

Unparalleled Combinations of Ions, Electrons, Radiation and Hot Gases

Acquire the e-Ion™ Plasma

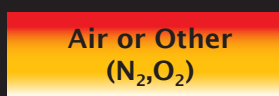
Modify and Create New Surfaces with Unusual Properties

IONS

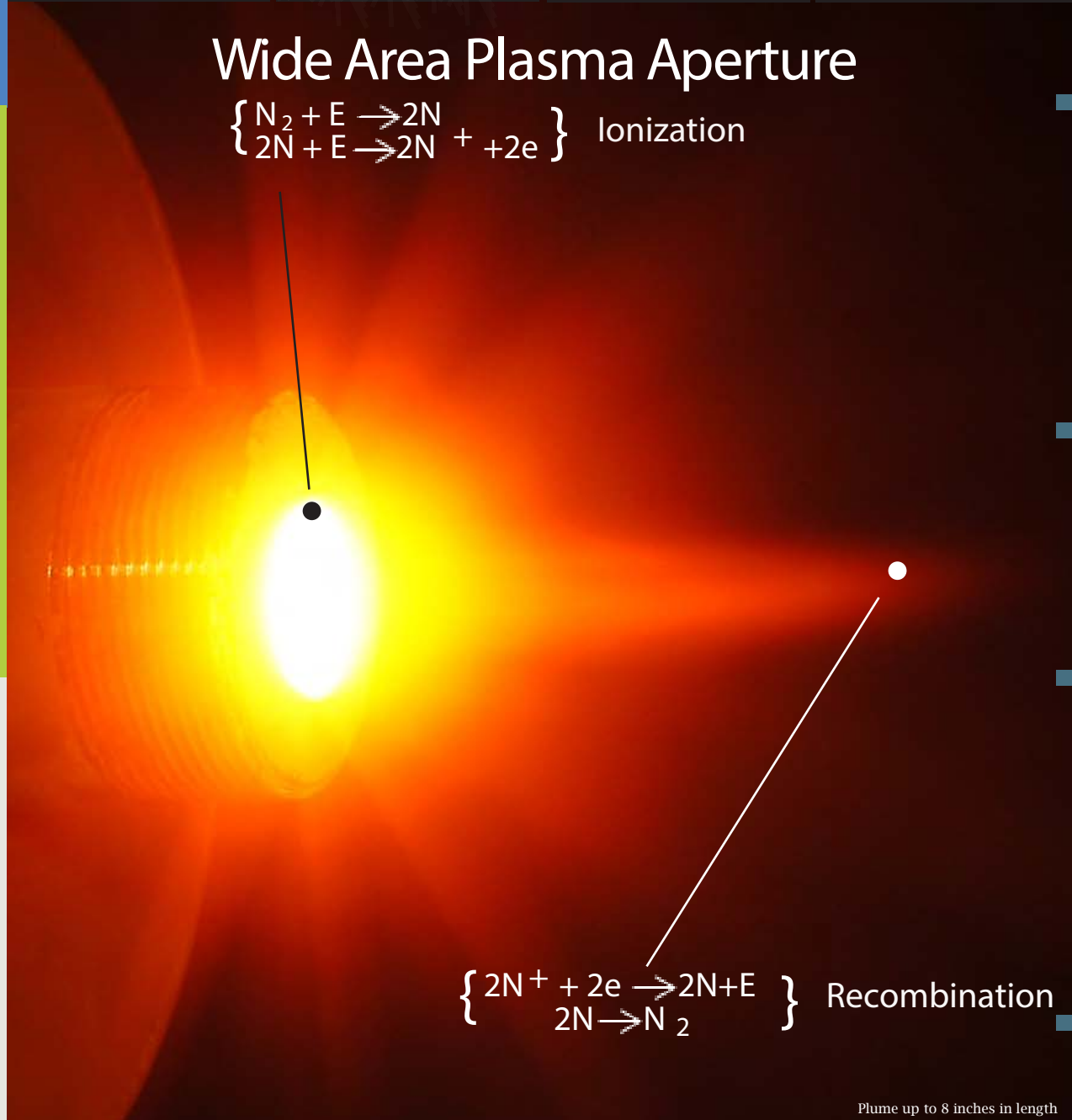
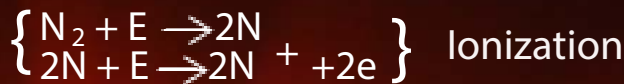
ELECTRONS

RADIATION

HOT GAS



Wide Area Plasma Aperture



Plume up to 8 inches in length

Environmentally Responsible

Green Sustainability

Energy Savings



www.mhi-inc.com

Impact

Create Unique Combinations of Ions™, Electrons, Radiation and Hot Gas with e-ion™ Plasma



Ideation *

Process Ideation

Self-Cleaning & Self-Healing Surfaces

Simultaneously improve environmental impact and your bottom line. Experience benefits to organic and inorganic materials such as the plastics and wood that are typically used in the Packaging Section. The e-ion™ Plasma produces high energy ions and electrons to make the surface become self cleaning for a duration of time. Self Clean™ is a Trademark of MHI Heal detrimental cracks.

Typical Use: At least 1-1000mm/sec withdrawal speed under an i-ion™ plasma pume an object surface can be plasma pre-treated and cured using the right ions, electrons and infra-red to ultraviolet radiation for the hot e-ion™ Plasma. The e-ion™ Plasma is able to create multiple wavelenghts for thermal densification for porous wood surface. The plasma treatment removes organic contaminants on the surface of the work piece by the bombardment of the reactive species of plasma on the surface thereby causing simultaneous surface modification. Subsequently, these free radicals couple with active species from the plasma environment to form polar groups such as $-(C-O)-$, $-(C=O)-$, and $-(C=O)-O-$ on the surface of the work piece. Activated surfaces show various contact angles with water and be tailored from speaking water to water resistant surfaces.

Impact Water. Make It Clean.

Properties of our unique plasma plume can provide environmental cleaning and sanitizing. Call MHI for the tests available to demonstrate removal of many germs, viruses and bacteria by the combined action of ions, electrons, radiation and thermal environment created by the plasma plume. Call MHI for assistance with make surfaces that provide environmental benefits.

Green Energy. Choice of Gases. Emission Free.

Any gas input (even free air) (see picture of air plasma on left)
No toxic emissions or combustion products to worry about.
Silent operation. No venting required. Improved insurance profile for user.
Plume Properties

- Re combination temperature $\sim 2500^{\circ}K$
- Convective plasma (variable gas temperature is $1600K$)
- Heat transfer coefficient $\sim 225kM/m^2$ (compare to $10kW/m^2$ for radiation)

Improved Labels with Plasma

MHI's LIP-G3 e-ion™ system bring technology to your process that truly affects your bottom line. LIP-G3 systems not only replace, but enhance conventional treatment systems by eliminating consumables, providing emission free operation, and enhancing your product. Most types of polymers, metals and glass can be enhanced. Picture shows a conveyor belt with the LIP e-ion™ on the left and right side.

Impact Research. Potential Uses in R & D

new simulations my help with R & D materials and plasma physics. For example solar simulation to provide a controllable indoor test facility under laboratory conditions, use the testing of the solar cells, sun screen, plastics and other materials and devices.



• Unique combination of electrons, ions, radiation, heat and heated gas is available in one source for many applications.

• Neutralize contaminants

• Recycle PE tops



• Use combination profiles of plasma



• 100% power transfer energy conversion efficiency



• Wide are heat treating for welding, sealing and debinding and many more

• Improve bonds for coatings

• Rapid solidification and hardening

• Clean air



• Faster throughput

• Cleans surface

• Smudge resistance

• Better shelf appearance



• Plasma physics

• Reaction catalysis

• Process reaction engineering

• No public health claims made or intended. Ideation does not guarantee a process. Please contact MHI for product advice.



Self-Cleaning of Multiple Surfaces



Rapid Recycle Bottle Caps




Wide Area e-ion™ Plume



Rapid Processing with LIP Plasma



Solar Simulation

Impact 

Ideation *

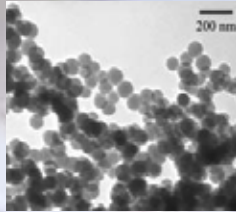


Make it Green & Clean. (wood)

The plasma polymerization on wooden substrates at atmospheric pressure can create water-repellent, cured, densificated, hardened surfaces. Non-chemical seasoning of wood is possible with the e-ion™ Plasma.



- Reduce wood waste
- Improved surface properties
- Non-chemical seasoning
- Non-chemical surface hardening/densification



Make Surfaces Functional.

An add on powder feeder can turn your plume into a deposition vehicle for chemicals and powders. Contact MHI for details. See cleaning on opposite page.



- Manufacture nano particles
- Air-Plasma surface functionalization for plastics used in the food industry



Remove Surface Enamel.

Use plasma for faster throughput than mechanical methods. Removing enamel from protected surfaces like copper can be done without the use of toxic chemicals. Many wires can be treated at one time. High energy ions and electrons can be used for breaking down or oxidizing molecules when required to do so at rapid rates or when chemicals could lead to toxicity by accumulating into harmful concentrations.



- Remove enamel coating on copper wires for electric motors
- No emission and no combustion
- Faster throughput
- Chemical free

Call MHI for technical assistance.



Build In-situ Layers of Protections.

Using a unique combination of electrons, ions, radiation heat and heated gas, one can create oxides, nitrides and many others to protect a variety of surfaces against dissolution, corrosion or wear.



- Protect copper tubes for safer and cleaner water
- Protect surfaces from corrosion and erosion

Call MHI for technical assistance.



2004 R&D Award Winner and is Patent Protected.

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Typical Configuration of Use



Use conveyor systems for continuous plasma and materials processing.



Opposing LIP Continuous Processing with Plasma. Green & clean.



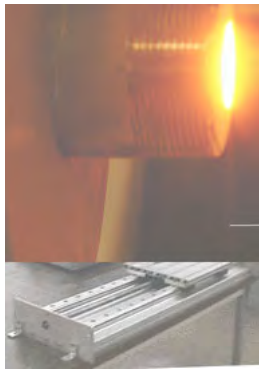
Use Plasma Aluminum Melting (For more information visit www.oneatmosphere.com)



e-Ion Zapper 200°C per second. Use for making high hardness and high wear/abrasion resistant surfaces for mining, tool bits, die hard surfacing, metal and semiconductor heat treatment and many more.



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e-Ion Zapper™

LIP e-ion™ System

The GEN 3, 6500W LIP e-ion™ System provides e-ion™ plasma for production-line setting. Our fully endorsed system requires no stand and is adjustable to meet the needs of your production or testing application. The robust construction, accurate controls and integral fan provide a platform for sustainable overall performance. The device can be paired with a choice of exit apertures to meet your unique needs. Contact MHI for more information.

- Highly Modular - drives great flexibility for your application or process.
- Energy Efficient
- Clean "Green" Technology - NO EMISSIONS
- No Combustion - Eliminates costly, dangerous and inefficient fuel source.
- No Noise! - Quiet, high temperature flame replacement improves your productivity.



Basic Unit: e-Ion™ Plasma 6.5kW

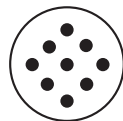
The 6.5kW (6500 watts) e-ion™ plasma is the core component in this product category. The robust stainless steel construction, accurate controls and integral fan provide a platform for sustainable overall performance. This device can be mounted and paired with a choice of exit apertures to meet your unique needs.

e-Ion™ Plasma Properties

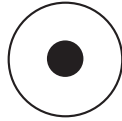
- Recombination temperature ~2500°K
- Convective plasma variable gas temperature is 1600
- High watt density (see article listing below).
- Heat transfer coefficient ~225kW/m² (compare to 10kW/m² for radiation)

Key Features	Controls and Software	Service
Bumper-to-bumper coverage On-site technical support available Installation and start-up assistance Parts and labor Technical support	1 atmosphere operation Multiple output apertures available Highly efficient Quiet operation Controllable output Robust construction	On-site service worldwide Quick repair/replacement Live product support Training Priority scheduling

Typical Aperture Configurations in LIP Systems: Factory installed.



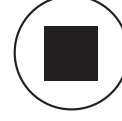
Diffusion e-Ion Flow



Focused e-Ion Flow



Narrow e-Ion Flow



Wide e-Ion Flow

Typical Technical Articles of Successful Use

- Heat-Transfer Enhancement Using Weakly-Ionized, Atmospheric Pressure Plasma in Metallurgical Applications, Metallurgical and Materials Transactions B, Volume 7B, August 2006 - p565 to 570
- Design and analysis of Alternative High Heat Flux Sources for Materials Fire Testing. AFRL-RX-TY-TP-2006-4549
- Low ionization Plasma Sources for Enhanced Aluminum Processing for Energy Savings, Environmental Benefit and Increased Productivity, International Journal of Thermal Technology, pp. 49-52, October 2006
- Enhancement of Heat Transfer due to Plasma Flow in Materials Processing Applications, Paper No. IMECE2005-79782, Proceedings of 2005 ASME International Mechanical Engineering Conference and Exposition, November 2005
- A Technique to Determine the Emissivity with the Temperature of a Fe-5.8%Al-22%Cr Alloy, Metallurgical and Materials Transactions B.725-728 (2007)

	e-Ion Plasma™	Laser	Electron Beam
Surface Impact	Beam up to 8 inches, large impact, improving	Average beam size is <2mm	.5mm beam
Welding/Joining	Yes, even for dissimilar materials	Yes, limited by beam parameters	Yes, limited by beam parameters
Drilling	No	Yes	Yes
Vacuum Required	No	No	Yes
Power Density Watt	10 ⁶ -10 ⁹ W/m ²	10 ⁶ -10 ⁹ W/m ²	~10 ⁸ W/m ² acceleration voltage and wavelength of beam
Water Requirement	None	High	High
Energy Efficiency	Very high	Very high	Very low