®KRi KAUFMAN & ROBINSON

The Ion Beam Authority℠

Gridless Ion & Plasma Sources

- Ion Beam Assisted Deposition
- In-situ Substrate Precleaning
- Direct Deposition Coating
- Surface Modifications

Mean free path, $T_{target} = T_{incident}$

$$\lambda = 1/\sqrt{2}\,nQ$$

Mean free path, $T_{target} = 0$

$$\lambda = 1/nQ$$

Distribution of path lengths

$$I = I_o \exp(-x/\lambda)$$

Debye length

$$\lambda_D = \sqrt{\varepsilon_o k T_e / n_e e^2}$$

Boltzmann equation

$$n_e = n_{eo} \exp(V_p / k T_e)$$

Child's law

$$j = (4\varepsilon_o/9)\sqrt{2e/m}\,(V^{3/2}/x^2)$$

Bohm conductivity $\perp B$

$$\sigma_B \approx e n_e / 16$$

Temperature–energy equivalence

$$1 \text{ ev} = 11{,}600 \text{ K}$$

Mean Maxwellian speed

$$\bar{v} = \sqrt{8kT/\pi m}$$

- Credibility
- Innovative
- Quality

Applications

- Adhesion
- Film Densification
- Chemical Conversion
- Smoothing
- LTCVD

End-Hall (eH) Ion / Plasma Beam Sources

- Low Cost
- Rugged
- Remote Plasma
- Directed Beam

Design Features

- Gridless
- Inert & Reactive Gases
- Optimized Configurations
- Modular Anode
- Low Energy Ions
- High Ion Currents
- Large Process Zone

EH1000

The Ion Beam Authority

Kaufman & Robinson offers gridless end-Hall "eH" Ion / Plasma Products. Our products include broad-beam End-Hall Ion Sources and automated power supplies controllers. All designs are straightforward which easily retrofit into existing vacuum systems, or easily integrate into new OEM systems.

Since 1978, Kaufman & Robinson (KRI), Inc. has designed and built broad-beam ion sources for the vacuum processing community including both manufacturers and researchers. The designs of the eH ion/plasma beam products were developed with our world-recognized expertise in plasma physics, ion source design, and power control engineering.

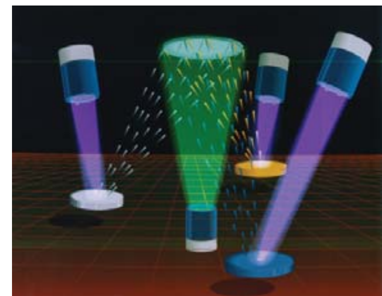
Currently, KRI holds more than 20 active patents in ion beam and plasma technology, including its innovative designs in the gridless end-Hall technology.

Meeting Your Application Needs

KRI's knowledge in material applications is captured in our product relevence. Our products are proven process tools which are connected to real results. For example:

The eH products output a high current and low energy beam ideally suited for surface treatment and thin film growth applications which include:

- *Ion Beam Assisted Deposition (IBAD)*
- *In-situ Substrate Precleaning*
- *Direct Deposition Coatings*
- *Low Energy Ion Beam Etching*
- *Surface Modification*
- *Biased Target Ion Beam Deposition*



eH Series of Broad Beam Ion Sources

The compact low profile eH series of broad beam ion sources are available in different sizes which covers both R&D and high yield production requirements. Large ion beam currents meet critical arrival ratios for high deposition rate processes. Low energy ions minimize ion bombardment damage to surfaces and interfaces. The broad divergent beam improves throughput by uniformly covering a wide deposition zone.

All eH models feature the patented modular anode. The simple plug / unplug task makes it easy to maintain, assemble and dissassemble, resulting in significant productivity benefits.

- Removable anode module for bench-top maintenance
- Self aligning anode module for simple reinstallation
- Double contoured anode for optimized plasma discharge
- Thermally decoupled magnet system
- Enhanced gas distribution for efficient gas management
- Shielded insulators for lower maintenance

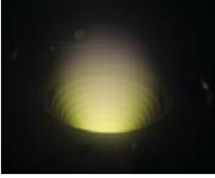
plug-in filament electron emitter
- hollow cathode system optional

modular anode (patented)
including anode and gas distribution

main module
including magnet system and electrical and gas inlets

adjustable angular mounting bracket (optional)

Cathode / Neutralizer Options


Grooved Anode with O_2

The eH source can be configured with different cathode and anode module components. The available cathode / neutralizer options include simple filaments or filamentless hollow cathodes. The anode module options include optimized configurations for a low energy / high output, extra current output for O_2 gas, or improved stability in dielectric environments.

EH200F

EH400HC

Electron Sources

All electron sources tightly control the electron emission current whether it is inexpensive filament designs or hollow cathode models used for extended run time and low temperature requirements.

- *LFN2000* *for up to 2 A emission current*
- *SHC1000* *for up to 5 A emission current*
- *MHC1000* *for up to 10 A emission current*
- *LHC1000* *for up to 20 A emission current*
- *DHC1000* *disposable hollow cathodes*
- *eH Sidewinder* *for up to 10 A emission current*

Electron Sources

Product Options

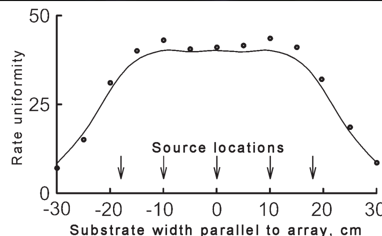
The eH models can be equipped with optional hardware to tailor the product to the customer's process and installation.

- *Vacuum feedthroughs*
- *Grooved anode*
- *Water cooled anode*
- *Water cooled front plate*
- *Angular mounting bracket*
- *Ti, Ta, graphite or stainless steel gas reflectors*
- *Magnetic field options*

eHL-X Linear Configurations

The linear eHL-X ion / plasma beam sources are suited for installation with linear movement substrates, such as in-line, web coating and rotary sputtering systems. Typical, applications are in-situ cleaning and ion assisted deposition where low energy & high currents are beneficial.

The modular linear configuration has unique optimization capabilities. It uses standard cylinderical end-Hall modules placed in a linear array. The spacing and number of the modules provides a strong benefit to the application. The modules can be spaced to optimize current density dose, uniformity and overall length. Since this configuration uses one electron source and a common power supply, the cost for the integrated modular linear package is minimized.



EH3000

Electron Sources

- Neutralization
- Ionization
- Plasma Stabilization
- Low Energy
- ESD Control
- Dielectric Substrates

EH1000F Sidewinder

Optional Accessories

- Temperature Management
- Lower MTBM
- Low Voltage Operation
- Installation Flexibility
- Process Optimization
- Long Filament Lifetime

Linear Sources

- Modular
- Optimize uniformity
- Optimize ion current dose
- Minimize lengths
- User adjustable
- Monolithic option

EHL200-3

Features

- Switch Mode
- Digital Control
- Low Stored Energy
- MFC Gas Control
- Discrete Modules
- Integrated Control
- Remote Control Interfaces
- Recipe Storage
- Dual Regulation

eH 400 with Filament and LHC

eH Ion / Plasma Sources

- Standard configurations
- Optimized configurations
- Application specific
- Controlled ion energy
- Controlled current density

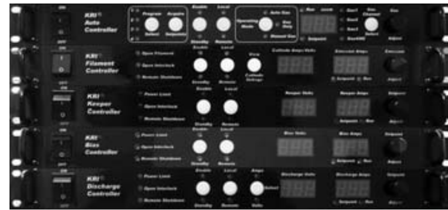
Power Supplies

All KRI power supplies feature advanced primary switched power modules with output control to protect power supply and load. Upgrades from basic configurations to advanced configuration are easily achieved by replacing or adding modules. Depending upon the model, the power supplies deliver either AC or DC signals with output powers ranging from 300 to 4000W.

- *Modular architecture with quick change power modules*
- *Reliable power modules, designed for industrial use*
- *Short and arc management through protection circuits*
- *Constant and stable ion beam parameter control over complete operating range*
- *Selection of operational modes to fit application*

eH Filament Power Supply Controller

eH Hollow Cathode Power Supply Controller



eH Filament & Hollow Cathode Power Supply Controller

eH High Power Controller

Nominal Specifications

KRI	eH200	eH400 eH400LE	eH1000 eH1000LE eH1000LO	eH1000xO_2	eH2000 eH2000LE eH2000HO	eH3000 eH3000LO eH3000MO
Cathode/Neutralizer	F or HC	F or HC	F or HC	F or HC	F or HC HC HC	HC
Discharge Voltage (V_D)	30-300V	50-300V 30-150V	50-300V 30-150V 50-300V	100-300V	50-300V 30-150V 50-250V	50-250V 50-300V 50-250V
Discharge Current ($I_{D\ max}$)	2A	5A 10A	10A 12A 5A	10A	10A 15A 15A	20A 10A 15A
Divergence (hwhm)	>45	>45	>45	>45	>45	>45
Gases	Ar, O_2, N_2, H_2, organic precursors, others					
Typical flows	1-15sccm	2-25sccm	2-50sccm	2-50sccm	2-75sccm	5-100sccm
Height	2.0“	3.0“	4.0“	4.0“	4.0“	6.0“
Diameter	2.5“	3.7“	5.7“	5.7“	5.7“	9.7“
Water coooled	no	optional	optional	optional	yes	optional

F = Filament; HC = Hollow Cathode; xO_2 = Optimized for O_2 current

tel +44 (0) 118 973 0546
fax +44 (0) 118 973 0546 (auto)
e-mail sales@ionbeam.co.uk
web www.ionbeam.co.uk
address Ionbeam Scientific, Chivers Drive, Wokingham, Berks, RG40 4EW, UK