

## *Product Information Brochure*



### *Hydrofluoric Acid Vapor Phase Etcher*

Idonus Sarl  
Rue Jaquet-Droz 1  
2002 Neuchatel  
Switzerland

Phone : +41 32 718 33 81  
Fax : +41 32 720 57 33  
Email : [info@idonus.com](mailto:info@idonus.com)  
Web : [www.idonus.com](http://www.idonus.com)

## Hydrofluoric Acid Vapor Phase Etcher

### General Information

Idonus is producing a hydro-fluoric acid vapor phase etching (HF VPE) apparatus for sticking free silicon dioxide etching in microfabrication.

Thinner gaps and fragile structures make the release of micro-electromechanical systems a difficult task. The cohesion forces of liquid HF acid destroys the tiny structures or makes them stick permanently.

Etching in an HF acid vapor atmosphere is a quasi dry process. By heating the substrate, the amount of water on the wafer can be controlled. Since the wafer is never in contact with any liquid, sticking free MEMS release can be performed. Typical etch rates are in the order of 4-10  $\mu\text{m}/\text{hour}$ .

The vapor phase etcher is available as 4", 6" and 8" version.

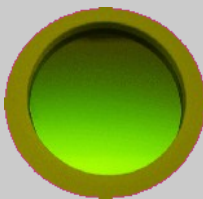


Hydrofluoric Acid Vapor Phase Etcher System showing communication chamber, mechanical and (optional) electrostatic clamping mechanism, reaction chamber and power supply.

### Special features of the HF Etcher:

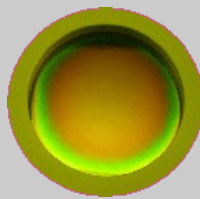
- Safe acid handling
- Re-usable HF acid
- Easy wafer clamping mechanism
- Ideal for all wafer sizes
- No installation required (apparatus is used in an acid wet bench)
- Upside down etching of wafers
- Back-side protection
- Low running costs

### Etching Process:



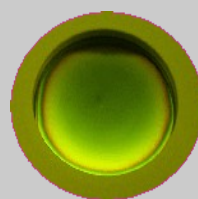
#### Before etching:

100mm silicon wafer with 1  $\mu\text{m}$  thermal oxide.



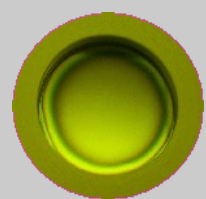
#### After 25 minutes:

The inner part having the same color indicates homogeneous etching.



#### After 30 minutes:

Some oxide is left.



#### After 35 minutes:

All oxide is removed on 80% of the wafer diameter.

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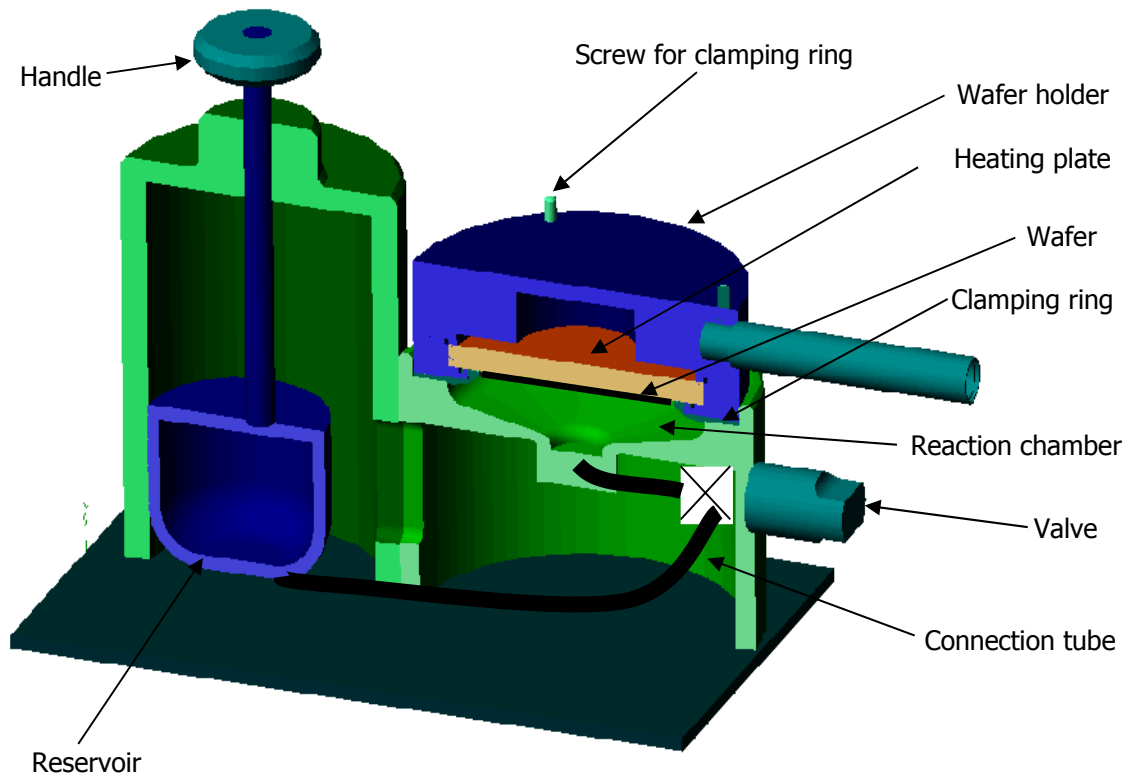
### Product Description

The VPE consists of a reaction chamber and a wafer holder. A heating element is integrated in the wafer holder. It controls the temperature of the substrate to be etched. Wafer clamping can be achieved in two ways: Wafers can be clamped mechanically using the clamping ring. The screwing is done from the backside of the apparatus, which is never in direct contact with the HF vapor. The 3 nuts are easy to handle with protection gloves. Idonus offers an optional electrostatic clamping mechanism. Single chips (longer than 5 mm) as well as wafers can be clamped to the heating element without the stress concentration of mechanical clamping. The backside of the wafer is protected from etching.

Liquid HF is filled into the reaction chamber. The reaction chamber is closed with the wafer holder. HF evaporates at room temperature and the etching process starts spontaneously. The etch rate is controlled by the wafer temperature that can be adjusted from 35°C to 60°C.

After processing, the acid can be stored in a reservoir for re-use in a sealable container. Liquid transfer is simply done by lowering the communicating reservoir with a handle. Due to gravity, the acid flows into the reservoir and can be closed by two valves. Refilling the reaction chamber with acid is done by opening the valves and lifting the handle. The acid flows into the reaction chamber. The acid can be re-used for multiple etchings.

The VPE system has a small footprint and can easily be integrated into an existing flow box.



# Hydrofluoric Acid Vapor Phase Etcher

## Product Description and Applications



Mechanical clamping ring.



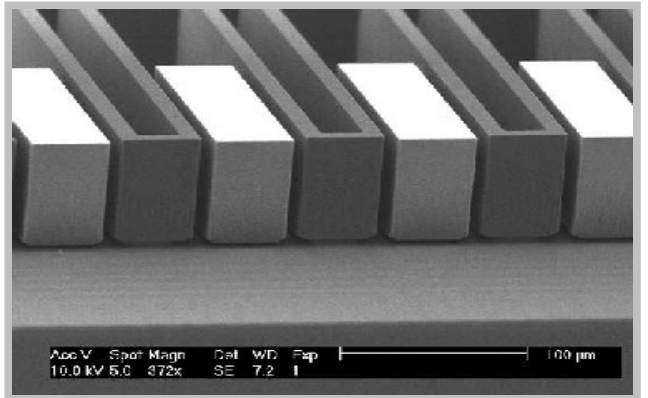
Wafer holder with mechanically clamped 100 mm wafer. The wafer is held by 6 clips to increase the etched area.



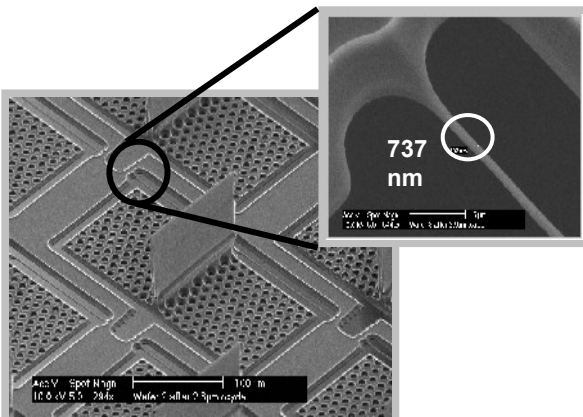
Hydrofluoric Acid Vapor Phase Etching system in operation. The reaction chamber is closed and the HF vapor remains in the chamber.

### Applications:

- Sticking free MEMS release
- Structure thinning
- Dicing free release of structures on SOI substrate
- Etch rate adjustable from 0 to about 10  $\mu\text{m}/\text{h}$  (sticking free)
- Single side  $\text{SiO}_2$  etching (back side protected during process)



Silicon isle structures on a SOI substrate. The undercut of the  $\text{SiO}_2$  is accurately controlled. (Source: IMT University of Neuchatel)



Micro-fabricated silicon actuator. Consecutive oxidation and HF vapor etching enables fabrication of silicon beams thinned to sub-micron diameter supporting a platform with vertical mirror. (Source: IMT University of Neuchatel)

## Hydrofluoric Acid Vapor Phase Etcher

### Options

#### Electrostatic Chuck for Multiple Chip Clamping

The electrostatic chuck is able to clamp multiple chips as well as parts of a wafer to the wafer holder by electrostatic force. This device is extremely useful for R&D institutions where working on complete wafers is not always possible.

The electrostatic clamping of chips allows to perform the harsh dicing process of MEMS wafers before the HF vapor release. By modifying the classical fabrication sequence, it becomes possible to produce MEMS devices with extremely soft suspensions.

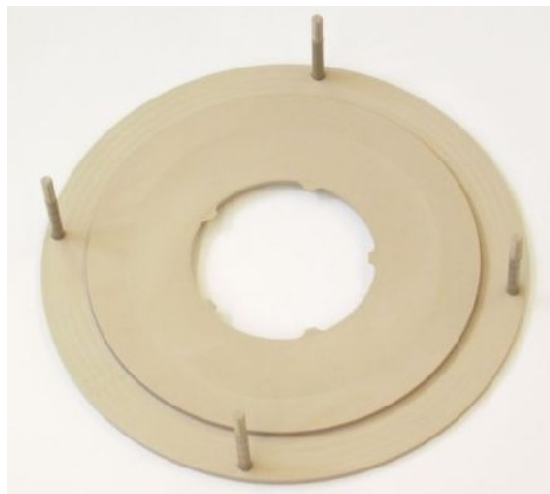
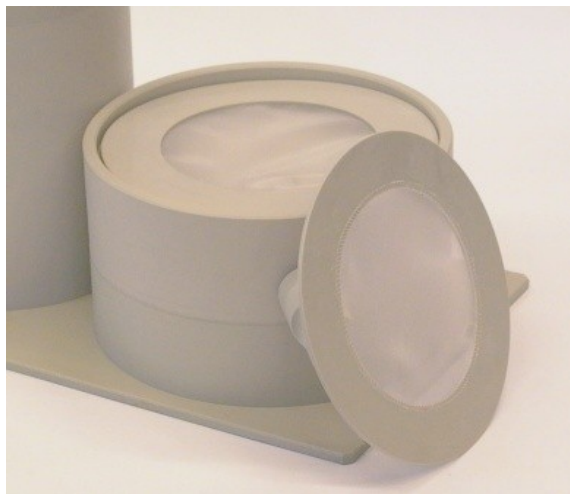
The usage of the electrostatic chuck is very simple. The chips are placed on the wafer holder and the electric force is turned on by a switch on the controller box. The electrostatic force can be adjusted.



#### Safety Mesh & Adaptor Rings for Wafer Holder

The safety mesh is a HF resistant mesh that is placed into the reaction chamber. Its purpose is to catch released parts that are not attached to the handle wafer. HF condenses on the mesh. Do not touch the safety mesh without protective clothing!

Adaptor rings to smaller wafer sizes are available for 150 mm and 200 mm wafer holders.



## Hydrofluoric Acid Vapor Phase Etcher

### Technical Specifications 100mm System

<b>Product Code</b>	<b>VPE100</b>
<b>Wafer sizes</b>	<b>100 mm or 4"</b>
<b>Etchant compatibility</b>	HF 50%, mixtures of HF and organic solvents
<b>Etching characteristics</b>	
Etch rate	2-30 $\mu\text{m/h}$
Etching homogeneity	Typically 90% (on wafer surface); min 50%
Back side protection	Typically 3mm exclusion from the edge
Etching exclusion	5mm from the edge of the clamping ring
Etched materials	Silicon dioxide ( $\text{SiO}_2$ )
Resistant materials	Silicon, poly-silicon, noble metals, aluminium
<b>Wafer holder with heating plate</b>	
Operating temperature	35°C to 60°C
<b>Wafer clamping :</b>	
Mechanical clamping ring	For 100 mm wafers (other sizes optional)
Wafer contact	By 6 clips at $\varnothing$ 94 mm
Mechanical clamping	Screwing with 3 large nuts from backside; nuts are never in direct contact with HF acid vapor
Electrostatic clamping (optional)	For single chips (>5 mm) as well as 100 mm wafers For all electrically conductive materials Bipolar electrostatic chuck
<b>Reaction chamber &amp; reservoir</b>	
	Communicating vessels Safe acid handling system Re-use of HF acid
Etchant volume	100 ml (max. 160 ml)
<b>Controller</b>	Separate housing or rack mounting version
Power supply	110 V AC 60 Hz or 230 V AC 50 Hz
Power consumption	200 VA
Front panel protection	IP65 (spraywater resistant)
<b>Materials</b>	All materials HF resistant
<b>Dimension (mm)</b>	
Wafer holder	$\varnothing$ 165 x 50 ; (with handle: 165 x 300 x 50)
Reaction chamber with reservoir	200 x 250 x 340 (w x h x l)
Controller unit	210 x 70 x 220 (w x h x l)
<b>Installation</b>	
Need of	Acid fume hood with air extraction Electrical power Water for rinsing

**Note:** Idonus fabricates the VPE for all wafer sizes. Please ask for specifications.

**Warning:** HF acid is an extremely dangerous chemical. Proper care must be taken when using this system. Idonus can provide information regarding installation, operation and maintenance of the vapor etcher. Idonus will not assume responsibility for misuse of this system or for any harm or damage caused by using this product.

**Note:** Idonus reserves the right to change specifications without notice at any time (Version 01.07.2008). Copyright © 2008 Idonus Sarl.

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## Hydrofluoric Acid Vapor Phase Etcher

### Technical Specifications 150mm System

<b>Product Code</b>	<b>VPE150</b>
<b>Wafer sizes</b>	<b>150 mm or 6"</b>
<b>Etchant compatibility</b>	HF 50%, mixtures of HF and organic solvents
<b>Etching characteristics</b>	
Etch rate	2-30 $\mu\text{m/h}$
Etching homogeneity	Typically 90% (on wafer surface); min 50%
Back side protection	Typically 3 mm exclusion from the edge
Etching exclusion	5mm from the edge of the clamping ring
Etched materials	Silicon dioxide ( $\text{SiO}_2$ )
Resistant materials	Silicon, poly-silicon, noble metals, aluminium
<b>Wafer holder with heating plate</b>	
Operating temperature	35°C to 60°C
<b>Wafer clamping :</b>	
Mechanical clamping ring	For 150 mm wafers (other sizes optional)
Wafer contact	By 8 clips at $\varnothing$ 144 mm
Mechanical clamping	Screwing with 3 large nuts from backside; nuts are never in direct contact with HF acid vapor
Electrostatic clamping (optional)	For single chips (>5 mm) as well as 150 mm wafers For all electrically conductive materials Bipolar electrostatic chuck
<b>Reaction chamber &amp; reservoir</b>	
	Communicating vessels Safe acid handling system Re-use of HF acid
Etchant volume	200 ml (max. 290 ml)
<b>Controller</b>	Separate housing or rack mounting version
Power supply	110 V AC 60 Hz or 230 V AC 50 Hz
Power consumption	200 VA
Front panel protection	IP65 (spraywater resistant)
<b>Materials</b>	All materials HF resistant
<b>Dimension (mm)</b>	
Wafer holder	$\varnothing$ 210 x 50 ; (with handle: 210 x 340 x 50)
Reaction chamber with reservoir	245 x 250 x 400 (w x h x l)
Controller unit	200 x 70 x 200 for 230 V / 200 x 90 x 300 for 110 V
<b>Installation</b>	
Need of	Acid fume hood with air extraction Electrical power Water for rinsing

**Note:** Idonus fabricates the VPE for all wafer sizes. Please ask for specifications.

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## Hydrofluoric Acid Vapor Phase Etcher

### Technical Specifications 200mm System

<b>Product Code</b>	<b>VPE200</b>
<b>Wafer sizes</b>	<b>200 mm or 8"</b>
<b>Etchant compatibility</b>	HF 50%, mixtures of HF and organic solvents
<b>Etching characteristics</b>	
Etch rate	2-30 $\mu\text{m/h}$
Etching homogeneity	Typically 90% (on wafer surface); min 50%
Back side protection	Typically 3 mm exclusion from the edge
Etching exclusion	5mm from the edge of the clamping ring
Etched materials	Silicon dioxide ( $\text{SiO}_2$ )
Resistant materials	Silicon, poly-silicon, noble metals, aluminium
<b>Wafer holder with heating plate</b>	
Operating temperature	35°C to 60°C
<b>Wafer clamping</b>	
Mechanical clamping ring	For 200 mm wafers (other sizes optional)
Wafer contact	By 8 clips at $\varnothing$ 194 mm
Mechanical clamping	Screwing with 4 large nuts from backside; nuts are never in direct contact with HF acid vapor
Electrostatic clamping (optional)	For single chips (>5 mm) as well as 200 mm wafers For all electrically conductive materials Bipolar electrostatic chuck
<b>Reaction chamber &amp; reservoir</b>	
	Communicating vessels Safe acid handling system Re-use of HF acid
Etchant volume	250 ml (max. 400 ml)
<b>Controller</b>	Separate housing or rack mounting version
Power supply	110 V AC 60 Hz or 230 V AC 50 Hz
Power consumption	200 VA
Front panel protection	IP65 (spraywater resistant)
<b>Materials</b>	All materials HF resistant
<b>Dimension (mm)</b>	
Wafer holder	$\varnothing$ 260x 50 ; (with handle: 260 x 390 x 50)
Reaction chamber with reservoir	295 x 250 x 455 (w x h x l)
Controller unit	200 x 70 x 200 for 230 V / 200 x 90 x 300 for 110 V
<b>Installation</b>	
Need of	Acid fume hood with air extraction Electrical power Water for rinsing

**Note:** Idonus fabricates the VPE for all wafer sizes. Please ask for specifications.

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