PRODUCT CATALOGUE

AMMT GmbH — Advanced Micromachining Tools
Anselm-Feuerbach-Strasse 6, 67227 Frankenthal, Germany
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We want to ensure that we have close contact with our customers. If you have any questions or special requirements, please do not hesitate to get in touch with us. This product information sheet is for general information purposes only. The product descriptions and the content of this document are not a substitute for our instructions in the product manual.

THE LEADING SUPPLIER OF SPECIALITY WET ETCHING EQUIPMENT
FOR THE MICROTECHNOLOGY WORLD.

AMMT

COMPANY OVERVIEW

Advanced Micromachining Tools GmbH (AMMT) provides solutions in the field of silicon micromachining. We are supplier of process control equipment for wet-chemical etching of silicon, possibly one of the most important fabrication processes of bulk micromachining. In our development team, MEMS engineers, electronics specialists and computer programmers combine their efforts to develop user-friendly, safe and demand-oriented systems for our clients. Our strong R&D cooperations with international research institutes.

PRODUCTS

Wet Etching

Single series
A wafer holder for a single wafer with backside protection

Tandem series
Unique wafer holders for two wafers mounted face-to-face

Single OW
Unique wafer holders with a backside optical window

Single IL
Unique wafer holders with built-in backside illumination

Single Chip
Special custom-made holders for single chips

Infrared Spectroscopy etch-stop

Single IRES
System for insitu measurement of membrane thickness

Electrochemical etch-stop

Wafer holder series

Single EC
Wafer holders for single wafers with electrical contacts for etch-stop

Electrode set
Complete set of platinum net and pseudo-reference electrodes for etch-stop

MEMS Potentiostat

Model SC
Compact potentiostat with special features for electrochemical etch-stop

Model MC
Multi-channel potentiostat for medium- to large scale manufacturing

Software
Software to control and monitor etch-stop processes using a PC

Electroplating

Electroplating
Wafer holder with front side contacts.

Porous silicon

Porous Silicon System PSB
Double cell HF-bath for porous silicon formation with wafer holders for full-wafer porosification or tests

Porous Silicon System PSB Single Cell
Single cell HF-bath for porous silicon formation

Compact Porous Silicon System
Small double cell etching system for porous silicon formation.

NEW

PS Power Supply and Control Software
Flexible programmable power supply with control software for time-based current profiles

Hydrofluoric acid vapor etcher

HF vapor etcher Basic (HFVE)
R&D setup for sticking free and dry silicon oxide removal

HF vapor etcher System (HFVE)
System for sticking free and dry silicon oxide removal including automated HF media handling

Customer specific developments

Certain challenges can only be resolved individually. For some applications, standard products have to be adapted while others require the development of an entirely new system. In such cases AMMT's engineers are on hand, with help and advice to develop a system from its first sketch to a final product. We offer not only customized engineering but also precise machining of PEEK and other polymers, sensing- and control-electronics, data acquisition, and software-development. Your problem is our challenge, and we are glad to assist you in solving this problem.

Mission Statement. Our focus is the development of smart instruments and reliable tools for silicon micromachining taking advantage of our inside knowledge of MEMS engineers' demands. We provide reliable all-in-one solutions for both research and industry.

References. AMMT works hard to satisfy its customers by providing reliable and user-friendly products - and in a service-based industry, the client is what a business is all about. AMMT had the privilege of working with some great clients. Here are just a few ...

Bosch
Siemens Corporate Technology
Sony
Honeywell Sensing & Control Division
Samsung Advanced Institute of Technology
Measurement Specialties, Inc.
Fraunhofer-Institut für Biomedizinische Technik (IBMT)
Fraunhofer-Institut für Physikalische Messtechnik (IPM)
Fraunhofer-Institut für Photonische Mikrosysteme (IPMS)
Micralyne – MEMS Foundry
XFAB Semiconductor Foundries AG
SMI Silicon Microstructures, Inc
Solexel
GE Sensing & Inspection Technologies
GE Global Research.
Korea Institute of Science and Technology

Visit us online at www.ammt.com for a full list of references.

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AMMT signed additional distribution agreements worldwide. Please ask for further details.

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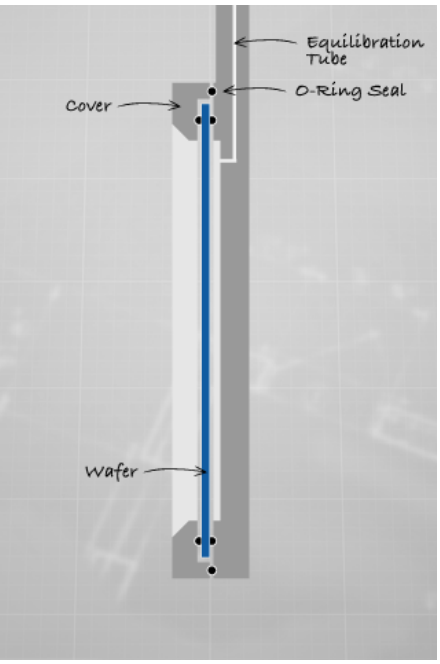
WAFER HOLDER — SINGLE
WITH BACKSIDE PROTECTION

PRODUCT INFORMATION SHEET WE



Single 12 (300 mm) , Single 6 (150 mm) and Single 4 (100 mm)

The Single wafer holders have been used for more than 15 years in MEMS industry and research. Wafer holders are available for wafers with 3", 4", 5", 6", and 8" diameters. The Single series wafer holder protects the wafer's back side and the edge from the etchant solution. Should etching capabilities for more than one wafer be required, AMMT offers the Tandem series of holders, which holds two wafers back to back.

All holders are made entirely from PEEK, in order to avoid any risk of etchant contamination by metal parts. They are suitable for nearly all etchants (KOH, TMAH, HF, H3PO4, etc.) over an extended temperature range.

The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. The cover-ring on the front side holds the wafers in place, fixed by six screws. Since the customer-specific wafer thickness is manufactured as a recess into the cover-ring, all screws can be tightened using a regular wrench, regardless of the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

Upon ordering the holder, the wafer thickness machined as a recess into the cover-ring needs to be specified. The holder tolerates wafers with a thickness of +/- 80 um around the specified target thickness. If more flexibility is required, additionally cover-rings with different recesses can always be ordered.

Furthermore, the volume between the wafer and holder body is connected by a venting tube to the ambient atmosphere in order to avoid pressure caused by temperature changes.

The regular Single series is designed for single-side etching processes that do not require electrical contacts, e. g. time based etching, etch-stop on oxide or nitride layers, SOI wafers, glass/quartz etching in HF, etc.

In order to keep maintenance costs low, all O-rings have dimensions in accordance with the American AS-568 standards.

TECHNICAL SPECIFICATIONS

Product code	**Single3**	**Single4**	**Single4 LAA***	**Single5**
Wafer size	3" or 75 mm	4" or 100 mm	4" or 100 mm	5" or 125 mm
Internal dimensions				
Width of the O-ring seal	1.78 mm	1.78 mm	1.78 mm	1.78 mm
Recommended edge exclusion width	7 mm	7 mm	3.75 mm	10 mm
Diameter of usable area	61 mm	86 mm	92.5 mm	105 mm
External dimensions				
Diameter	114 mm	140 mm	140 mm	158 mm
Thickness	26 mm	27 mm	27 mm	28 mm
Materials				
Main Body and corver-ring material	PEEK			
O-ring material	EPDM 70 – upon request FPM (Viton®) or FFPM (Kalrez®)			
Etchant compatibility	KOH, TMAH, HF, H_3PO_4 and various acids			
Temperature range	5° C - 150° C			

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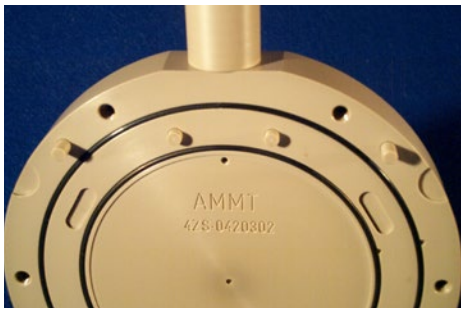
	Single6	Single6 LAA*	Single8
Wafer size	6" or 150 mm	6" or 150 mm	8" or 200 mm
Internal dimensions			
Width of the O-ring seal	1.78 mm	2.62 mm	2.62 mm
Recommended edge exclusion width	10 mm	5.5 mm	5.5 mm
Diameter of usable area	130 mm	140.5 mm	189 mm
External dimensions			
Diameter	186 mm	185 mm	240 mm
Thickness	28 mm	28 mm	30 mm
Materials			
Main Body and corver-ring material	PEEK		
O-ring material	EPDM 70– upon request FPM (Viton®) or FFPM (Kalrez®)		
Etchant compatibility	KOH, TMAH, HF, H_3PO_4 and various acids	KOH, TMAH, HF, H_3PO_4 and various acids	KOH, TMAH, HF, H_3PO_4 and various acids
Temperature range	5° C - 150° C	5° C - 150° C	5° C - 150° C

* Wafer holder with enlarge active area option (LAA), the o-ring shape is adapted to wafers flat.



Standard configuration the o-ring shape is fully around.

OPTIONS

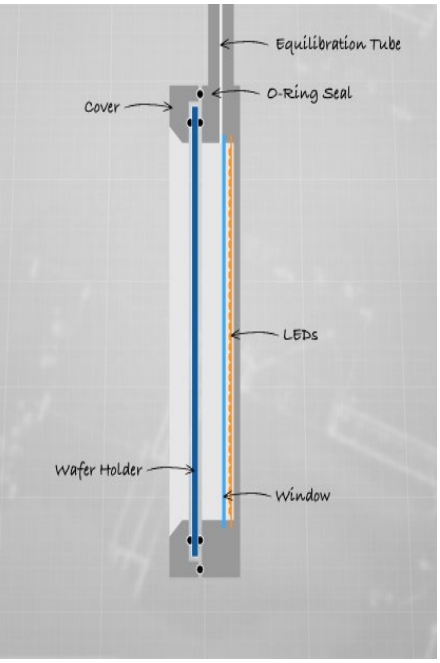
The handle length is customer specific. Please inquire for customer specific mounting options.

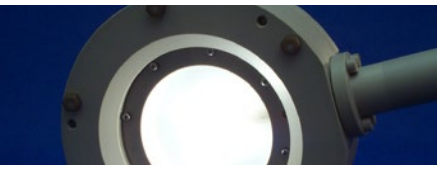
NOTE

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

WAFER HOLDER — SINGLE IL
WITH BACKSIDE ILLUMINATION

Schematic diagram
of the Single IL wafer holder with LEDs





The Single IL wafer holders have been used for more than 15 years in MEMS industry and research. Wafer holders are available for wafers with 3", 4", 5", 6", and 8" diameters. The Single series wafer holder protects the wafer's back side and the edge from the etchant solution.

A unique feature of the IL series is an integrated halogen lamp or an LED array for inspection of the membrane thickness. Silicon membranes of about 22 µm or less are optically transmissive and appear in different shades of brown depending on their thickness. The backside illumination feature is a tool which helps to overcome some of the shortcomings of time-based etch stops.

The holder is made entirely from PEEK; it is suitable for nearly all etchants (KOH, TMAH, HF, H3PO4, etc.)

The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. The cover-ring on the front side holds the wafers in place, fixed by six screws. Since the customer-specific wafer thickness is manufactured as a recess into the cover-ring, all screws can be tightened using a regular wrench, regardless of the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

Upon ordering the holder, the wafer thickness machined as a recess into the cover-ring needs to be specified. The holder tolerates wafers with a thickness of +/- 80 um around the specified target thickness. If more flexibility is required, additionally cover-rings with different recesses can always be ordered.

Furthermore, the volume between the wafer and holder body is connected by a venting tube to the ambient atmosphere in order to avoid pressure caused by temperature changes.

In order to keep maintenance costs low, all O-rings have dimensions in accordance with the American AS-568 standards.

TECHNICAL SPECIFICATIONS

Product code	**Single4 IL**	**Single6 IL**	**Single8 IL**
Wafer size	4" or 100 mm	6" or 150 mm	8" or 200 mm
Internal dimensions			
Width of the O-ring seal	1.78 mm	1.78 mm	2.62 mm
Recommended edge exclusion width	7 mm	10 mm	9 mm
Diameter of usable area	86 mm	130 mm	182 mm
Diameter of optical area	86 mm	130 mm	182 mm
External dimensions			
Diameter	140 mm	183 mm	240 mm
Thickness with halogen bulb	23 mm (+9 mm)	23 mm (+10 mm)	25 mm (+11 mm)
Thickness with LEDs	18 mm (+9 mm)	18 mm (+10 mm)	20 mm (+11 mm)
Etchant compatibility	KOH, TMAH, HF and various acids	KOH, TMAH, HF and various acids	KOH, TMAH, HF and various acids
Temperature range	5° C - 150° C	5° C - 150° C	5° C - 150° C

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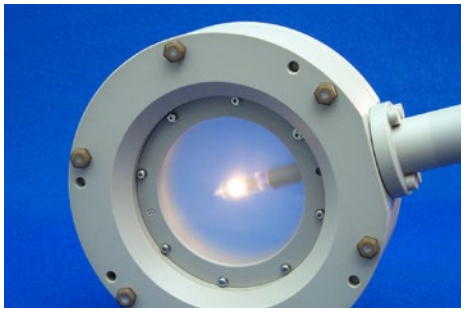
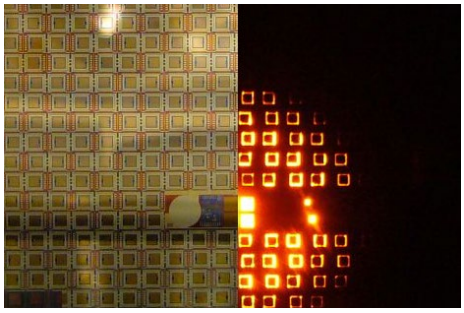


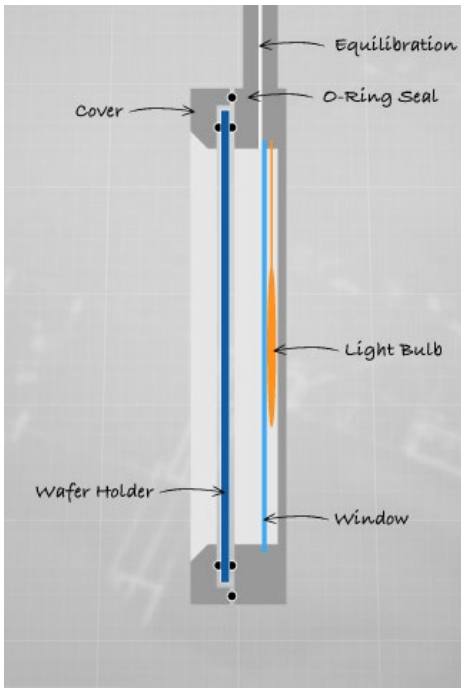
Image of a Single 100 IL

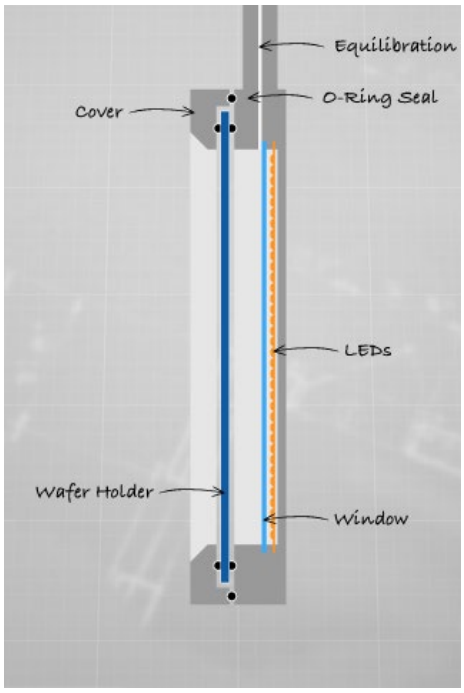


(left side) Wafer without illumination — with illumination turned on (right side), silicon membranes of about 22 µm or less are optically transmissive and appear in different shades of brown depending on their thickness

The Single IL wafer holder is available with a halogen bulb or LEDs for backside illumination.

OPTIONS





The halogen bulb version is also available in a Tandem configuration.

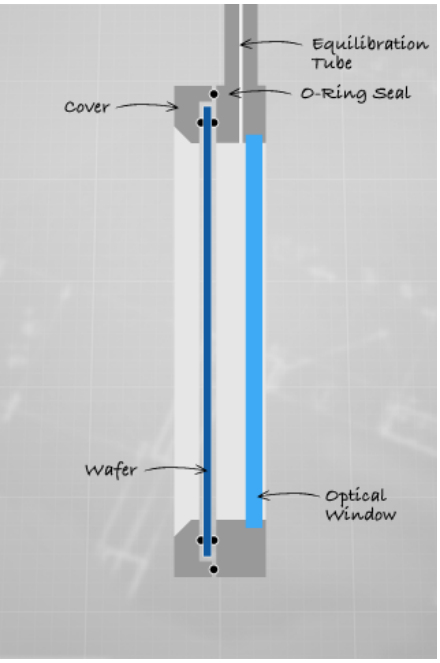
NOTE

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

WAFER HOLDER — SINGLE OW
WITH OPTICAL BACKSIDE WINDOW

PRODUCT INFORMATION SHEET WE

Schematic diagram
of the Single OW wafer holder



The Single OW wafer holder series has been used for more than 15 years in MEMS industry and research. Wafer holders are available for wafers with 3", 4", 5", 6", and 8" diameters. The Single series wafer holder protects the wafer's back side and the edge from the etchant solution.

A unique feature of the OW series is an optical backside window for inspection of the membrane thickness. Silicon membranes of about 22 µm or less are optically transmissive and appear in different shades of brown depending on their thickness. The OW series of wafer holders features a transparent back side for optical inspection without built-in illumination. Pyrex glass is used for KOH- and TMAH-etching, or as an option, a solid sapphire window for HF. The holder is made entirely from PEEK; it is suitable for nearly all etchants (KOH, TMAH, HF, H3PO4, etc.)

The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. The cover-ring on the front side holds the wafers in place, fixed by six screws. Since the customer-specific wafer thickness is manufactured as a recess into the cover-ring, all screws can be tightened using a regular wrench, regardless of the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

Upon ordering the holder, the wafer thickness machined as a recess into the cover-ring needs to be specified. The holder tolerates wafers with a thickness of +/- 80 um around the specified target thickness. If more flexibility is required, additionally cover-rings with different recesses can always be ordered.

Furthermore, the volume between the wafer and holder body is connected by a venting tube to the ambient atmosphere in order to avoid pressure caused by temperature changes.

In order to keep maintenance costs low, all O-rings have dimensions in accordance with the American AS-568 standards.

TECHNICAL SPECIFICATIONS

Product code	Single4 OW	Single6 OW	Single8 OW
Wafer size	4" or 100 mm	6" or 150 mm	8" or 200 mm
Internal dimensions			
Width of the O-ring seal	1.78 mm	1.78 mm	2.62 mm
Recommended edge exclusion width	7 mm	10 mm	5.5 mm
Diameter of usable area	86 mm	130 mm	182 mm
Diameter of optical window	86 mm	130 mm	182 mm
External dimensions			
Diameter	140 mm	183 mm	240 mm
Thickness	18 mm (+9 mm)	18 mm (+10 mm)	20 mm (+11 mm)
Etchant compatibility	KOH, TMAH, HF and various acids	KOH, TMAH, HF and various acids	KOH, TMAH, HF and various acids
Temperature range	5° C - 150° C	5° C - 150° C	5° C - 150° C

NOTE

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

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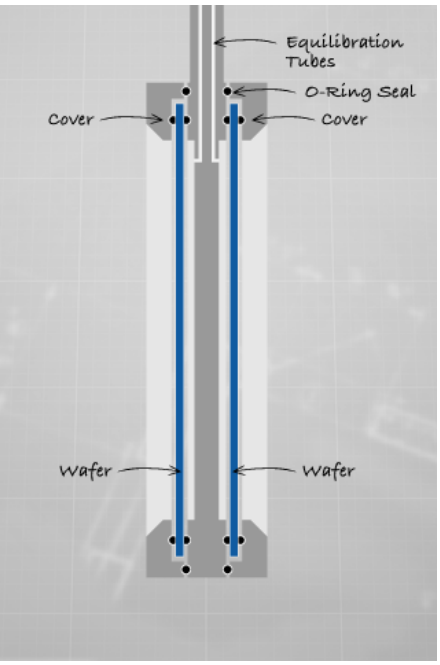
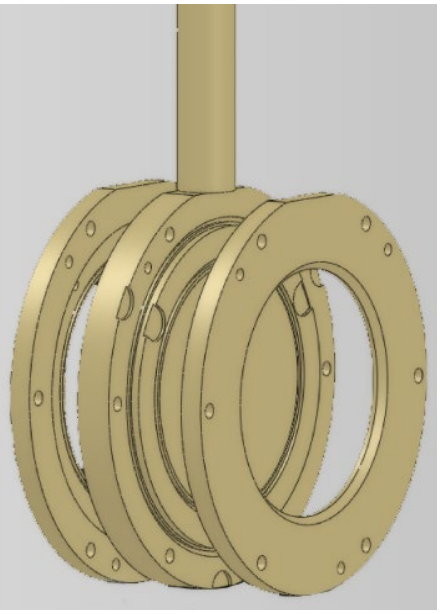
WAFER HOLDER — TANDEM
WITH BACKSIDE PROTECTION

PRODUCT INFORMATION SHEET WE





Working principle of the Tandem wafer holder

The Tandem wafer holders have been used for more than 15 years in MEMS industry and research. Tandem wafer holders are available for wafers with 3", 4", 5", 6", and 8" diameters. The Tandem series wafer holder protects the wafer's back side and the edge from the etchant solution. A unique feature of AMMT's Tandem holders is their symmetrical, small-footprint construction that allows one to mount two wafers with the etchant protected sides facing each other. However, it is important to note that both sides are fully independent from each other. Consequently, even a small etchant bath can be used to etch a number of wafers simultaneously. If only one wafer needs to be processed, blind covers are available for purchase.

All holders are made entirely from PEEK, in order to avoid any risk of etchant contamination by metal parts. They are suitable for nearly all etchants (KOH, TMAH, HF, H3PO4, etc.) over an extended temperature range. The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. Two covers on the front and back side hold the wafers in place, fixed by six screws. As the customer-specific wafer thickness is machined as a recess into the cover, all screws can be tightened using a regular wrench without sensitivity to the applied torque. This ensures a minimum mechanical stress on the fragile wafer. Upon ordering the holder, the wafer thickness machined as a recess into the cover-ring needs to be specified. The holder tolerates wafers with a thickness of +/- 80 um around the specified target thickness. If more flexibility is required, additionally cover-rings with different recesses can always be ordered. Furthermore, the volume between the wafer and holder's body is connected by a venting tube (one separate for each side) to the ambient atmosphere in order to avoid pressure caused by temperature changes.

The standard Tandem series is designed for single side etching processes that do not require electrical contact, e. g. time based etching, etch-stop on oxide or nitride layers, SOI wafers, glass/quartz etching in HF, etc.

In order to keep maintenance costs low, all O-rings have dimensions in accordance with the American AS-568 standards.

TECHNICAL SPECIFICATIONS

Product code	Tandem3	Tandem4	Tandem4 LAA	Tandem5
Wafer size	3" or 75 mm	4" or 100 mm	4" or 100 mm	5" or 125 mm
Internal dimensions				
Width of the O-ring seal	1.78 mm	1.78 mm	1.78 mm	1.78 mm
Recommended edge exclusion width	7 mm	7 mm	3.75 mm	10 mm
Diameter of usable area	61 mm	86 mm	92.5 mm	105 mm
External dimensions				
Diameter	114 mm	140 mm	140 mm	158 mm
Thickness	34 mm	38 mm	38 mm	38 mm
Materials				
Main Body and corver-ring material	PEEK			
O-ring material	EPDM 70 – upon request FPM (Viton®) or FFPM (Kalrez®)			
Etchant compatibility	KOH, TMAH, HF and various acids			
Temperature range	5 °C – 150 °C			

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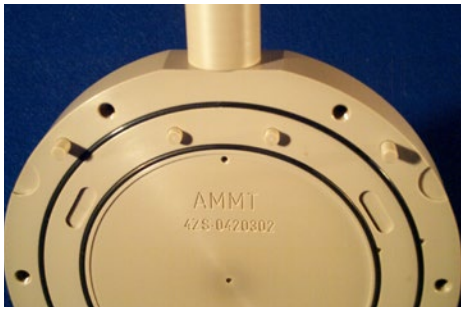
Product code	Tandem6	Tandem6 LAA*	Tandem8	Tandem8 exp195
Wafer size	6" or 150 mm	6" or 150 mm	8" or 200 mm	8" or 200 mm
Internal dimensions				
Width of the O-ring seal	1.78 mm	2.62 mm	2.62 mm	1.78 mm
Recommended edge exclusion width	10 mm	5.5 mm	5.5 mm	2.5 mm
Diameter of usable area	130 mm	140.5 mm	189 mm	195 mm
External dimensions				
Diameter	186 mm	186 mm	240 mm	240 mm
Thickness	38 mm	38 mm	41 mm	41 mm
Materials				
Main Body and corver-ring material	PEEK			
O-ring material	EPDM 70 – upon request FPM (Viton®) or FFPM (Kalrez®)			
Etchant compatibility	KOH, TMAH, HF and various acids			
Temperature range	5 °C – 150 °C			

* Wafer holder with enlarge active area option (LAA), the o-ring shape is adapted to wafers flat.



Standard configuration the o-ring shape is fully around.

OPTIONS

The handle length is customer specific. Please inquire for customer specific mounting options.

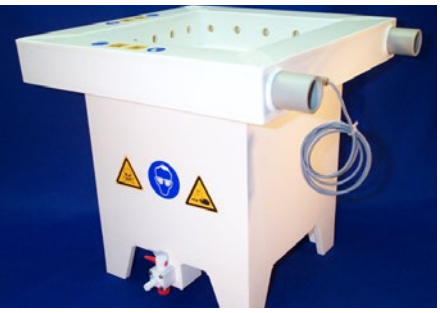
NOTE

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

WET ETCHING – HF ETCH BOX

SOLUTION FOR MEDIUM SCALE HF-ETCHING

HF Etch Box



AMMT's Hydrofluoric Acid Etching System (HFE) holds up to four Single type wafer holders for single side etching of glass, quartz , and silicon substrates. Applications are the fabrication of microfluidic devices in SiO -based materials, or through-hole etching into glass cover plates and the like. The system is designed primarily to ensure both workplace safety and state-of-the-art etching performance.

Because HF is a very hazardous substance to work with, several system features ensure minimum exposure to the etchant and its vapors:

- Stable and reliably welded PP construction.
- A tight lid reduces evaporation into the working environment.
- An extraction system above the lid removes vapors safely into the extraction lines of your lab or fab.
- Integrated drain cock for easy etchant replacement.

The Single wafer holders used in the HF Bath etching system are similar to our standard Single wafer holders used for other applications. Each wafer holder holds a single 4" wafer and protects its back side and edge from the etchant solution.

The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. Two covers on the front and back side hold the wafers in place, fixed by six screws. Since the customer-specific wafer thickness is machined as a recess into the cover, all screws can be tightened using a regular wrench, without sensitivity to the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

Holders for other wafer sizes as well as for single chips and glass substrates are available upon request.

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

TECHNICAL SPECIFICATIONS

Wafer size	4" or 100 mm
Internal dimensions	
Width x Height x Depth	200 x 200 x 200 mm^3
External dimensions	
Width x Height x Depth with vapor extraction	320 x 330 x 320 mm^3
Material	Polypropylene (PP), welded
Wafer holder	Single wafer holder: Width of the O-ring seal: 1.8 mm Recommended edge exclusion: 7 mm Diameter of active area: 86 mm Larger active area optional
Stirrer	Vertical, rotational stirrer prepared for motor drive

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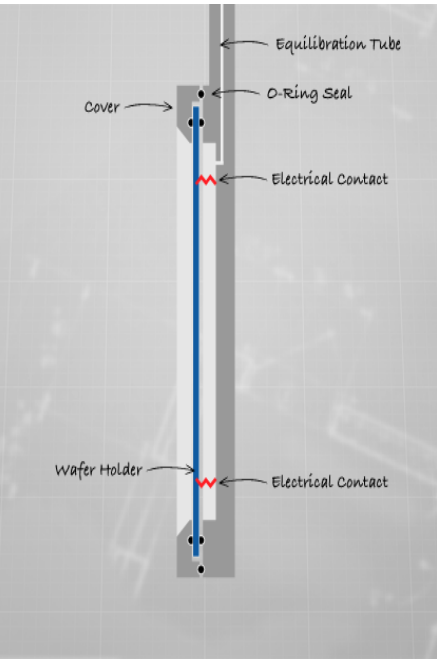
Connections	
Fluidic	drain cock (+GF+ ball walve 546 PPH - DN10) pneumatic actor optional
Extraction	Two connectors for HF vapor extraction (50 mm long, 33 mm outer diameter, 26 mm inner diameter)
Fixtures	Welded threaded joints for wet bench mounting
Cover	PP cover plate with holder (below extraction)
Etchant compatibility	HF and HF-ethanol mixtures
Temperature range	10° C - 30° C

WAFER HOLDER — SINGLE EC
WITH ELECTRICAL CONTACTS

PRODUCT INFORMATION SHEET EC

Schematic diagram
of the Single EC wafer holder



The Single EC wafer holders are based on the regular Single wafer holders which are in used for more than 15 years in MEMS industry and research. Wafer holders are available for wafers with 3", 4", 5", 6", and 8" diameters. The Single EC series wafer holder protects the wafer's back side and the edge from the etchant solution while allowing to electrically contact the wafers back-side. Should etching capabilities for more than one wafer be required, AMMT offers the Tandem series of holders, which holds two wafers back to back.

All holders are made entirely from PEEK, they are suitable for nearly all etchants (KOH, TMAH, HF, H3P04, etc.) over an extended temperature range. The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. The cover-ring on the front side holds the wafers in place, fixed by six screws. Since the customer-specific wafer thickness is manufactured as a recess into the cover-ring, all screws can be tightened using a regular wrench, regardless of the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

Upon ordering the holder, the wafer thickness machined as a recess into the cover-ring needs to be specified.

The holder tolerates wafers with a thickness of +/- 80 µm around the specified target thickness. If more flexibility is required, additionally cover-rings with different recesses can always be ordered.

Furthermore, the volume between the wafer and holder body is connected by a venting tube to the ambient atmosphere in order to avoid pressure caused by temperature changes.

The regular Single EC series is designed for single-side etching processes that do require electrical contacts to the wafers back-side, e. g. electrochemical etch-stop processes or porous silicon formation. Therefore it is equipped with two gold-plated, spring mounted electrical contacts that are placed according to user requirements. In order to keep maintenance costs low, all O-rings have dimensions in accordance with the American AS-568 standards.

TECHNICAL SPECIFICATIONS

Product code	Single3 EC	Single4 EC	Single4 EC-LAA	Single5 EC
Wafer size	3" or 75 mm	4" or 100 mm	4" or 100 mm	5" or 125 mm
Internal dimensions				
Width of the O-ring seal	1.8 mm	1.8 mm	1.8 mm	1.8 mm
Recommended edge exclusion width	7 mm	7 mm	3.75 mm	7 mm
Diameter of usable area	61 mm	86 mm	92.5 mm	105 mm
External dimensions				
Diameter	114 mm	140 mm	140 mm	158 mm
Thickness	26 mm	27 mm	27 mm	27 mm
Electrical contacts				
Spring loaded pins (gold-plated)	2 contacts (more up request)			
Etchant compatibility	KOH, TMAH, HF and various acids			
Temperature range	5° C - 150 °C			

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Product code	Single 6 EC	Single 6 EC LAA	Single 8 EC
Wafer size	6" or 150 mm	6" or 150 mm	8" or 200 mm
Internal dimensions			
Width of the O-ring seal	1.8 mm	2.62 mm	2.62 mm
Recommended edge exclusion width	7 mm	5.5 mm	5.5 mm
Diameter of usable area	130 mm	140.5 mm	189 mm
External dimensions			
Diameter	186 mm	185 mm	240 mm
Thickness	28 mm	28 mm	30 mm
Electrical contacts			
Spring loaded pins (gold-plated)	2 contacts (more up request) Contact positions customer specific		
Etchant compatibility	KOH, TMAH, HF and various acids		
Temperature range	5° C - 150 °C		

NOTE

AMMT manufactures wafer holders for all sizes of wafers. Holders for single chips and rectangular substrates are available as well. Please inquire for specifications and prices.

MEMS POTENTIOSTAT MODEL SC

PRODUCT INFORMATION SHEET EC

MEMS Potentiostat Model SC

The MEMS Potentiostat has been specially designed for use with electrochemical etch-stop techniques.

The fabrication of many microelectro-mechanical systems (MEMS) depends on a reliable and easy to use potential controller for this processing step.

The MEMS Potentiostat meets both of these demands. A high degree of integration and a powerful microcontroller underscore the technical refinement of this system. Low noise op-amps, precision voltage references and high accuracy A/D- and D/A-converters guarantee excellent reproducibility of your etch-stop process.

Furthermore, the unit detects common errors, such as a broken wafer or cable, and alerts the operator with an error description. The MEMS Potentiostat has been designed for easy and safe operation. A display indicates the current process values, time and etch-stop status. The potentiostat offers both manual and computer controlled operation for a high degree of flexibility in research and production. In manual mode the user sets the bias voltage directly on the potentiostat. In computer controlled mode dedicated Windows software gives the user control over all potentiostat settings.

Software. A dedicated software package for Microsoft Windows (Vista, Win 7/8) gives you convenient control over all potentiostat settings. During the etching process the program logs all data and presents it on screen in an I/t-diagram. The potentiostat readout is permanently checked to ensure fast detection of problems during the process. All process relevant information is saved on the computer's hard disk for later use with other programs.

The integrated data analysis tool allows the user not only to reload data from disk, but also to view, print and customize diagrams or listed data and to include charts into other Windows programs via the Windows clipboard. Furthermore, AMMT's software engineers have included a cataloguing system that keeps track of every single wafer that you have processed with the MEMS Potentiostat.

Every piece of information, e. g. bias voltage, processing time and your wafer ID, are stored to help you to insure production quality.

Potential Controller. We have chosen a potential range of -10 to 10 V and a maximum output current of 750 mA that meet the needs of a MEMS fab line perfectly. By limiting the output voltage to a value appropriate for electrochemical etch-stop techniques, a significant reduction of the potentiostat's size and cost has been achieved. Thus, you can save both money and valuable cleanroom space. Moreover, the MEMS Potentiostat is a precision instrument offering a wide variety of interesting features, e. g. an additional voltage output for a four electrode configuration.

Microcontroller. A RISC microprocessor controls all functions of the potentiostat, such as the real-time display, manual mode and the autoranging current-to-voltage-converter. It also serves as protocol server for the computer interfaces and handles user programming via these ports.

Error detection. Often the etch-stop is the last processing step in microsystem fabrication and replacing a wafer lost due to etchant leakage or a broken electrode cable is expensive. Therefore, the MEMS Potentiostat firmware includes error detection that alerts the process operator and provides an error description on the display. In many cases, the setup can be corrected before the wafer is damaged if quick action is assured.

End-point detection. The software includes an end-point detection algorithm that identifies the current peak prior to passivation of the exposed silicon surface. The potentiostat indicates the end of the etch-stop process and switches an output relay, that could, for instance, control a DI water rinsing pump.

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Interfaces. A serial RS232, USB, or Ethernet interface provides a standard connection to any PC compatible computer. An easy to use command set makes it possible to integrate the MEMS Potentiostat in any computer application. Two user configurable relay-outputs allow the controlling of process related devices, e.g. electrical valves or pumps.

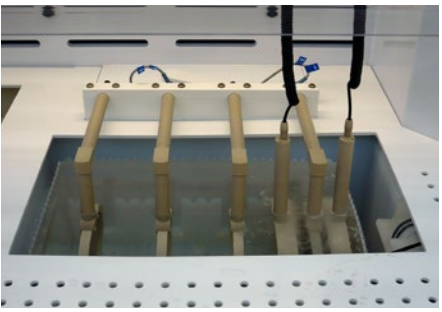
TECHNICAL SPECIFICATIONS

Product code	**MEMS Potentiostat Model SC**	
Bias output	-10V to +10V DC 16-bit D/A-converter 5 mVpp ripple 750 mA maximum output current	
4EC output	0V to -10V DC 16-bit D/A-converter 5 mVpp ripple 230 mA maximum output current	
RE input	Input impedance: 10^6 Common reference input for bath, additional reference input at wafer holder	
Current-to-Voltage converter Automatic range adjust	**Range**	**Accuracy**
	0 mA to 10 mA	1.6 µA
	10 mA to 750 mA	25 µA
A/D converter	16-bit A/D-converter	
Relay outputs	Two relays, up to 5 W each max. voltage 30 V max. current 0.5 A	
Control inputs	Two opto-coupled inputs max voltage 14 V DC max current 10 mA	
Computer interfaces	RS-232-C serial interface USB 2.0-interface Ethernet 10 MBit/s	
End-point detection	Built-in end-point detection algorithm connected to a relay	
Error detection	Built-in error detection (broken cable, broken wafer) connected to a relay	
Etch Process Control software (EPC)	A Windows program controls all features of the potentiostat, stores and presents etch-stop data, draws and prints I/t-diagrams. Also suitable for I/V-diagrams for passivation point measurement.	
Power supply	110 to 240 V AC (45 to 63 Hz)	
Size	105 x 105 x 220 mm (WxHxD) 4" x 4" x 8"	
Weight	1.1 kg, 2.3 lb	

MEMS POTENTIOSTAT MODEL MC
MULTI-CHANNEL POTENTIOSTAT

PRODUCT INFORMATION SHEET EC

MEMS Potentiostat Model MC



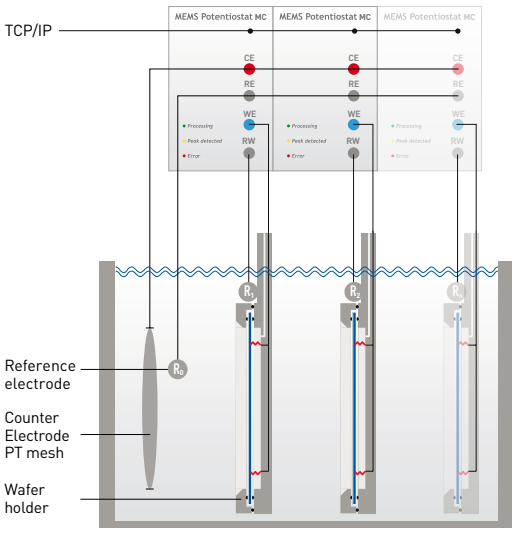
The MEMS Potentiostat Model MC has been especially designed for the use with electrochemical etch-stop techniques in silicon micromachining. The fabrication of many microelectromechanical systems (MEMS) depends on a reliable and easy to use potential controller for this step of processing. While our Model SC primarily focuses on research and development purposes, the Model MC is a solution for medium to large scale production of MEMS devices. Each Model MC incorporates four fully independent potentiostat units, which can be connected to a computer via the USB interface. Up to four Model MC can be connected to the same PC by our dedicated control software. Thus the system adapts flexibly to your demand.

As each sub-system is fully electrically insulated, up to 16 wafers can be etched simultaneously and independently in the same anisotropic etching bath. An optimum utilization of your KOH- or TMAH-equipment is thereby assured while saving your company's financial and personal resources.

The WetBenchPort, a customer-specific control unit, serves as an interface to automated wet benches for full integration of the system into a production environment. Via opto-coupled TTL lines and relays, the WetBenchPort is capable of controlling rinsing cycles, wafer transport, or safety interlocks.

Features of the MEMS Potentiostat Model MC are:

- output voltage from -10 V to +10 V DC
- supplementary voltage for four electrode configuration (0 to -10 V)
- output current up to 750 mA
- all outputs with short-circuit protection and thermal shut-down
- auto-ranging current-to voltage converter
- computer control via USB port or Ethernet
- dedicated software for Vista, Win 7/8
- compact design
- error detection (broken wafer, broken cable, current overload)
- detection algorithm for current peak.



MEMS Potentiostat Model MC

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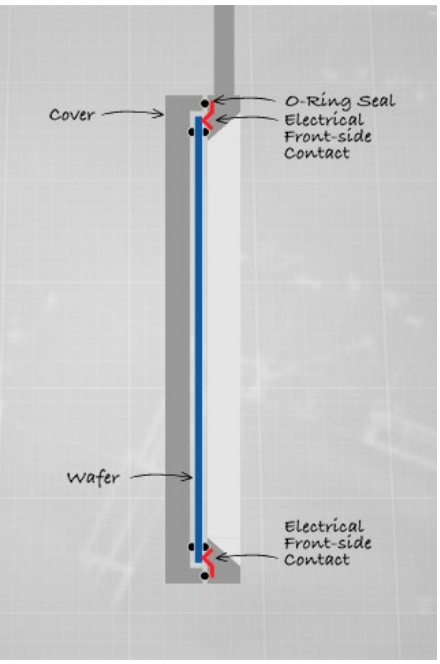
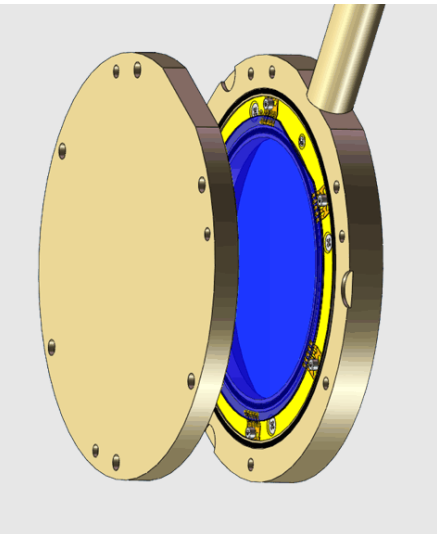
Product code	**MEMS Potentiostat Model MC**	
Potentiostat modules	Up to four autonomous potentiostat modules can be mounted in the 19"-compatible rack of the MC4. Each module has own bias and 4EC outputs and an own RE input.	
Bias output	-10V to +10V DC 16-bit D/A-converter 5 mVpp ripple 750 mA maximum output current	
4EC output	0V to -10V DC 16-bit D/A-converter 5 mVpp ripple 230 mA maximum output current	
RE input	Input impedance: 10^6	
Current-to-Voltage converter Automatic range adjust	**Range**	**Accuracy**
	0 mA to 10 mA	1.6 µA
	10 mA to 750 mA	25 µA
A/D converter	16-bit A/D-converter	
Relay outputs	Two relays, up to 10 W each max. voltage 50 V max. current 0.5 A	
Computer interfaces	USB 2.0-interface Ethernet 10 MBit/s	
End-point detection	Built-in end-point detection algorithm connected to a relay	
Error detection	Built-in error detection (broken cable, broken wafer, leak) connected to a relay	
Etch Process Control software (EPC)	A Windows program controls up to 16 potentiostats simultaneously, stores and presents etch-stop data, draws and prints I/t-diagrams. For more details, see separate product info.	
Wafer identification	1-wire memory or RFID read out	
Power supply	110 to 240 V AC (45 to 63 Hz)	
Size	105 x 105 x 220 mm (WxHxD) 4" x 4" x 8"	
Weight	1.1 kg, 2.3 lb	

WAFER HOLDER — SINGLE EP
WITH ELECTRICAL FRONTSIDE CONTACTS

PRODUCT INFORMATION SHEET EP

Schematic diagram
of the Single EP wafer holder





The Single EP wafer holders are designed for wafer electroplating applications. The tool contacts the wafer's front while protecting its back side. Single EP wafer holders have been used for more than 15 years in MEMS industry and research.

The wafer is sealed by a double precision O-ring system that reduces mechanical stress on the wafer to a minimum. A cover on the back side holds the wafers in place, fixed by six screws. As the customer-specific wafer thickness is machined as recess into the cover, all screws can be tightened using a regular wrench without sensitivity to the applied torque. This ensures a minimum mechanical stress on the fragile wafer.

The Single EP series wafer holders are equipped with gold-plated, spring-mounted electrical contacts, placed around the edge of the wafer holder's body to contact the wafer's front side. The contacts are located in between two O-ring seals, and are thus within the dry edge area. Additional contacts for high plating currents may be added upon request.

TECHNICAL SPECIFICATIONS

Product code	**S-76-EP-FH**	**S-76-EP-FH-RLAA**	**S-100-EP-FH**	**S-100-EP-FH-LAA**
Wafer size	3" or 76 mm	3" or 76 mm	4" or 100 mm	5" or 125 mm
Internal dimensions				
Width of the O-ring seal	1.78 mm	1.78 mm	1.78 mm	1.78 mm
Contact diameter	73 mm	75.2 mm	7 mm	97.35 mm
Usable plating area	65 mm	68 mm	86 mm	90.4 mm
External dimensions				
Diameter	120 mm	120 mm	140 mm	140 mm
Thickness	20 mm	20 mm	26 mm	26 mm
Electrical contacts				
Number of contact pads (with 5 gold plated fingers each)	4 pads	4 pads	6 pads	6 pads
Materials				
Main Body and corver-ring material	PEEK			
O-ring material	EPDM 70 – upon request FPM (Viton®) or FFPM (Kalrez®)			
Temperature range	5° C - 150° C			

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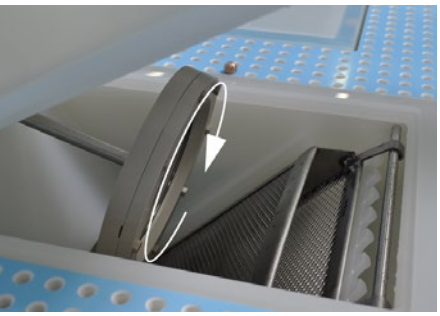
Product code	S-150-EP-FH-RND	S-150-EP-FH	S-200-EP-FH	S-300-EP-FH
Wafer size	6" or 150 mm	6" or 150 mm	8" or 200 mm	300 mm
Internal dimensions				
Width of the O-ring seal	1.78 mm	1.6 mm	1.6 mm	1.6 mm
Contact diameter	141.7 mm	149.15 mm	199 mm	199.02 mm
Diameter of usable area	130 mm	143 mm	193 mm	293 mm
External dimensions				
Diameter	185 mm	185 mm	240 mm	360 mm
Thickness	28 mm	28 mm	32 mm	32 mm
Electrical contacts				
Spring loaded pins (gold-plated)	8 contacts	8 contacts	8 contacts	12 contacts
Materials				
Main Body and corver-ring material	PEEK			
O-ring material	EPDM 70 – upon request FPM (Viton®) or FFPM (Kalrez®)			
Temperature range	5° C - 150° C			

NOTE

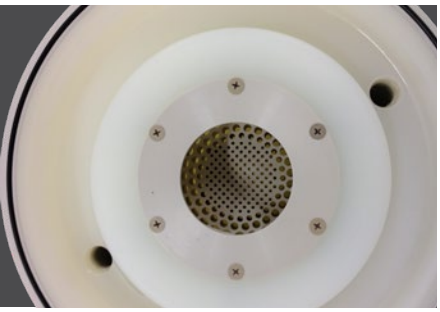
AMMT manufactures electroplating wafer holders for all sizes of wafers. Holders for single chips, wafer stacks, and rectangular substrates are available as well. Please inquire for specifications and prices.

µGALV PRO – ELECTROPLATING SYSTEM
FOR INTENSIVE R&D TO PILOT PRODUCTION

PRODUCT INFORMATION SHEET EP



45° flow plating



fountain plating

µGalvPro is a turn-key systems for electroplating, achieving excellent uniformity due to a 45° flow-plating cell design and a rotating wafer holder. Process cells for various metals (Au, Ni, Cu) and alloys (Ni-Fe, Ni-Co, Ni-W, Sn-Pb) as well as additional rinsing cells or quick dump rinsers are available.

The µGalv Pro system is the ideal platform for electroplating applications from intensive R&D to pilot production.

Body	Material: standard PP white, optional PPs white, PVDF (with yellow card), elements CNC machined and welded
Operating Elements, electrical, regulation units, pneumatics	All process operating elements are integrated into the front panel, all electrical an pneumatically components are integrated in an independent compartment in the back side service area, DI-H_2O and N_2-Spray gun integrated in the workdeck.
Plating Modules	Overflow process consisting of a process cell and reserve tank with overflow/filtration circuit. Electroforming of pure metals like Ni, Cu, Au, Ag, ... Electroplating of alloy like NiFe, NiCo, NiW, SnPb Electro less plating of Ni, Au, SnPb Process cell configuration as rack plater, fountain tower or 45° flow channel (titled Wafer rotating) Depending on electrolyte, pH control (Acid and/or base) or cooling integrated Pulse plating with minimum pulse time of 0.10 msec
Wafer holder	PEEK, with stainless steel 1.4404 contact ring and gold plated wafer contacts, various edge excluisions available, min 3.5 mm edge exclusion
Cleaning Module	Standard Overflow-Rinser, optional Ultrasonic or Mega-sonic Cell cleaning module, optional QDR-module, optional SRD (Spin-Rinse-Dryer)
Process options	Process Cell with multiple process slots Basket handling in the case of electro less plating Pulse & reverse pulse rectifier with minimum pulse time of 0.1 msec

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Standard components	Valves: membrane valves, ball valves, different diameter Pump: centrifugal pump made of PP, optional PVDF Filter housing: PP 20", optional PVDF PP plumbing, optional PVDF or PFA tube 1/2", 3/4", 1" with PFA flaretek fittings Acess panel: touch panel display controller Remark: customized solutions available if requested
Other options	Automatic handling (semi auto, dry in – dry out) Integration of pre or post process cells possible Laminar-flow-units Vacuum twizer Quick connector fluid drain

µGALV R&D – ELECTROPLATING SYSTEM
UNIVERSAL ELECTROPLATING SYSTEM

µGalv R&D is a turn-key electroplating system for various metals (Au, Ni, Cu) as well as additional rinsing cells or quick dump rinsers are available.

The µGalv Pro system is the ideal platform for electroplating applications from intensive R&D to pilot production.

Body	Material: standard PP white, optional PPs white, PVDF (with yellow card), elements CNC machined and welded
Operating Elements, electrical, regulation units, pneumatics	All process operating elements are integrated into the front panel, all electrical an pneumatically components are integrated in an independent compartment in the back side service area, DI-H_2O and N_2-Spray gun integrated in the workdeck.
Plating Module	Overflow process consisting of a process cell and reserve tank with overflow/filtration circuit. Electroforming of pure metals like Ni, Cu, Au, Ag, ... Electro less plating of Ni, Au, SnPb Process cell configuration as rack plater Depending on electrolyte, pH control (Acid and/or base) or cooling integrated Pulse plating with minimum pulse time of 0.10 msec, reverse pulse optional
Wafer holder	PEEK, with stainless steel 1.4404 contact ring and gold plated wafer contacts, various edge excluisions available, min 3.5 mm edge exclusion
Cleaning Module	Standard Overflow-Rinser, optional Mega sonic Cell wa-shing module, optional QDR-module, optional SRD (Spin-Rinse-Dryer)
Process options	Process Cell with multiple process slots (including seperate rectifiers) Basket handling in the case of electro less plating Pulse & reverse pulse rectifier with minimum pulse time of 0.1 msec
Standard components	Valves: membrane valves, ball valves, different diameter Pump: centrifugal pump made of PP, optional PVDF Filter housing: PP 10", optional PVDF PP plumbing, optional PVDF or PFA tube 1/2", 3/4", 1" with PFA flaretek fittings Remark: customized solutions available if requested
Other options	Integration of pre or post process cells possible Laminar-flow-units Vacuum twizer Quick connector fluid drain

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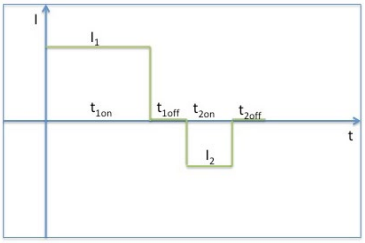
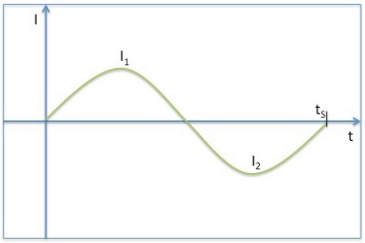
µGALVANO – WAVE SEQUENCING POWER SUPPLY

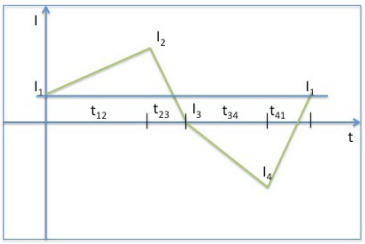
PRODUCT INFORMATION SHEET EP



Pulse/reverse pulse



Sine



Triangle

The µGalvano is a wave sequencing power supply dedicated for electroplating applications in MEMS technology and wafer electroplating.

Unlike a standard rectifier the device offers a variety of functionality like constant current, pulse / pause current, pulse and reverse pulse current output as well as triangle, ramps, and sinus forms.

The µGalvano is currently available in two configurations, with 1 Amp or 10 Amps as maximum output current.

With its micro-controller based web server, the µGalvano can be conveniently controlled by any kind of web-browser. Furthermore, the the µGalvano can be also controlled by any PC and PLC using a TCP/IP socket connection.

Waveform Current Source – 1 Amp / 10 Amp Version

Hardware		
Input	100-240V AC 50-60Hz 100 Watt	
Outputs	U= +/-10V I=+/-1A Resolution 0,1mA Ripple < 1% I_{eff}	U= +/-10V I=+/-10A Resolution 1mA Ripple < 1% I_{eff}
Wave Forms	Constant Current DC Pulse Pause Pulse / Reverse Pulse / Pause Sinus Triangle function Ramp	
HMI	Integrated Web-Interface (TCP/IP), Ethernet 10/100 MBit/s	
Case	19" standard housing – 3HE	

System Status	
Total Charge Transfer (Totalizer)	A h (Amp hours), A min (Amp minutes), A sec (Amp seconds)

System Configuration	
Analog Monitor I-Output	BNC female connector I=+/-10 A ==> U=+/-10 V
Analog Monitor U-Output	BNC female connector U=+/-10 V

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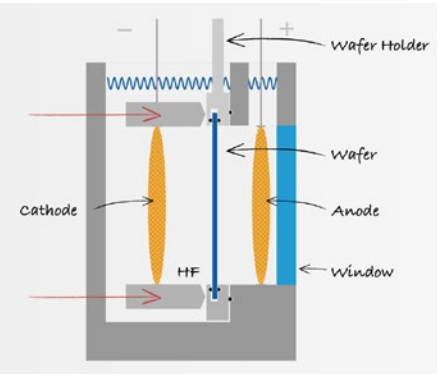
WET ETCHING SYSTEM FOR POROUS SILICON (MPSB)

DOUBLE CELL HF TANK FOR POROUS SILICON ETCHING WITH ELECTROLYTICAL BACKSIDE CONTACT

PRODUCT INFORMATION SHEET **PS**

Schematic diagram
of the MPSB double cell wet etching system



The MPSB wet etching system for porous silicon is a complete solution for porous silicon formation and electropolishing of silicon. Together with our Porous Silicon Power Supply PS2, AMMT offers an all-in-one solution for this range of fabrication methods. The MPSB is available for 4", 6" and 8" wafer sizes. For safety purposes, the bath is equipped with connections for continuous HF vapor extraction. PTFE drain valves are connected for direct HF disposal. As an option, an optical windows allows for light-assisted porous silicon formation. An HF resistant sapphire window, supported by thick quartz disks as protection against fracture, can be mounted into sealed flanges. If illumination is not necessary, blind PP covers can be mounted instead.

The wafer is mounted into a removable wafer holder, which is sealed with double O-rings. The wafer holder is then placed in front of the circular opening in the separation plate and is finally fixed in place by a pneumatic actor driven catch . Once the catch is closed, both HF compartments are electrically insulated in the MOhm-range. Two platinum mesh electrodes, one in each cell, are used to contact the wafer from both sides. In order to ensure a homogeneous electrical field, the electrodes are of the same size as the wafer. If a completely metal-ion free environment is required, the Pt electrodes can optionally be replaced by Si sacrificial electrodes. The HF liquid can optionally be re-circulated by a PTFE membrane pump. This circulation loop also allows for HF cooling by means of a in-loop heat exchanger.

TECHNICAL SPECIFICATIONS

Product code	**MPSB 100**	**MPSB 150**	**MPSB 200**
Wafer size	100 mm (4") or smaller	150 mm (6") or smaller	200 mm (8") or smaller
Etchant Volume			
Tank volume only options results in additional volume	~1,4 litre	~2,5 litre	~3,8 litre
Safety receptacle external dimensions			
Width × Height × Depth with vapor extraction	440 x 450 x 440 mm^3	440 x 450 x 440 mm^3	480 x 570 x 480 mm^3
Separation plate	This cell separater plate devides the bath into two chambers and has a circular opening of		
	⌀ 92 mm	⌀ 142 mm	⌀ 189 mm
Electrical isolation between chambers	> 10^5 Ω when bayonette catch is closed with isolating wafer subtitute		
Standard Wafer holder			
Edge exclusion area	7 mm	10 mm	9 mm
HF exposed area	86 mm	130 mm	182mm
Electrodes (2)			
Size (diameter)	90 mm	140 mm	190 mm

AMMT GmbH — Advanced Micromachining Tools
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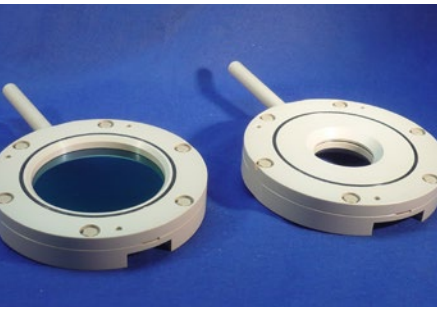

Product code		MPSB 100		MPSB 150		MPSB 200	
Distance between wafer and electrode							
		Si	Pt	Si	Pt	Si	Pt
Processing Side (Left / Anode)		29 mm	35 mm	48 mm	54 mm	46 mm	55 mm
Electroalytical Contact Side (Right / Cathode)		58 mm	52 mm	48 mm	54 mm	46 mm	55 mm
Material	w/ optical window	Platinum meshed electrode (Pt/Ir) in a PEEK frame					
	w/o optical window	Platinum (Pt) plate in a PEEK frame or Silicon sacrificial electrode					
Optical window (optional, Plus system only)							
Size		⌀ 93 mm		⌀ 130 mm		⌀ 189 mm	
Material		1 mm sapphire window backed with quartz disk					
Connections							
Fluidic drain		PTFE hose (ID: 6mm OD: 8 mm)					
Air pressure		6 bar					
Etchant compatibility		HF and HF-ethanol mixtures					
Temperature range		10 °C – 30 °C					

MPSB WAFER HOLDERS

Besides regular wafer holders for 2", 3", 4", 5", 6" and 8" wafers we also offer unique wafer holder for the porous silicon system.

AVAILABLE FEATURES

» Test wafer holder
The test wafer holder allows to perform up to five etches on a single wafer thus helping to increase the speed of development of a set of parameters.

» Chip holder & square substrate holder
AMMT also offers holders for rectangular substrates typically used in the PV industry; holders for individual chip sizes can be manufactured customer specifically for almost any chip or substrate size.

» Silicon electrodes
Some environments require fully metal-ion free wafer processing, for example if the wafers are supposed to go into a CMOS line for further processing. AMMT offers the MPSB also with silicon electrodes, either with Si sacrificial electrodes or with a conductive diamond-like carbon coating.

» HF etchant recirculation & cooling
The HF liquid can optionally be re-circulated by a PTFE membrane pump. This circulation loop also allows for HF cooling by means of an in-loop heat exchanger. HF recirculation avoids etchant depletion at the surface and ensures bubble removal. Cooling the etchant avoids etchant warming if high current densities are desired.

» Wet bench integration
AMMT offers a small-footprint R&D wetbench, which is designed as turn-key system housing the MPSB double cell as well as all other components of the system. If comes with a laptop PC controlling the PS2 constant current source and allows for monitoring the etchant temperature etc

» MPSB wafer holders
Besides regular wafer holders for 2", 3", 4", 5", 6" and 8" wafers we also offer unique wafer holder for the porous silicon system.

NOTE: Hydrofluoric acid (HF) is an extremely dangerous substance to work with. Special care has to be taken when installing, maintaining and operating this system. In particular, a secure mount of the device and an appropriate vapor extraction has to be assured. AMMT can provide information about the installation and operation of the MPSB, but will not assume any responsibility for harm or damage caused by using this product.

POWER SUPPLY FOR POROUS SILICON (PS2)

CONSTANT CURRENT / VOLTAGE SOURCE FOR POROUS SILICON FORMATION

PRODUCT INFORMATION SHEET PS

Porous silicon power supply
— 12 A version

AMMT's Porous Silicon Power Supply (PS2) is a constant current / constant voltage source adapted for porous silicon formation and electropolishing of silicon in hydrofluoric acid. Together with a Windows based softwafer package it is the first system completely dedicated to MEMS fabrication technology, with many unique features to increase production yield and reproducibility in commercial environments. At the same time, the PS2 is a perfect instrument for research and development, providing a high degree of flexibility and a proven, reliable solution for lab work.

TECHNICAL SPECIFICATIONS

Product code	
Current range	Two output stages are available: » 0-12 A (PS2-12A) » 0-24 A (PS2-24) Output stages can be upgraded on demand.
Current polarity	Unipolar
Voltage swing	0-34 V
Output voltage ripple	< 5 mV rms (5 Hz - 1 MHz bandwidth)
Time constant	50 ms (serial RS232 programming)
Voltage programming	10 mV resolution 0.02% + 26 mV remote sense The etching cell's voltage drop is monitored (using the cell electrodes)
Safety features	» Over-voltage protection » Thermal protection » Auto-disconnect after process end » Error detection for broken cables, contact failures leakage and short circuits » Safety power connectors
Computer interface	All functions of the PS2 can be controlled via a 9600 baud standard serial RS232 interface. A USB-interface option is available (PS2-XX-USB). Several PS2 units can be connected and controlled by one PC.
Software	AMMT's PS2C software package for Microsoft Windows is included with the PS2. Features of this dedicated software include: » All relevant data is logged and stored for later use » User-definable current density profiles » Short current pulses (50 ms) to fabricate thin layers of porous silicon » Complete methods can be defined for production-like enviroments » Detection of error conditions
Manual control	Manual operation is possible via the control panel
EMC compliance	All EMC values compliant with EN 55022-B, FCC-B, VCCI-2, EN 55022-A, FCC-A, VCCI-1
Power supply	85-265 V, 47-63 Hz
Dimensions	70 x 124 x 350 mm, 3.2 kg (12A) 140 x 124 x 350 mm, 5.8 kg (24A)

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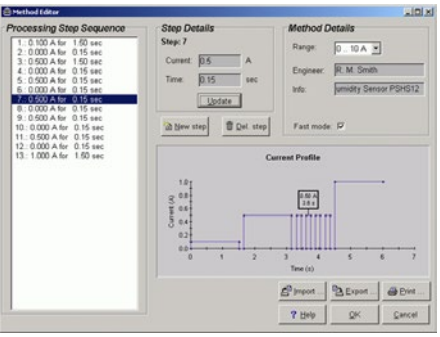
PS2 CONTROL SOFTWARE
FOR WINDOWS NT, 2000 AND XP

Screenshot of
the current profile editor



Computer control is one of the main features of AMMT's Porous Silicon Power Supply PS2. Each PS2 comes with Windows based software, dedicated to control a porous silicon etching process. It allows one to:

- define and edit time-based current profiles for etching,
- change all PS2 parameters in real-time,
- monitor all relevant information during the etching process and to store it in data files,
- print and store concise reports for each etching process.

Screenshot of the process control window.

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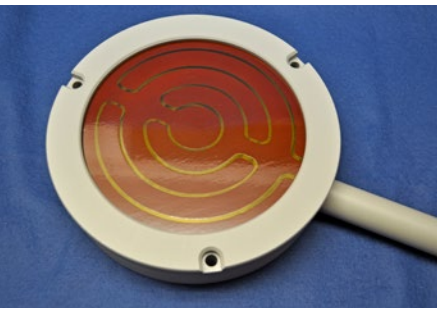
HF VAPOR ETCHER
HFVE STANDARD

PRODUCT INFORMATION SHEET HFVE

HFVE Standard with electronic control unit



HFVE Standard electrotatic chuck

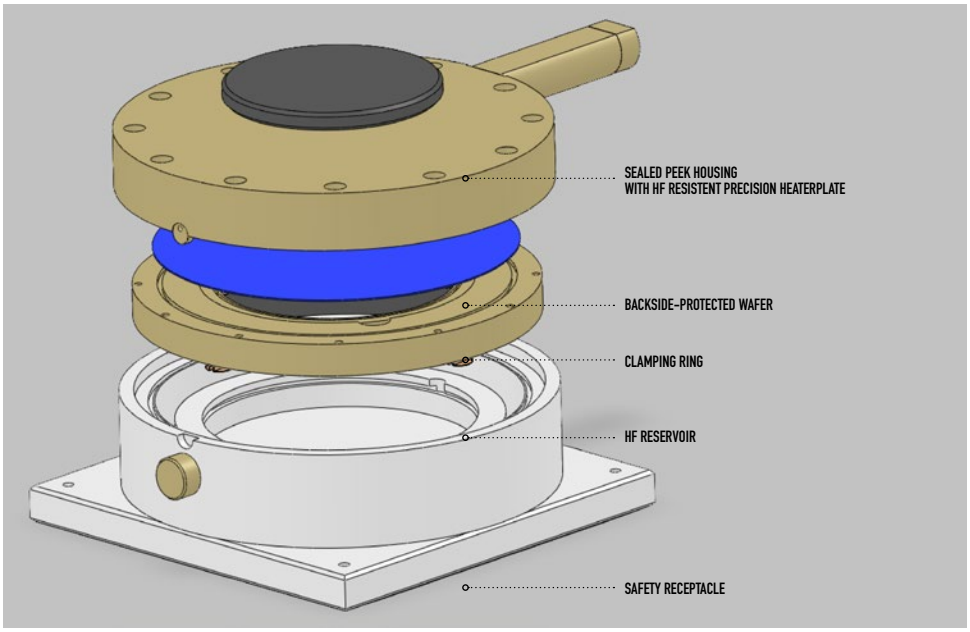
Hydrofluoric acid (HF) is an ideal etchant for all silicon oxide types used in micromachining, allowing fast etch rates and being highly selective to silicon. A typical application for HF etching is the removal of sacrificial oxide layers in MEMS fabrication. However, it is typical for liquid-phase etchants to have a high risk of the movable structure sticking to the substrate due to the effects of surface tension.

AMMT's HF Vapor Etcher solves this problem by working entirely in the vapor phase. HF vapor is generated passively from a small liquid reservoir, ensuring a small footprint of the system. The HF Vapor Etcher is perfectly adapted to surface micromachining, SOI-MEMS, dicing-free release, structure thinning, and many other applications.

The wafer is mounted onto the reservoir with the etching side facing down. The HF vapor reacts with the SiO on the wafer surface to form volatile SiF4, which readily desorbs from the surface. The reaction also requires small amounts of water to be present on the surface. In order to ensure a film of microscopic water on the surface without producing droplets which could cause sticking, the wafer is gently heated from the back side by an HF-resistant precision heater plate. An excellent etching homogeneity is achieved by a special heater design, which reduces temperature gradients over the wafer that could potentially affect the etch rate.

Safety is important when working with HF. AMMT's engineers have designed an easy-to-use etching system with a maximum of security, including an easy to use HF storage device which allows to fill and drain the reaction chamber with HF liquid.

For full wafers the HFVE comes with a clamping ring to seal the wafer edge and back side using a double O-ring system. For small chips the HFVE heated wafer chuck can also be equipped with an electrostatic clamping device.



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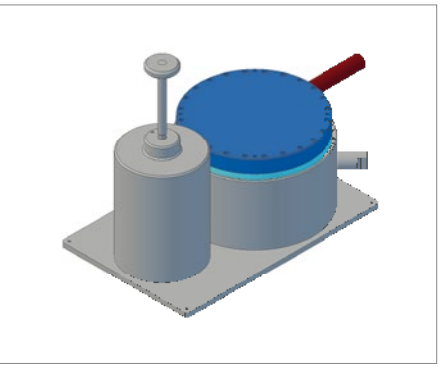
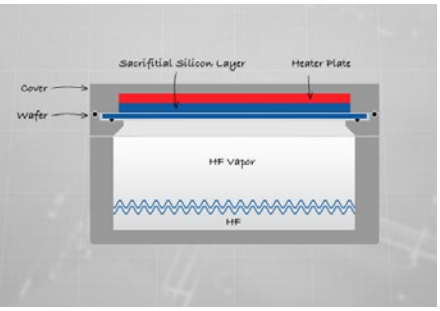


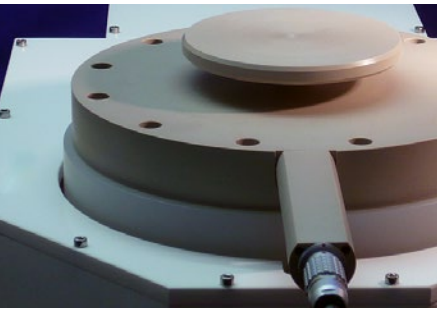
NOTE: Hydrofluoric acid (HF) is an extremely dangerous substance to work with. Special care has to be taken when installing, maintaining and operating this system. In particular, a secure mount of the device and an appropriate vapor extraction has to be assured. AMMT can provide information about the installation and operation of the PSB, but will not assume any responsibility for harm or damage caused by using this product.

Product code	**HFVE 100**	**HFVE Std. 150**	**HFVE Std. 200**
Wafer size	4" (100mm) or smaller	6" (150mm) or smaller	8" (200mm) or smaller
Etchant compatibility	HF 50%, mixtures of HF and organic solvents		
Etching characteristics			
Etch rate Etching homogeneity Back side protection Etching exclusion Etched materials Resistant materials	2-30 µm/h Typically 90% (on wafer surface); min 50% Typically 3mm exclusion from the edge 5 mm from the edge of the clamping ring Silicon dioxide (SiO2) Silicon, poly-silicon, noble metals, aluminium		
Wafer holder with heating plate			
Operating temperature	35°C to 60°C ; 95°F to 140°F		
Wafer clamping:			
Mechanical clamping ring	For 100 mm wafers (other sizes optional)	For 150 mm wafers (other sizes optional)	For 200 mm wafers (other sizes optional)
Wafer contact	6 clips @ Ø 94 mm	8 clips @ Ø 144 mm	8 clips @ Ø 194 mm
Mechanical clamping	Screwing with 4 large nuts from backside; nuts never in direct contact with HF acid vapor		
Electrostatic clamping (optional)	For single chips (>5x5 mm2) as well as 100 mm wafers	For single chips (>5x5 mm2) as well as 150 mm wafers	For single chips (>5x5 mm2) as well as 200 mm wafers
	For all conductive materials		
	Bipolar type		
Reaction chamber & reservoir	Communicating vessels Safe acid handling system Reuse of HF acid		
Etchant volume	100ml (max. 160 ml)	200ml (max. 290 ml)	250ml (max. 400 ml)
Controller			
Power supply	110 V AC 60 Hz or 230 V AC 50 Hz		
Fuse	110V T2.5A or 230V T1A		
Power consumption	150VA		
Electrostatic clamping	Max. 1500V DC		
Electrostatic force controller	Max. 12V DC		
Front panel protection	IP65 (spray water resistant)		
External Dimensions (mm)			
Wafer holder	Ø165 x 50 (with handle: 165 x 300 x 50)	Ø210 x 50 (with handle: 210 x 340 x 50)	Ø260 x 50 (with handle: 260 x 390 x 50)
Reaction chamber with reservoir (l x w x h)	340 x 200 x 250	400 x 245 x 250	455 x 295 x 250
Controller unit (w x h x l)	200 x 150 x 200		
Installation			
Need of	Acid fume hood with air extraction Electrical power supply Water for rinsing		

HF VAPOR ETCHER
HFVE SYSTEM

Working principle of HF vapor etching





HFVE System with head stage

HF Vapor Etching. Hydrofluoric acid (HF) is an ideal etchant for all silicon oxide types used in micromachining,since it allows fast etch rates and is highly selective against silicon. A typical application for HF etching is the removal of sacrificial oxide layers in MEMS fabrication. However, as is typical for liquid-phase etchants, there is a high risk of the movable structure sticking to the substrate due to the effects of surface tension.

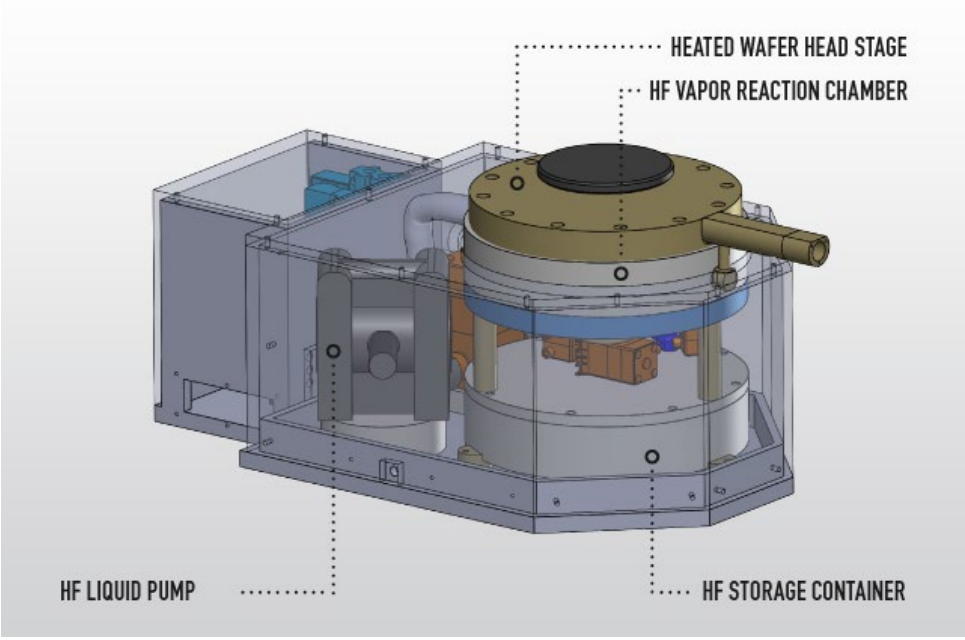
AMMT's HF Vapor Etcher solves this problem by working entirely in the vapor phase, which is a quasi dry process.. The HF Vapor Etcher is perfectly adapted to surface micromachining, SOI-MEMS, dicing-free release, structure thinning, and many other applications.

The wafer is mounted onto the reaction cell with the etching side facing down. HF vapor is generated passively from a small liquid reservoir at the bottom of the reaction cell. The HF vapor reacts with theSiO2 on the wafer surface to form volatile SiF4, which desorbs readily from the surface. The reaction also requires small amounts of water to be present on the surface. In order to ensure a microscopic water film on the surface without producing droplets which could cause sticking, the wafer is gently heated from the backside by an HF-resistant precision heater plate. An excellent etching homogeneity is achieved by our special heater design, which minimizes temperature gradients over the wafer that could affect the etch rate.

HFVE System & process cycle. The HFVE system consists of a reaction cell, a heated wafer holder, and an HF handling system with an HF storage container, in addition to an electronic control unit. The wafer temperature and process duration are set at the control unit.

First the wafer has to be mounted in the wafer holder and placed onto the reaction cell. Once the wafer's temperature has reached the set point, the system automatically pumps HF from the storage container into the reaction cell. After the preset process duration is over, the HF is automatically drained into the storage container and the reaction cell is flushed out with nitrogen.

The wafer can now be removed safely, because the reaction cell is free of HF vapor. The HF can be used for multiple etching cycles.



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TECHNICAL SPECIFICATIONS

Product code	HFVE System 4	HFVE System 6
Wafer size	4" (100mm) or smaller	6" (150mm) or smaller
External dimensions		
Etcher (width x width x height)	657 x 340 x 288 mm^3	
Base plate (width x width)	580 x 340 mm^2	
Control unit (width x height x depth)	200 x 150 x 200 mm^3	
Materials		
Heater housing and wafer holder Heater HF reaction cell Safety receptacle O-rings	PEEK Fully sealed aluminum heater with silicon cover PP PP wellded Viton	
Etchant volume	350 ml	
Etchant compatibility	HF 50% or less and mixtures of HF and organic solvents	
Temperature control		
Heater type	Resistive heater, fully HF protected	
Heater power	60 W max.	
Heater power supply	110 - 230 V, 60 VA, 48-63 Hz	
Temperature range	Room temperature to 60°C	
Temperature sensors	Pt100 (one embedded heater, one in the main unit)	
Temperature controller	Electronic PID controller with differential temperature measurement and PWM output	
User parameters	Process duration, Wafer temperature Nitrogen preflush time, Nitrogen endflush time	
Mode of operation	absolute temperature / relative temperature in respect to room temperature	
Required supplies		
Nitrogen	[6 .. 7 bar]	
Vapor exhaust	acid proof, flow min. 30m/min	

OPTIONS

For dicing free release applications a HF proof mesh is available.
For small chips an electrostatic chuck is available.

HFVE electrostatic chuck

HFVE System electronic control unit

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