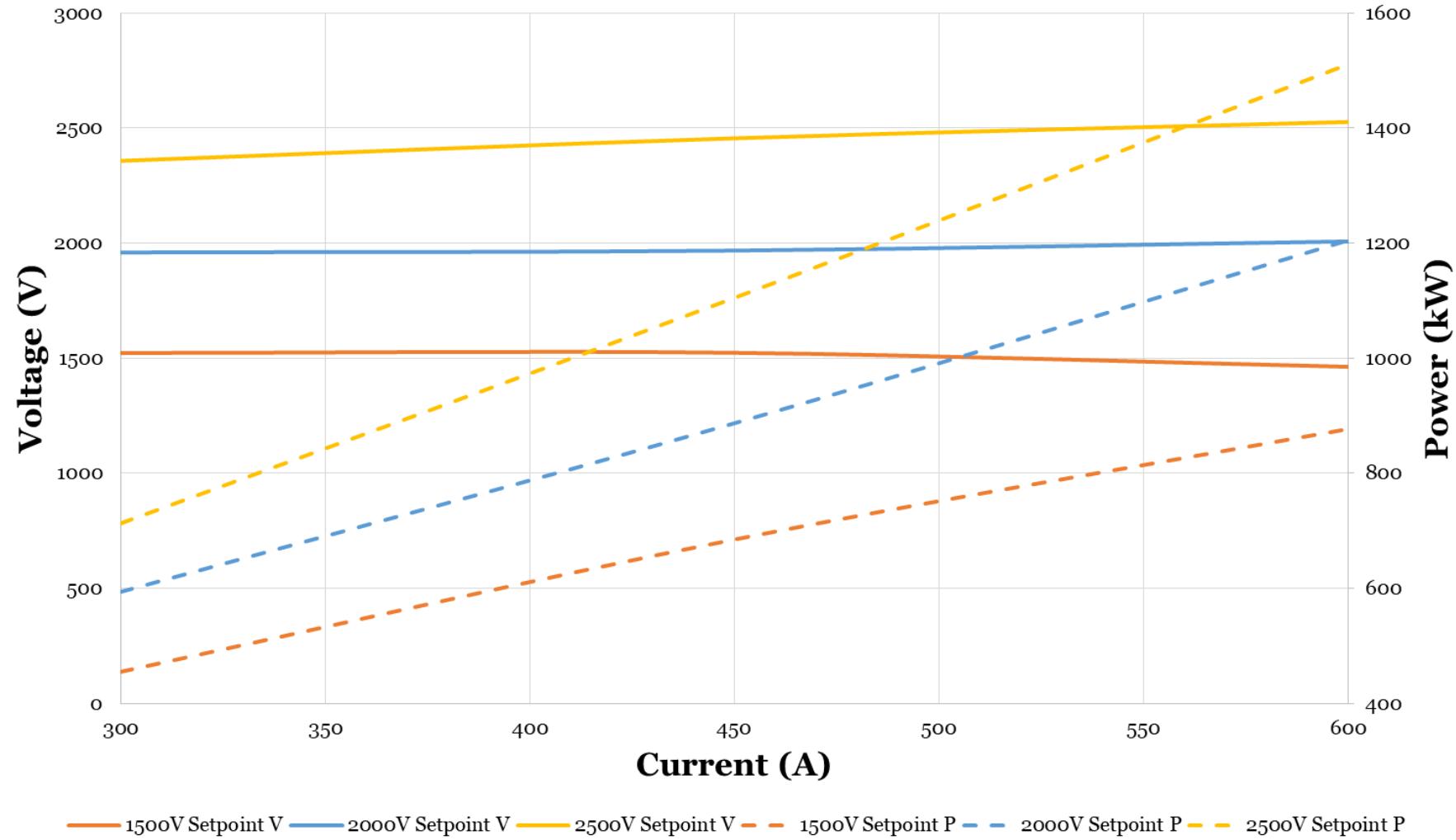


The Genco im300 and im3000 power supplies automatically regulate the

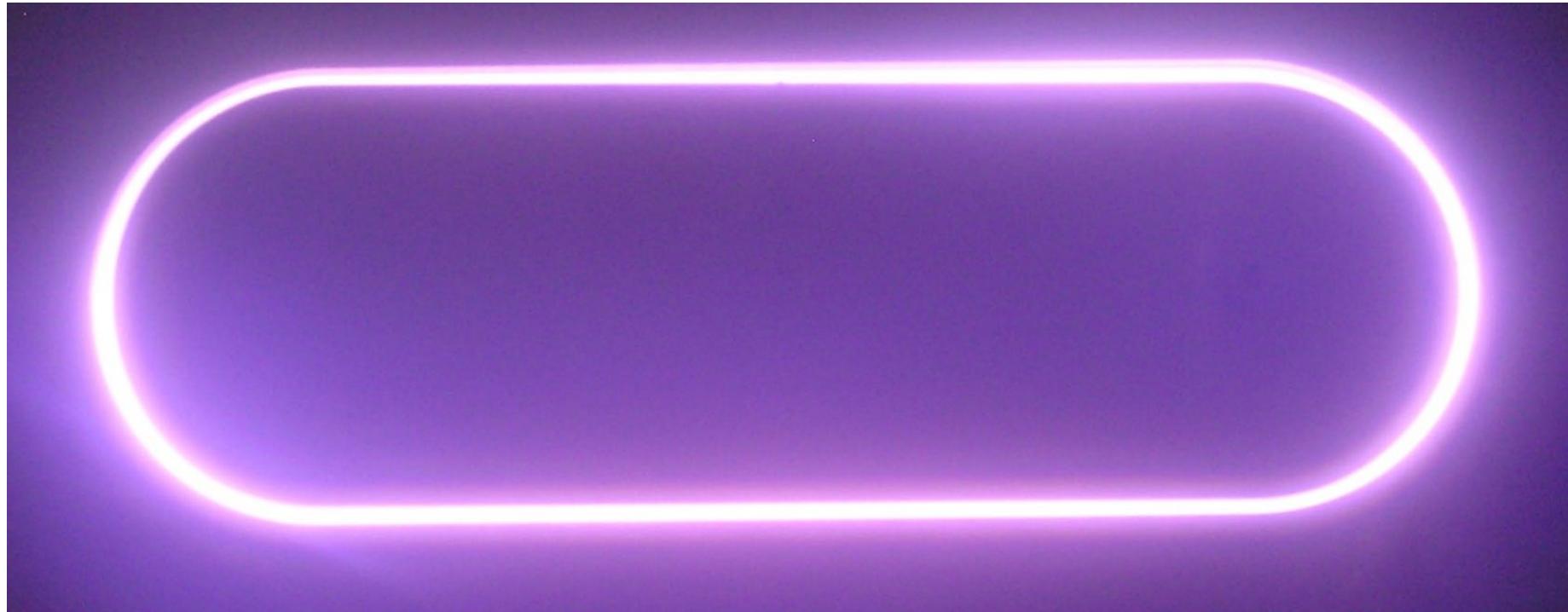
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beam energy by automatically adjusting gas flow

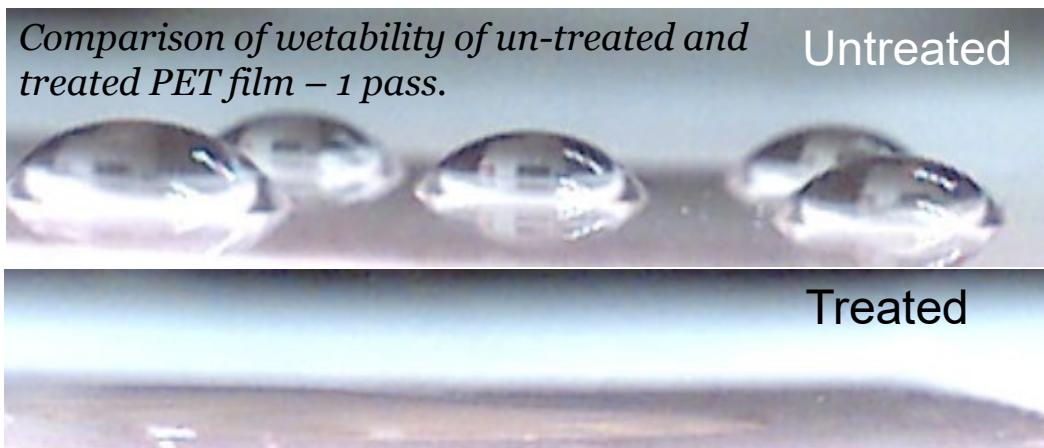
### Voltage / Current Curve with power for automatic gas feedback mode for beam voltage regulation



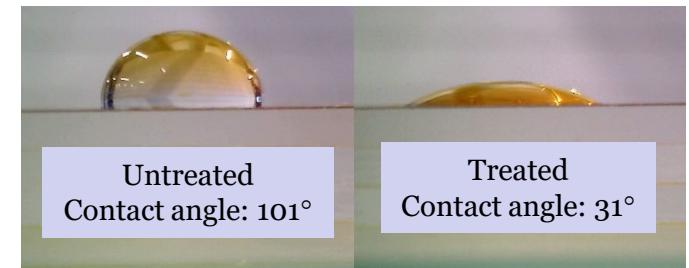
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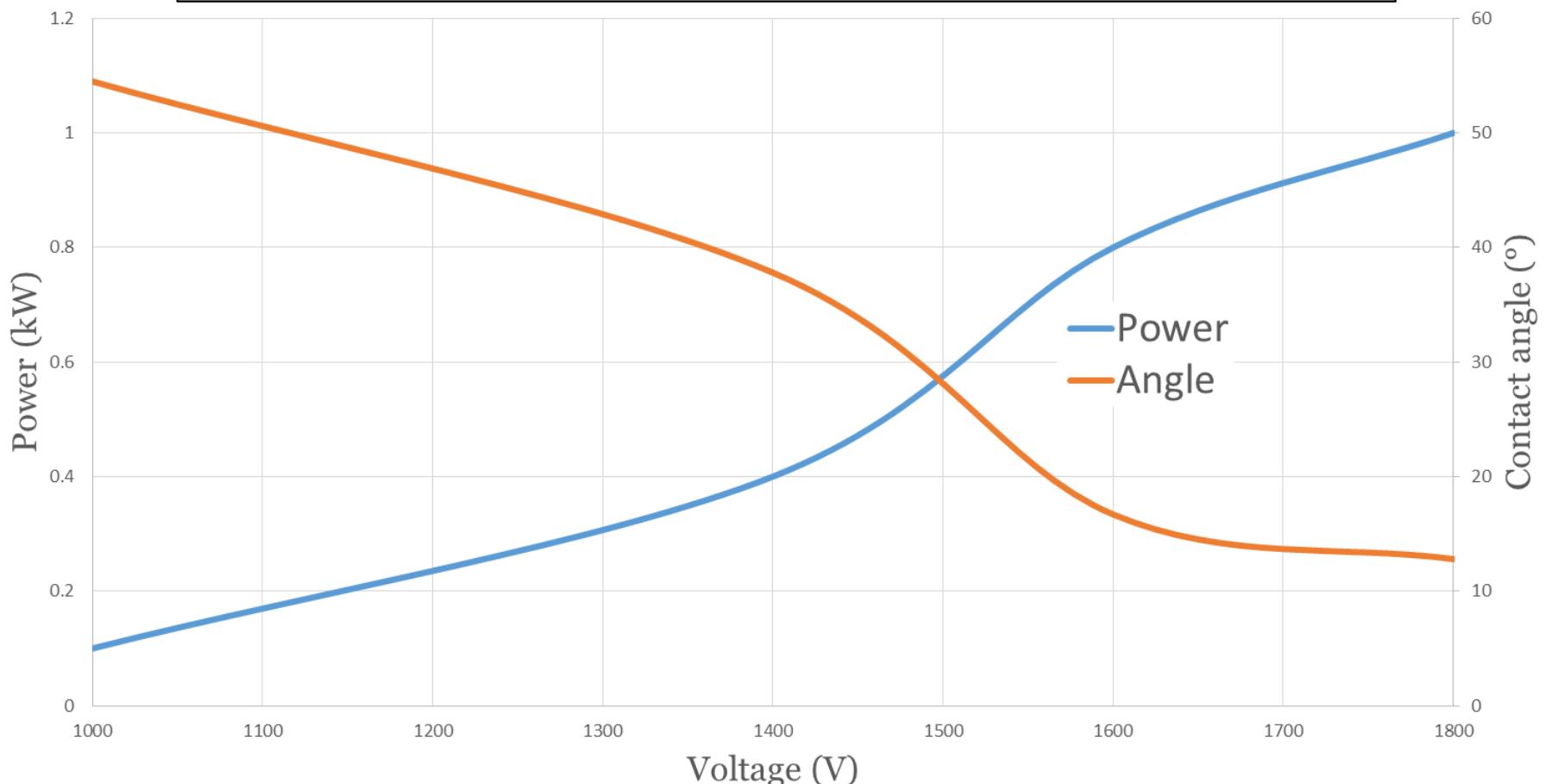
*Comparison of wettability of un-treated and treated PET film – 1 pass.*



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

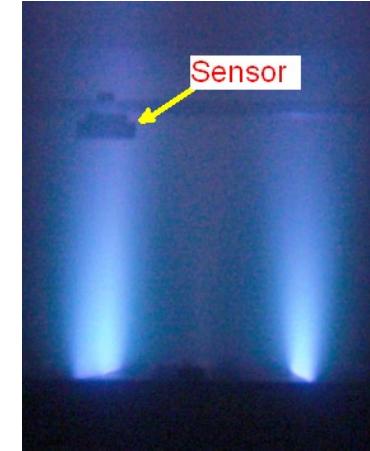


### Comparison of voltage with power and water contact angle on glass after IM1850 linear ion source 1 pass



# Typical etch rates for different materials

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## Polymer etch rates:

Gas: O<sub>2</sub>

IM400: 200 mA beam @ +1.5 kV

Substrate in rotation at equivalent 600mm/min linear speed (80 passes)

Example of polymer: silicone

Etching rate ~ 20 Å/pass

Example of polymer: acrylic

Etching rate ~ 38 Å/pass

## Example of metal Ti:

Etching rates: 0.5-1 Å/pass (170 mA @ +1.82 kV)

## Oxide etch rates:

Gas Ar

IM600, 300 mA beam @ +1.6 kV

Example of oxide: SiO<sub>x</sub>

Etching rate: 5 nm/min static (over 8 mm diameter substrate, total time 23 mins)



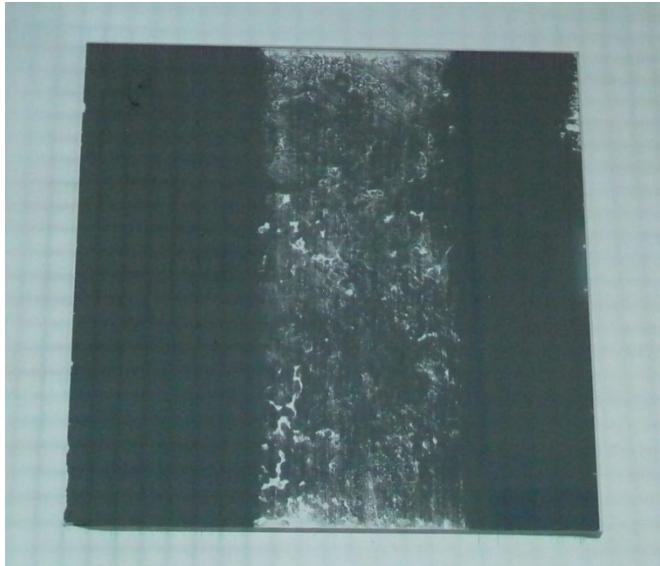
## Elcometer abrasion test (ISO 11998)

- 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

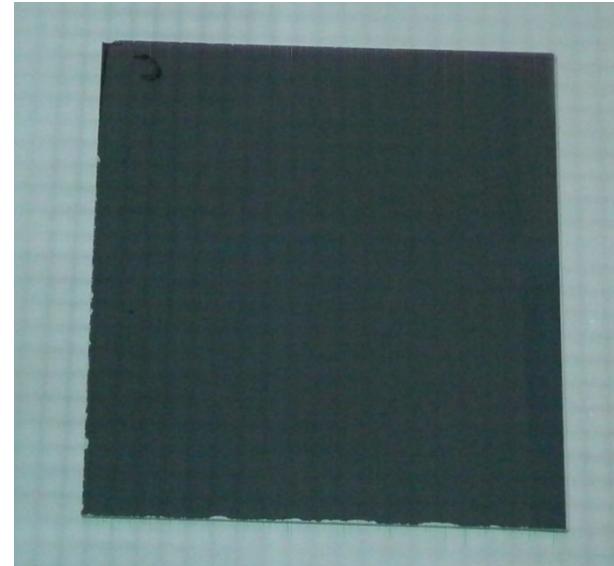


Results of single pass plasma pre-treat

**Sample without ion-beam pretreatment**



**Sample treated by ion beam**



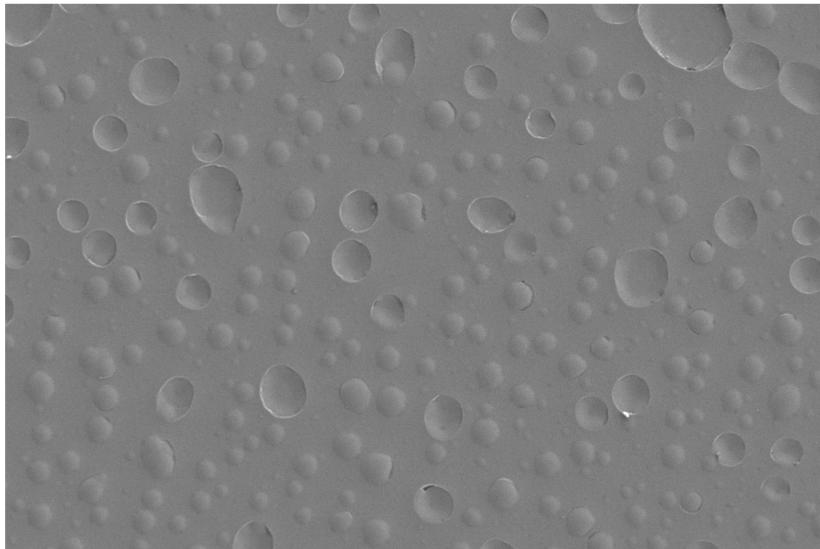
# Comparison of tempered glass with and without the use of a single pass

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plasma pre-treat with linear ion source

Parallel on-axis in-lens secondary electron detection

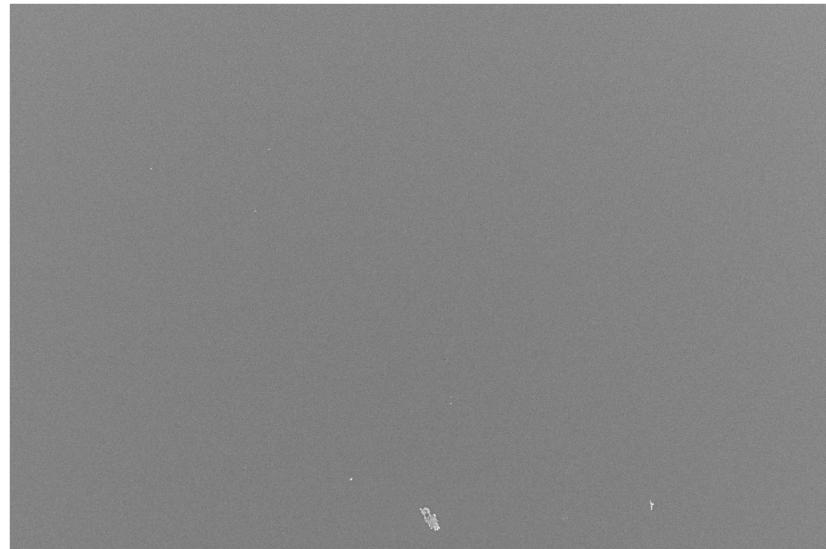
**Sample not treated by ion beam**



10 μm      EHT = 5.00 kV      WD = 5.5 mm      Signal = 1.0000      Signal A = SE2  
ESB Grid = 1500 V      Mag = 1.00 K X      Pixel Size = 111.6 nm      Signal B = AsB  
I Probe = 400 pA      Date :13 Apr 2015      File Name = ST\_sup\_01.tif

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

**Sample with ion-beam pre-treatment**



10 μm      EHT = 15.00 kV      WD = 5.2 mm      Signal = 1.0000      Signal A = InLens  
ESB Grid = 1500 V      Mag = 1.00 K X      Pixel Size = 111.6 nm      Signal B = AsB  
I Probe = 400 pA      Date :13 Apr 2015      File Name = CT\_sup\_01.tif

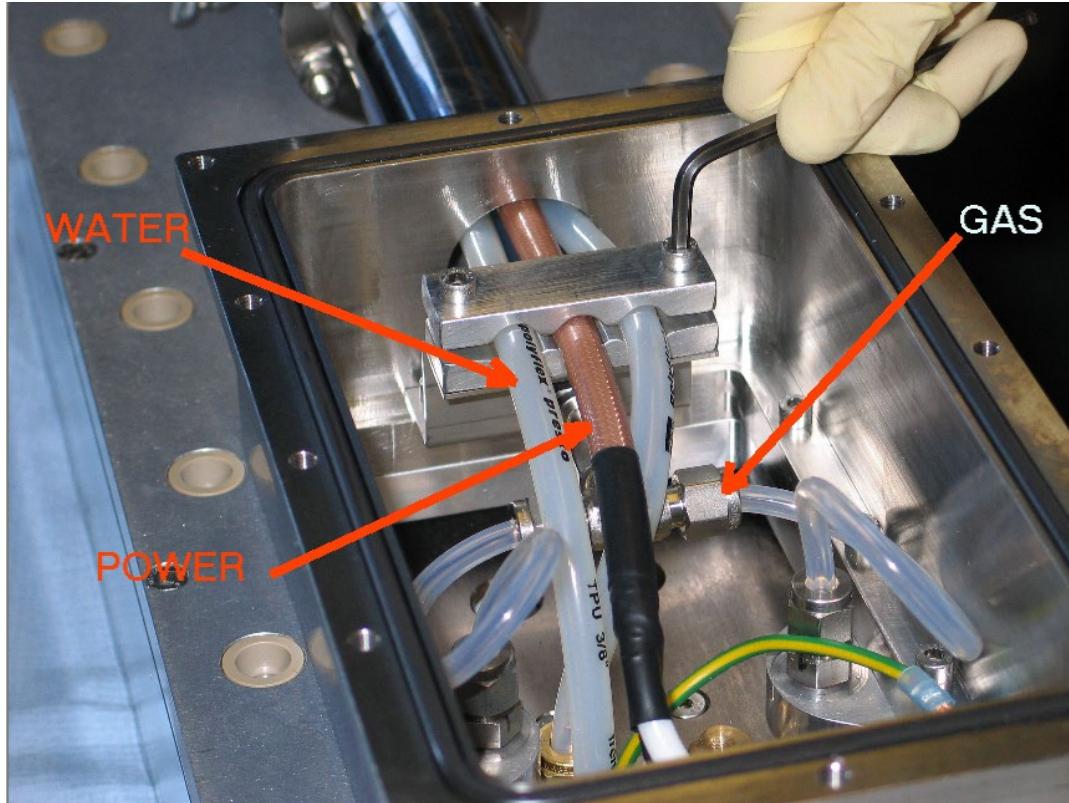
After the tempering process no visible defects were detected on the coating.

SEM analysis confirm the good state of the coating.



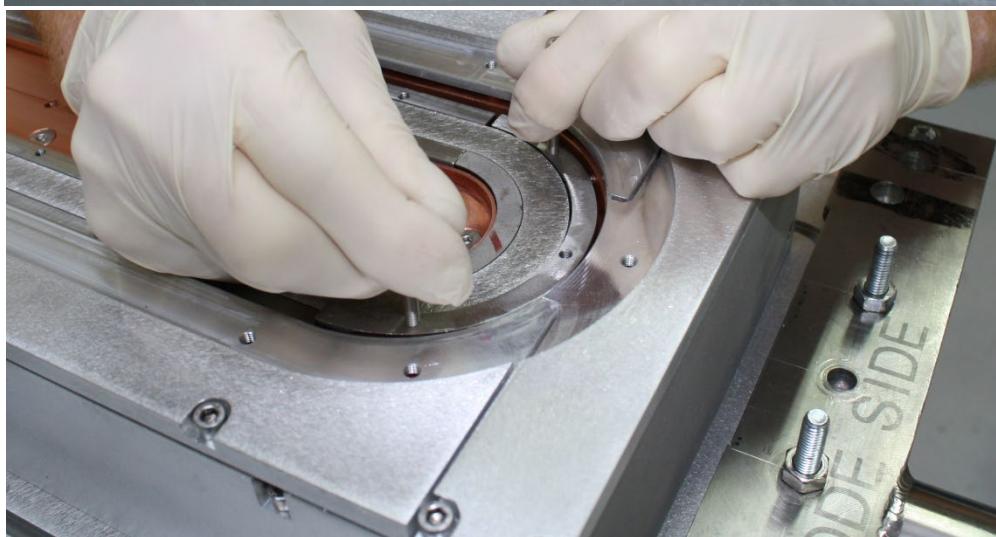
Robust mechanical design, easy to access and connect

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Long operating lifetime, very easy to service and maintain

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*No water or vacuum seal broken during anode / cathode change, typically 2 hours for full conversion from straight beam to focused beam mode.*



Gencoа provide a unique customer built power supply that automatically regulates the gas

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flow for ease of operation (300 & 3000 w)

<i>Output voltage</i>	Up to 2500V ( 3000V ignition voltage )
<i>Output current</i>	2 A @ 2000V, short circuit 2.5A
<i>Output Power</i>	4000W @ 2000V
<i>Output polarity</i>	Positive
<i>Regulation Mode</i>	Current 0-2.5A
<i>Output connector</i>	Fischer, type 105, 10kV rating for RG213 coax cable
<i>Mains input</i>	3x400Vac +/- 10% 50Hz ( L1,L2,L3 PE)
<i>Dimensions</i>	Standard Rack 19" 4U=177mm High
<i>Weight</i>	12kg
<i>Cooling</i>	Forced air cooling
<i>Working temperature</i>	15-35°C



# IM300 power supply for smaller sized linear ion sources 500mm long or

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lower power longer beams



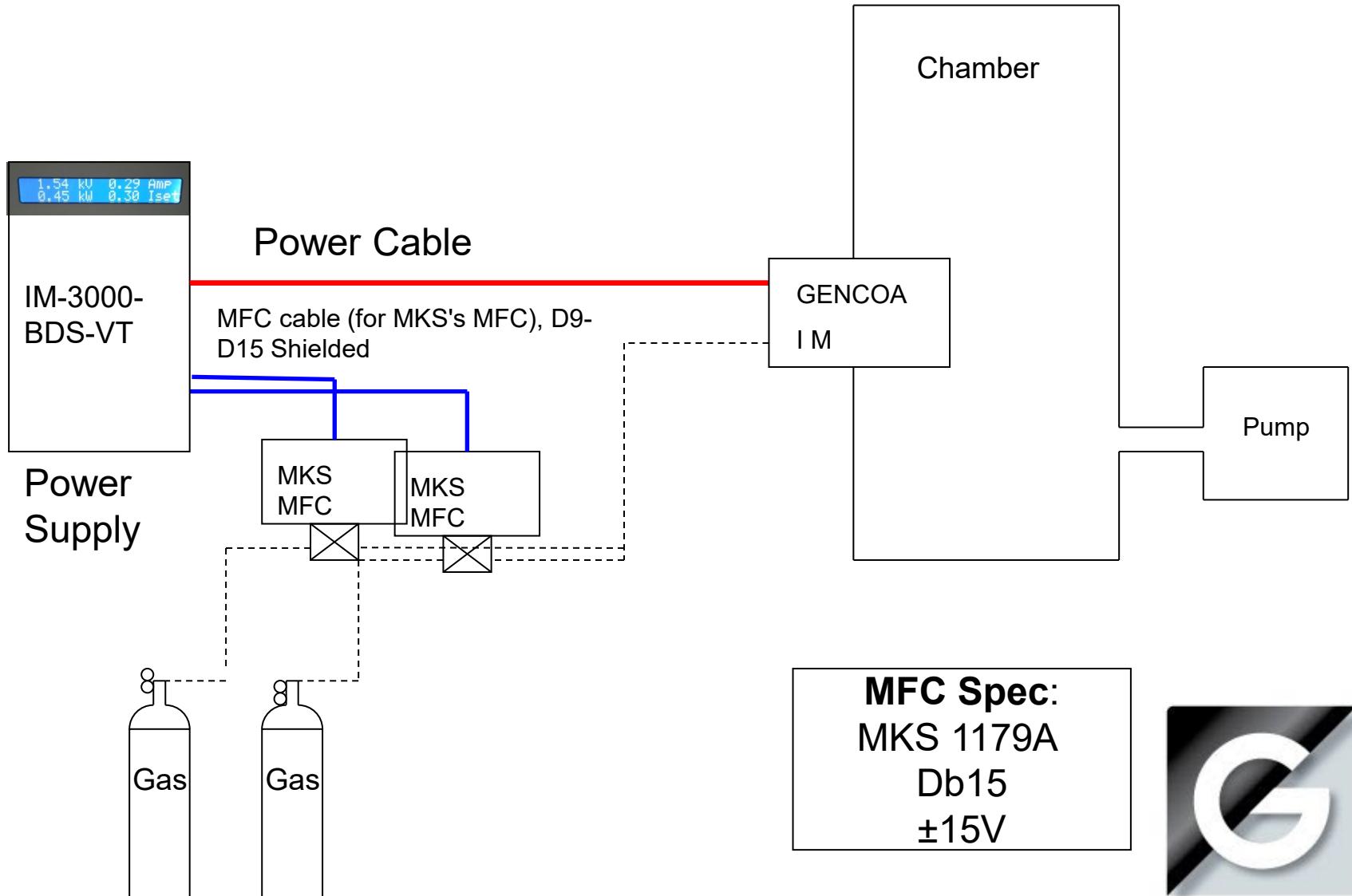
ITEM	Description
Footprint	3UI rack mount L=240mm H=178mm D=300mm
Supply	220 AC or 110 ac switch selector inside max 600va
Voltage strike	Greater than 3kV, positive
Nominal voltage	2500V – 200mA - 500Watts
Short circuit current	Minimum 400mA
Inverter frequency	36kHz
Power input connector	Computer type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



# Schematic of the ion source with power supply and automatic gas regulation

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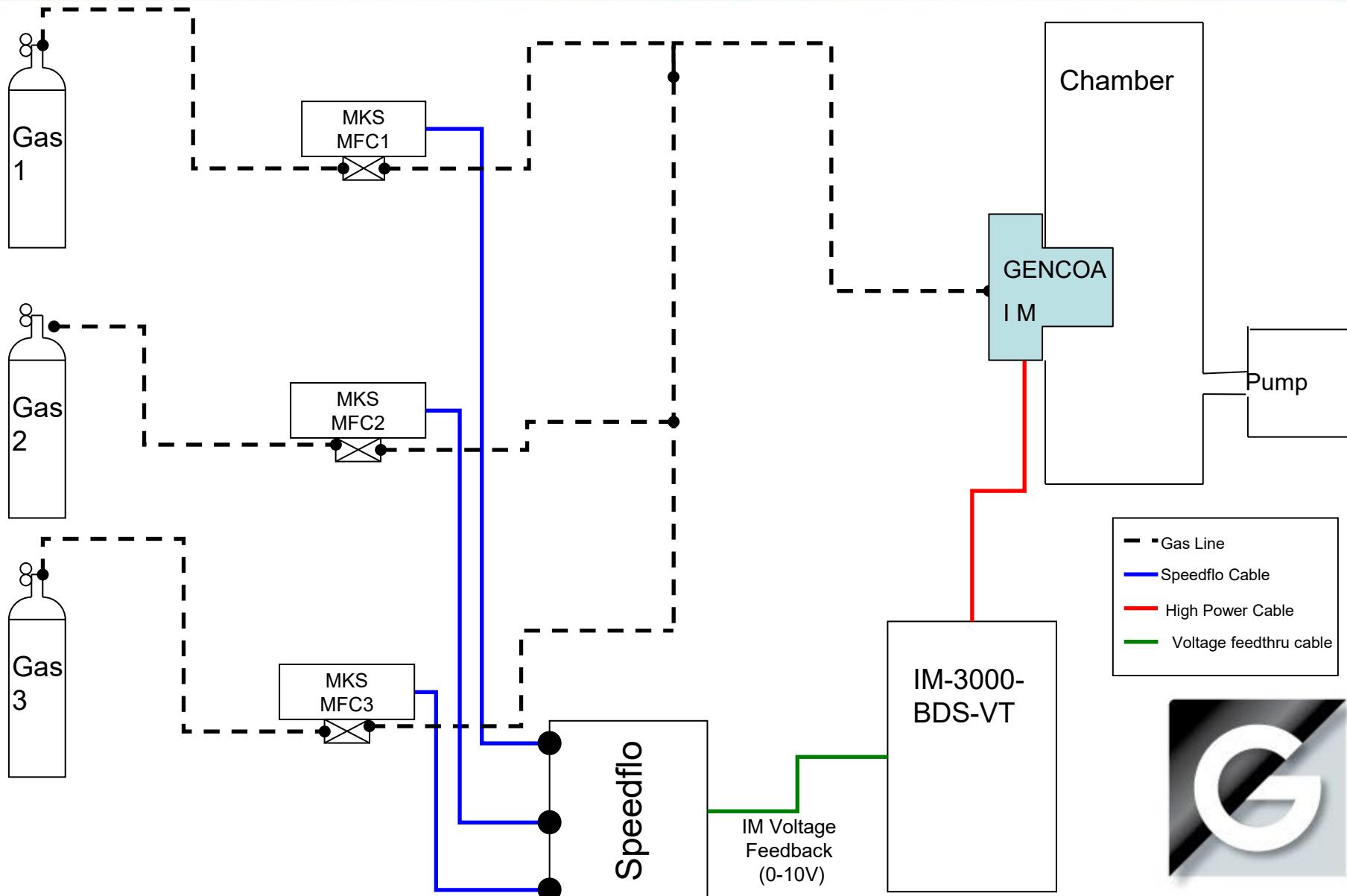
Removes beam variation – I & V regulated



# Schematic of the ion source with power supply and automatic gas regulation

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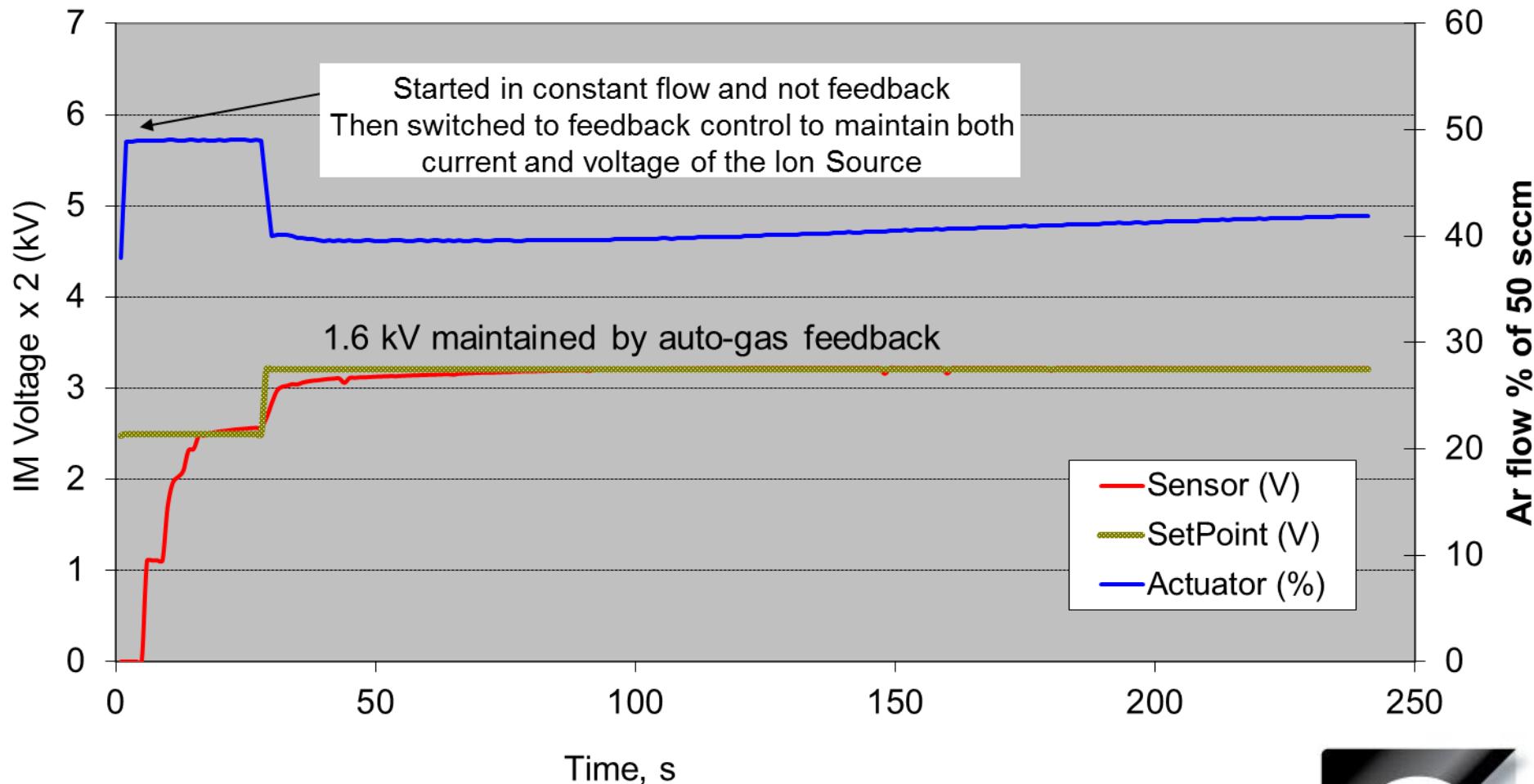
Of more 3 gas types – needs speedflo mini



# IM600 at 300mA - gas Ar - Example of voltage

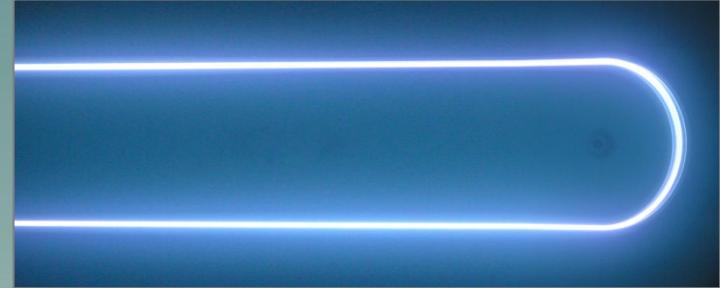
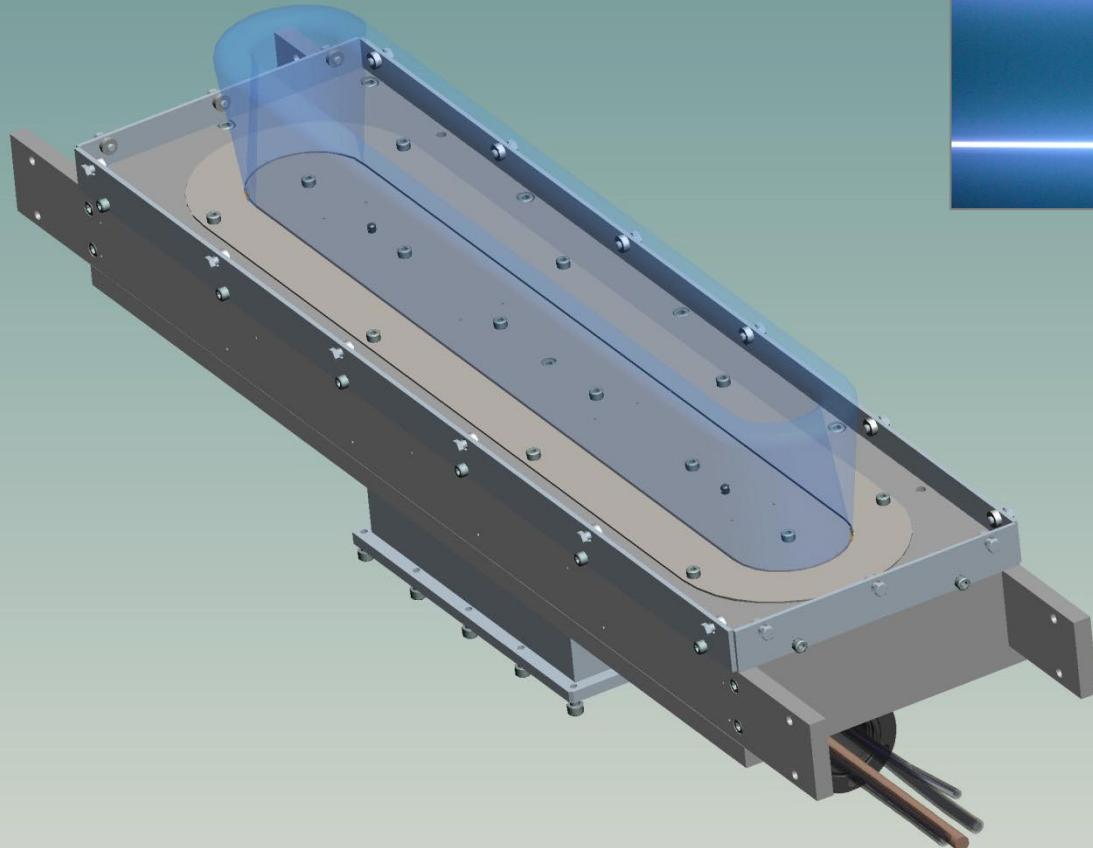
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tracking feature via auto control of gas



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

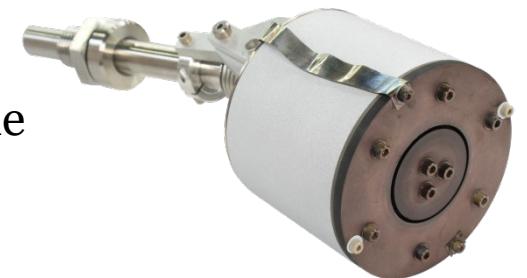
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# Genco IM75 plasma source for ***Research and Development***

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A multi-functional plasma beam



- 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 Gencoа Plasma Generation and Pre-treatment Products

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<i>Plasma Treatment Product Categories:</i>	<i>Application / use</i>
DC Linear ion sources	Low speed web & glass
<i>DC magnetron based plasma treaters</i>	Low to High speed / power
<i>AC type plasma cleaning sources</i>	Low to High speed / power
<i>AC type gas activation sources – O<sub>2</sub> plasma generation for reactive gas reactions</i>	Low to High speed / power
<i>Hipims<sup>+</sup> positive beam ion etching</i>	Etching of metallic substrates
<i>Positive pulsed power inverted magnetron metal strip etching source</i>	Etching of metallic plate or web

DC, AC and *Hipims<sup>+</sup>* 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<sup>+</sup>* positive ion etching technology covered by Gencoа patent application



# Standard straight and focused beam arrangements

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*Different kinds of plasma sources from Gencoа*

