

# Ultra Thin Wafer Treatment applying Remote Cold Dry Etch Processes



## Main Applications

- Wafer Level Stress Relief
- Chip Level Stress Relief (Chip Side Healing CSH)
- Post Polish Treatment
- Wafer Thinning
- Surface Passivation
- Surface Cleaning

# Remote Cold Dry Etch

**The PVA TePla AG, Division Plasma Systems**, develops, assembles and markets turn-key plasma based equipment and processes for wafer manufacturing and related semiconductor areas. After the acquisition of ASYNTIS in 2006 we have optimized the ASYNTIS remote cold dry etching process technology and equipment for Ultra Thin wafers and for chips in order to create the highest throughput and most versatile mass production machines available.

For the first time, Microwave remote plasma etch meets the industrial requirements in terms of process performance as well as high throughput for a large variety of thinned wafer/chip applications.

Leading semiconductor companies are using PVA TePla systems in backend manufacturing processes for thin wafer/chip, solar cells and diode production.

Beyond today's applications, PVA TePla is dedicated to expand the usage of its unique Dry Etch technology towards new applications along the Ultra Thin wafer production line, replacing or substituting existing backend process technologies which are no longer applicable or effective with decreasing wafer thickness.

All machines and process solutions are available for manufacturing common wafer sizes up to 12" and 12" framed wafers on manual machines, OEM, and fully automatic stand-alone systems.

## Why Ultra Thin Wafers?

As the electronics market continues its miniaturization of packaged products, integrated circuit (IC) packaged devices must follow the trend of miniaturization. The key enabling technology for smaller IC packages is 3D-Interconnect technology and multiple stacked dies that exceed the number of stacked chips for conventional wire bonding.

The principle market is consumer electronics, pushing for the vertical integration with stacked dies like NAND and Flash RAM. Also RF-Tags (chips-in paper etc.) require thin chips enabling a very small bending radius and high flexibility. The next group is the power device market where higher output from thin chips is the goal to help minimize heat generation inside the thin silicon.

### Package height reduction

- Handheld electronics
- Vertical integration (3D-Interconnect)
- Stacked dies: NAND, Flash RAM

### Compliant electronic assemblies

- Smart labels
- Chip-on-flex, chip-in-paper, chip-in-board
- Thickness of 50  $\mu\text{m}$  and below needed

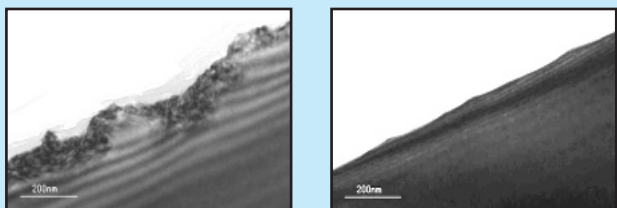
### Heat dissipation

- Power devices
- Microprocessors
- Low thermal resistance of thinned chip (today 200-250  $\mu\text{m}$  Future 30-80  $\mu\text{m}$ )

# Remote Cold Dry Etch

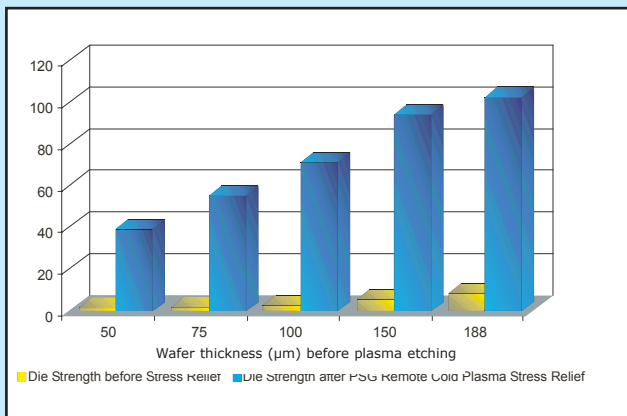
## Stress Relief Technology

In between device processing ("Front End") and packaging of chips ("Back End") the wafer is thinned and singulated into chips ("Pre Assembly"). These two activities induce a lot of stress in the brittle wafer material when performed by typical mechanical processes (grinding, dicing saw or laser processing).



The thinner the wafer the greater the risks. At this stage the wafers and chips are most vulnerable to breakage due to damage induced by the mechanical treatment.

Remote plasma etching (pure dry chemical etching) restores the mechanical integrity of these thin chips by the elimination of damage on the wafer backside and chip side wall. In brief, die strength is improved by stress relief by factor 30 (2900%).

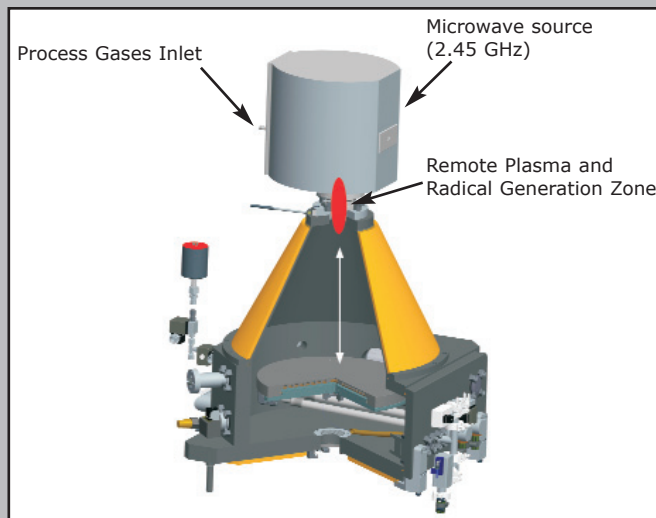


## Why Remote Cold Dry Etch?

The Remote Cold Dry Etch applies a high efficiency Microwave source in Argon Downstream mode (Remote). Here the plasma is located about 60 cm above the substrate enforcing pure dry chemical etching on the substrate surfaces. Fluorine radicals are carried by a directed stream of argon to the work piece and there provides a soft surface treatment of the brittle, ultra thin wafers.

This single wafer process is very stable, with reactant gases continually being refreshed and product gases continually pumped away. Since no wet chemicals are used there is greatly reduced risk of cross contamination.

By the *in-situ* change of the gas composition the remote plasma technology is the only technology offering a passivation process directly after the stress relief.



### Advantages

- No direct plasma on the substrate
- No wet chemicals
- No cross contamination

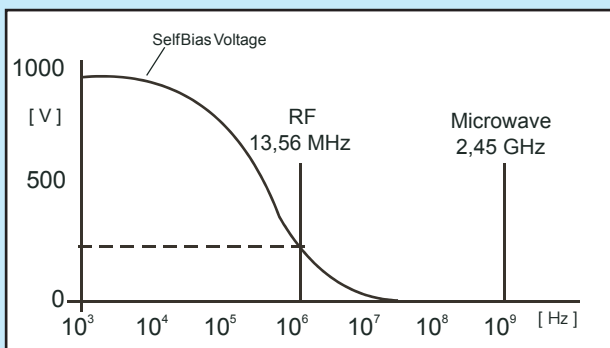
# Remote Cold Dry Etch

## Why Microwave?

For processing devices that are sensitive to electro static discharge, microwave generated plasmas have distinct advantages over RF. Due to the higher frequency oscillations of the electric field in microwave plasmas, electrons travel shorter distances compared to RF plasmas before they switch direction.

This means that fewer electrons reach the device surface per switching cycle, thus minimizing the surface charging effect. With surface charge at a minimum there is no potential for accelerating ions towards the surface that may cause undesirable surface bombardment.

Microwave plasma etching is very well suited for radical based and therefore isotropic in nature and ideal for Dry Etching Applications.



## Advantages

- No ESD charging effect
- No ion bombardment
- No bias

## Benefits for our Customers

The PVA TePla technology combined with the world wide patented radical distribution system allows high uniformity even at 12" substrates. Good uniformity is pre-requisite for an overall high etch rate at lowest possible process temperatures (e.g. 70-80°C). In addition, our technology achieves full water relaxation by removal of only 3 μm silicon layers after mesh #2000 grinding or e.g. 7 μm removal after mesh #1500 grinding.

Hence, our solutions offer significant throughput, application and handling improvements compared to wet etch or polishing.

## Low Temperature and Easy Process Integration

The PVA TePla plasma etch tools do not require extensive gas or water purification treatment, and can be easily integrated into existing manufacturing lines.

## Controlled Process Quality and High Uniformity for Tunable Surfaces

The chamber and chuck design has been optimized for maximum radial etch uniformity. Supported by a computer aided process control, our customers achieve consistent high-quality wafer surfaces, no matter what surfaces are required (mirror-like or matt).

## Low Cost of Ownership and Rapid ROI

Our technological benefits turn into clear economical benefits for customers.

Benchmark tests with competing technology result in cost advantages beyond a factor of 2. PVA TePla supports its customers worldwide to implement rapid ROI.

We can apply our technology to 2"-12" wafers and substrates up to 12" dicing frame. Our systems are available in manual, OEM and fully automatic stand-alone versions.

## Advantages

- Manual
- OEM
- Stand Alone

# The Power of Plasma

# Remote Cold Dry Etch

## Wafer Level Stress Relief

applicable to ground wafers:

- on backgrinding tapes
- on hard support and ring carriers
- as carrier-free wafers

## Chip Level Stress Relief (CSH) (Chip Side Healing)

applicable to singulated substrates  
(blade/laser):

- as single chips on tape
- as singulated wafers on dicing tape
- as singulated or partially diced wafers on grinding tape

## Substrate Thinning

applicable to:

- down to 10  $\mu\text{m}$  thickness
- to any substrate size up to 12" wafers
- single relocated chips on tape

## Post Polish Treatment

applicable to thinned wafers:

- as pre-metal step on shiny surfaces

## Surface Passivation

applicable to wafers and chips:

- seals against contamination
- generates hydrophilic surface

## Surface Cleaning

applicable to wafers and chips:

- eliminates loose organic material
- prepares the substrates for etching



# The Power of Plasma

