Gambetti
Vacuum Technology
and Related Solutions

Heron

Heron 80

Heron 80 is a stand alone plasma system, designed for surface cleaning, modification, activation and etching.

It can operate on different materials such as metals, plastic, ceramic, paper and others.

The user friendly graphical interface combined with the efficient RF system makes Heron 80 an easy and versatile solution for small productions or R&D environments.

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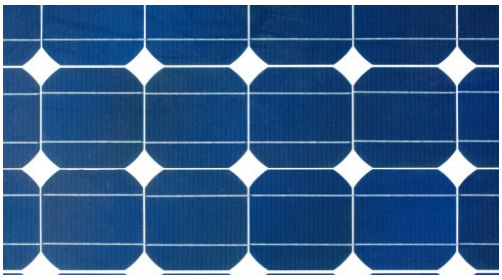
Examples of applications

Semiconductors

- Photoresist removal (stripping) and its residues (descumming).
- Organic incineration (Ashing), isotropic removal of organic polymers (eg. Polyamides, etc.) and silicon oxides/nitrides .
- Cleaning or surface modification before wire bonding (both on bond ads and chip carriers)
- Isotropic etching
- Reverse engineering applications (removal of passivation, decapsulation and delineation of cross sections)



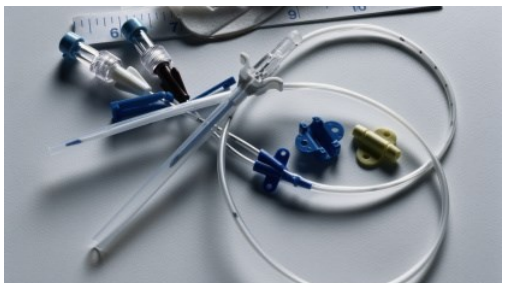
Solar (PV)

- Possibility to process single cells or batches (rounded or squared up to 156 mm square)
- Isotropic removal of silicon nitride for isolation of cell edges
- Isotropic removal of amorphous and multi-crystalline silicon
- Surface texturization of mono and multi-crystalline silicon for reflectivity reduction and efficiency enhancement.

Textile Industry

Cleaning and surface modification, in order to obtain hydrophilic surfaces before staining or printing on natural or synthetic fibers.

Only for R&D purpose, not for massive production



Bio-Medical

Surface cleaning and modification for wettability and unwettability purposes, for the following applications :

- Selective filtration of biologic fluids
- Implant devices
- Bonding among different materials (like syringe needles, catheters, etc.)
- Final ultrafine atomic level cleaning from organic residues after typical industrial cleaning cycles
- Contact and intraocular lenses
- Stents
- Vials
- Sterilization on sensible plastic materials

Gambetti Vacuum Technology

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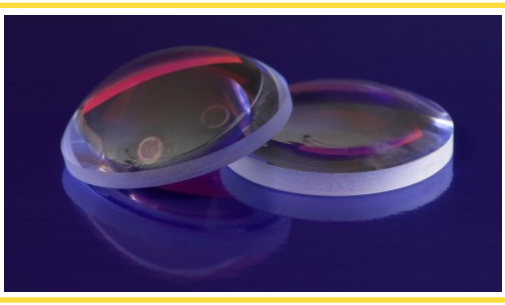
Plastic Industry

Surface cleaning and modification for wettability and unwettability purposes, for the following applications :

- Plastics bonding to plastics or other materials
- Surface activation before painting, with possibility to eliminate the usage of Primers
- Wettability before printing
- Removal of organic residues after molding before painting/printing
- Surface fluorination for enhanced functionality
- Crosslinking
- Surface polimerization

Precision mechanics

Cleaning at the atomic level of metal and ceramic surfaces after industrial washing to improve paintability or other types of coatings (eg PVD).



Optical and ophthalmic

Cleaning at the atomic level and pre-treatment after industrial washing to improve the adhesion of anti-glare coatings, scratch-resistant and various; polymerization of layers scratch and anti-fog.

Cultural heritage

Antibacterial and fungicide treatments for the recovery and preservation of old books and antique glass.

Sistemi di Processo
Caratterizzazione Superficiale
Strumentazione Controllo di Processo
Prodotti di Consumo

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Technical description of the system

Heron 80 is a large size stand alone plasma system, designed for surface cleaning, modification and activation. It can operate on different materials such as metals, plastic, ceramic, paper and others. The characteristics described below make Heron 80 an easy and versatile solution for small productions or R&D environments.

The **mainframe** is made of stainless steel, with removable back and side panels for an easy access for maintenance or troubleshooting purposes. The exterior finishing is "light brushed".

It can also be installed in Clean Rooms with a "through the wall" configuration.

The **control system** of Heron 80 is based on an advanced PLC equipped with a touch screen HMI operator panel. Thanks to the user friendly graphical interface it is possible to directly operate on the system components or let the PLC to carry out a process based on a recipe editable by the user. The PLC, with its fast scanning time, continuously measures all the system parameters in order to ensure uniform and reliable processes. The only manual handling that can not be avoided is the step of loading/unloading the samples.

Heron 80 is a **plasma reactor**[1] capacitively coupled and comprises a cylindrical process chamber with a couple of concentric cage electrodes inside.

The Process **chamber** is made of Aluminium. Thanks to the natural Al oxide formation on the surface, aluminium can be used in the presence of many process gases (included fluorinated etch gas), this feature makes these reactors suitable for most of the reactive plasma environments (i.e. etching, Ashing...). The absence of welds ensures a better seal thus preventing external contamination during the process

Two perforated **electrodes** in a cage arrangement (also referred as "faraday cage" arrangement) are placed inside the chamber, with one RF biased and the other one grounded. This set up allows to generate a plasma between the two electrodes, by using a Radio Frequency electromagnetic excitation and allowing only to chemical active species (radicals and neutrals) to diffuse to the center of the chamber where samples to be processed are placed; the physical component of the plasma (ions) is confined and not impinging the samples. This configuration allows to treat also delicate materials that could degrade due to ion bombardment and overheating. The inner cage electrode size allows to process wafer up to 150 mm or other types of samples shapes, as single pieces or batches.

The **front door** allows full access to the inside of the chamber, for easy loading, unloading and maintenance. It is equipped with a viewport, suitably shielded against RF and UV.

The **RF signal delivery system** consists mainly of a radio frequency generator and an automated matching network. The RF generator is a 600 W@13,56 MHz solid state generator, it provides the necessary signal to light and maintain the plasma and it is fully protected against any load mismatch or adverse load condition.

RF load matching is performed by a fast acting variable air capacitors based Automatic Matching Network, thanks to this part it is possible to obtain the maximum transfer of power from the generator to the plasma.

The vacuum in the process chamber is achieved using an external **pump**[2]. Usually a suitable two stage rotary vane vacuum pump, with a pumping capacity no less of 40 m^3/hours, is supplied with the system.

The **process pressure** is measured by a temperature controlled absolute capacitance manometer (Baratron™), moreover an independent pressure switch is installed to check the vacuum integrity for safety purposes, in fact, it prohibits the introduction of the process gases and the RF signal supply above a pressure threshold.

The system could be equipped with up to three process **gas lines**. Each gas line is equipped with an appropriate mass flow controller (MFC) and a shut-off valve.

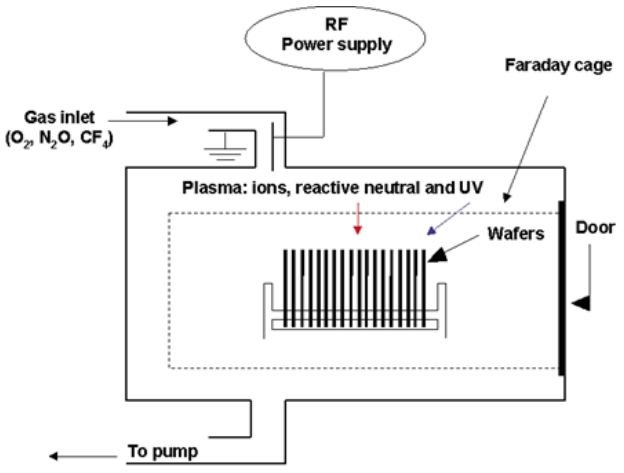
In case it is required to speed up the plasma reaction on some material (i.e. resins, polymers). it is possible to equip the system with an **external heating** as optional.

[1] Built on the well-known Oxford Instruments Plasma Technology Barrel plasma PRS 80 reactor original process chamber design, with suitable modern control electronics and state of the art internal components supplied by leading manufacturers.

[2] for oxygen based processes it is strongly recommended to use perfluorinated polyether inert fluids or dry pumps

Principle of operation

SYSTEM FRONTAL VIEW



PLASMA REACTOR SCHEME

When a gas under sufficiently low pressure is subjected to a high frequency oscillating electromagnetic field, the accelerated ions in the gas collide with the gas molecules ionizing them and forming plasma.

The ionized gas particles in the plasma interact with solid surfaces placed in the same environment. A chemical reaction occurs between the plasma gas molecules and the surface undergoing treatment.

The sample is placed in the reaction chamber. The pressure inside the chamber is reduced using the vacuum pump.

Low rates of one or more process gases are introduced into the process chamber by using mass flow controllers (MFCs).

A radio frequency (RF) signal is led to the electrodes into the chamber subjecting the gas to a RF electromagnetic field. This field, interacting with the gas molecules, creates the plasma within the chamber.

The generated plasma provides reactive ionic species that act on the first monolayer of the substrate surface to be treated.

The type of interaction between the plasma and the surface depends on parameters such as:

- intensity and frequency of the RF power used to excite the plasma
- type, pressure and flow rate of the gases that are ionized
- type of sample
- amount of time the surface is exposed to the plasma.

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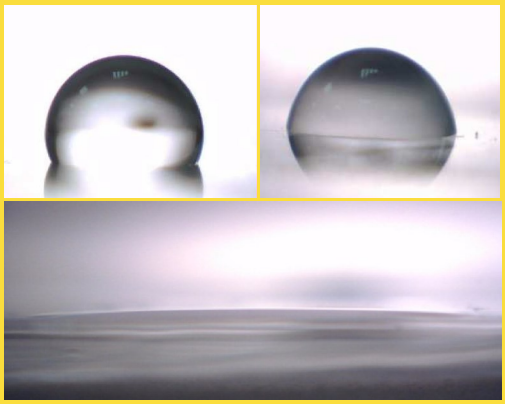
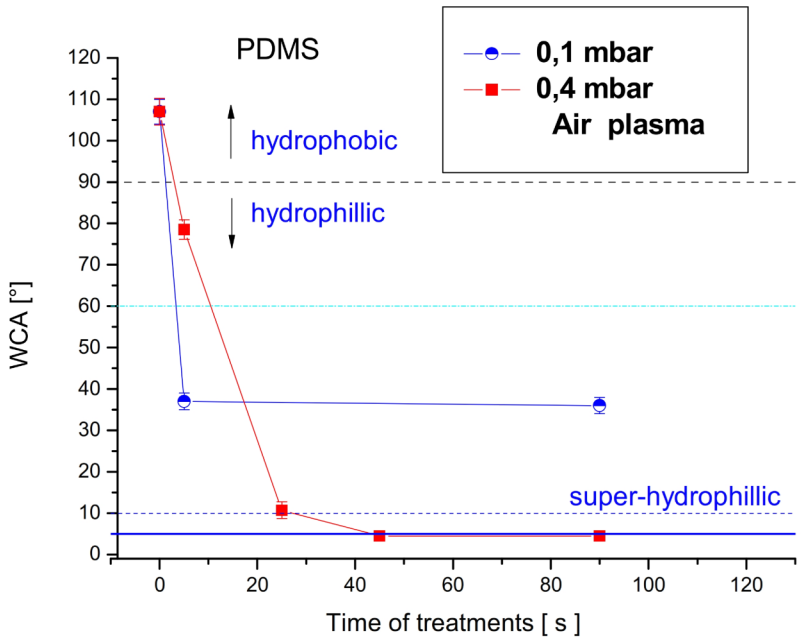
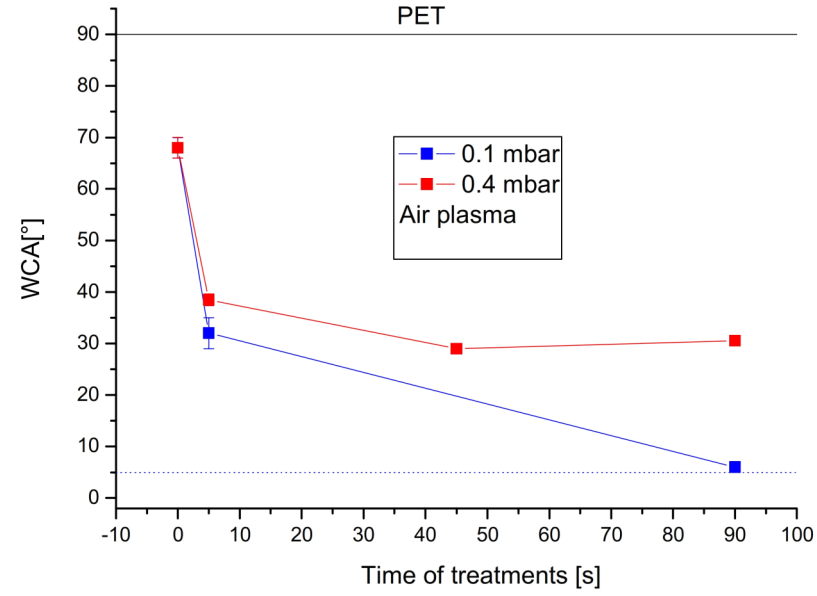
Experimental results



Change in contact angle of PDMS in function of time for different pressure values.
The insets show the micrographs of the droplet before and after air plasma treatment.



Change in contact angle as a function of the treatment time on the surface PET.



*Reference: R.Bartali[1], L. Lorenzelli[1], M.Scarpa[2], E.Morganti[1], C.Collini[1], V.Micheli[1], G. Gottardi[1],A. Gambetti[3],G. Gambetti[3],G. Coser[1],R. Pandiyan[1],I. Luciu[1], N. Laidani[1], "**Super-Hydrophilic PDMS and PET Surfaces for Microfluidic Devices**", Advances in Science and Technology, Vol. 81, pp. 96-100, 2013*

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2) Department of Physics University of Trento, Trento, Italy
3) Gambetti Kenologia, Binasco Milano

PRODUCT FEATURES

- Low cost of ownership
- The touch screen display provides in real-time all the main information for excellent process control and rapid analysis
- Able to process up to ten different editable recipes
- Uniformity for Consistent Results
- Datalogging capabilities, frequency <0.5 Hz, for historical condition of the process
- Excellent process control and long term reliability and stability
- Primary brands components used, such as vacuum gauges and mass flow controllers (MKS Instruments)
- RF power level adjustable in the range 1W to 600W

TECHNICAL SPECIFICATION

Dimensions	W x L x H – Footprint	700 x 600 x 1750 mm
	Net Weight	130 Kg without vacuum pump
	Clearances	Right, Left, Front – 600 mm, Back – 254 mm
Chamber	Material	Aluminum
	Max Volume	22.5 lt. (1373 in³) - Ø 343 mm L 280 mm
Electrode	Material	Aluminum
	Active work area/Sample tray	239 mm x 250 mm
	Height	168 mm
RF Signal	Max Power	600W
	Frequency	13,56 MHz
Process Gases	Available flows	10, 20, 50, 100, 200 or 500 sccm
	Max gases lines	3 (Mass Flow Controller from MKS Instruments)
Control Interface	Control	PLC
	User Interface	Touchscreen Display
Facility Service	Power supply	Three-phase + N + Earth 380/415 VAC, 32 Amax 50/60 Hz, 7 AWG Three-phase + N + Earth 208/240 VAC, 40 Amax, 50/60 Hz, 5 AWG
	Process Gas inlets, type and dimensions	6,35 mm (0.25 in.) OD, Swagelok®
	Process gas pressure	From 1 bar (15 psig) min. to 3 bar (45 psig) max., regulated
	Purge Gas inlets, type and dimensions	6,35 mm (0.25 in.) OD, Swagelok®
	Suggested Purge Gas	N2, Air
	Purge Gas Pressure	From 1 bar (15 psig) min. to 3 bar (45 psig) max., regulated
	Exhaust	NW40 ISO-KF
	Pneumatic Valve gas Purity	Compressed Air, Oil Free, Dew point ≤7°C (45°F), particulate dimensions <5 µm
	Pneumatic Valve gas pressure	From 2 bar (30 psig) min. to 6 bar (90 psig) max., regulated
Compliance	International	CE Marked

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