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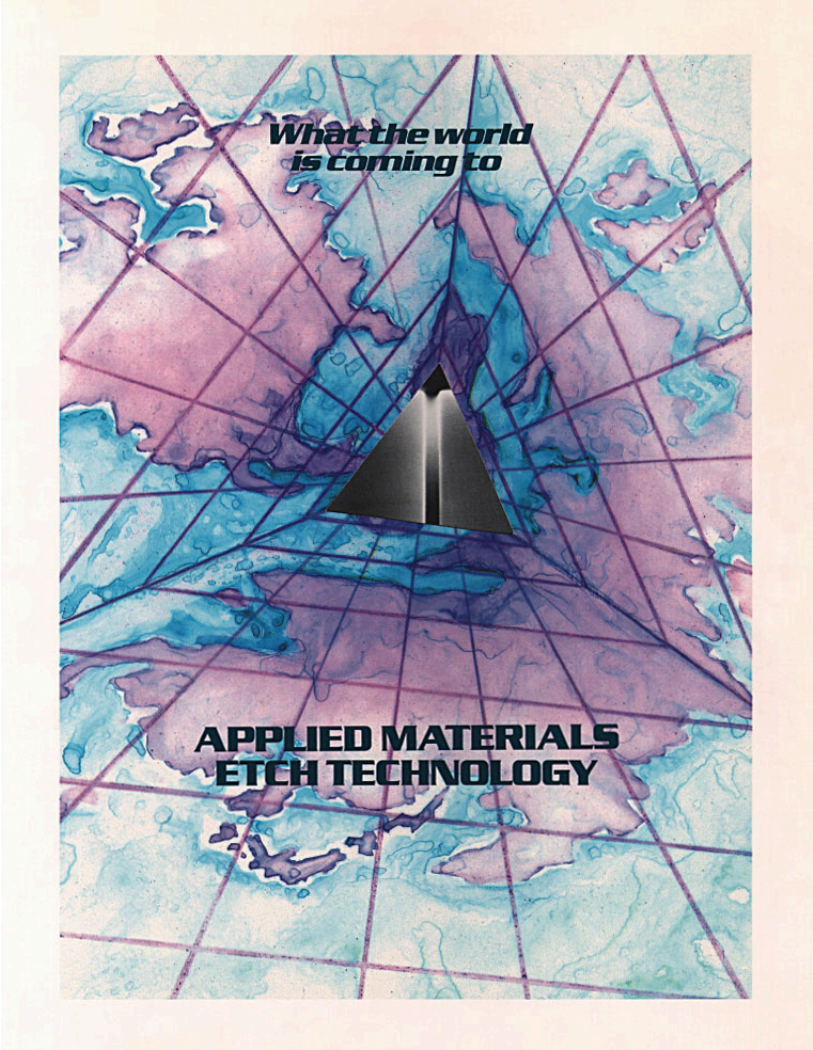
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Applied Materials - P5000, Etcher

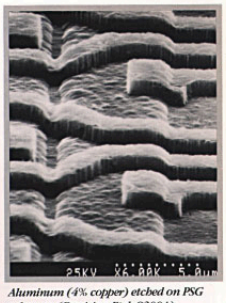
Organization Name : Applied Materials

Summary : Applied Materials - P5000, Etcher :1985-89 - Followed the 8300, but was eclipsed.

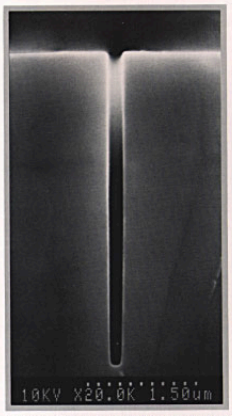


What the world is coming to

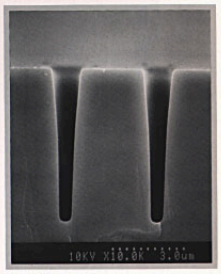
Manufacturing advanced semiconductors demands the ability to etch devices with submicron features. To meet this requirement, manufacturers throughout the semiconductor world are coming to low-pressure reactive ion etching (RIE). And Applied Materials is the vendor they are turning to for RIE. The Precision Etch 8300A already is the industry standard for metals and dielectric materials. Now comes the Precision 5000 Etch* for low-pressure RIE of single crystal silicon and other critical silicon films. Take a look at these results on the wafer. They'll show you why low-pressure RIE from Applied Materials is what the world is coming to.



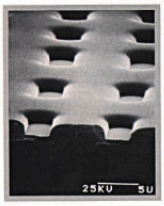
Aluminum (4% copper) etched on PSG substrate (Precision Etch 8300A).



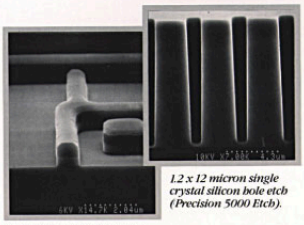
0.2 x 4.2 micron single crystal silicon trench etch, 21:1 aspect ratio (Precision 5000 Etch).



1.25 x 6.5 micron single crystal silicon trench etch with 85° top taper, 89° bottom taper (Precision 5000 Etch).



Tapered oxide contact windows (Precision Etch 8300A).



1.2 x 12 micron single crystal silicon hole etch (Precision 5000 Etch).

Submicron polysilicon etch stopping on oxide (Precision 5000 Etch).

*Patents pending

LOW-PRESSURE RIE FROM
Enabling Technology for Submicron

Precision Etch 8300A

Applied Materials introduced low-pressure RIE in 1981 with the AME 8100 and followed that with the Precision Etch 8300 in 1985. These systems, and the current 8300A with its Etch Automation/Simplification Enhancement (EASE™), established the benefits of low-pressure reactive ion etch in the semiconductor industry. As a result, the Company is now the industry leader for RIE systems in semiconductor fabrication.

The 8300A utilizes a vertical hexode process chamber which provides inherently clean, anisotropic etching with controlled profiles. The system produces the high degree of selectivity to a relevant base layer required for advanced devices designed with thin underlayers and shallow junctions. Like all of Applied's newest systems, the 8300A incorporates the highest levels of particulate control and throughput in the industry. Among the features making this possible are automated cassette-to-cassette wafer handling through a vacuum load lock, multi-wafer processing, closed-loop end point detection, and a sealed flush-mounted cleanroom interface that allows through-the-wall installation with all maintenance performed outside the cleanroom. The 8300A's microprocessor-controlled wafer management system gives it enormous flexibility, enabling users to process partial loads without operator intervention, or to mix wafers requiring different process steps in a single lot.

The Precision Etch 8300A is the system of choice for etching of metals and dielectric materials, such as aluminum, aluminum alloys, thermal oxide, PSG, BPSG, composite films such as O-N-O and sandwich metallization structures.



APPLIED MATERIALS:
Geometries

Introducing the Precision 5000 Etch

Applied Materials now introduces the newest member of its family of etch products, the Precision 5000 Etch. The 5000 Etch combines low-pressure RIE with a magnetically enhanced plasma in a unique system architecture. It represents an enabling technology for etching high aspect ratio single crystal silicon with such precise control that deep trenches and holes can be etched with smooth sidewalls and round bottoms. For other critical silicon films, the 5000 provides precise pattern replication, CD control, and anisotropic profiles with minimal underlayer loss. These capabilities are needed by semiconductor manufacturers to increase the density of active areas in 4- and 16-megabit DRAMs and to produce advanced CMOS, Bi-CMOS and bipolar devices.

The 5000 Etch utilizes the multi-chamber architecture introduced by Applied Materials with the Precision 5000 CVD.™ This unique configuration provides the flexibility, contamination control and reliability needed to produce current and future circuit designs.

The multi-chamber architecture of the 5000 Etch allows the user to take advantage of low-pressure RIE while maintaining throughput in both high-volume and ASIC applications.



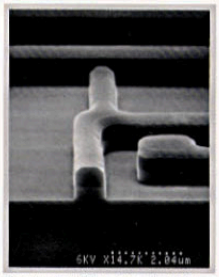
The 5000 Etch Advantages

LOW-PRESSURE RIE

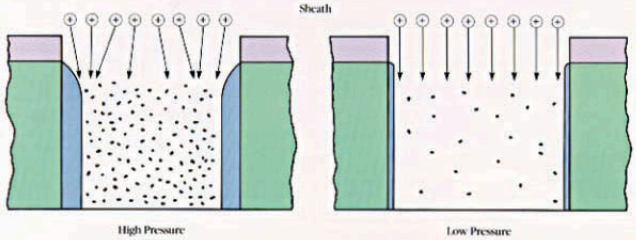
The effectiveness of the Precision 5000 Etch results from combining low-pressure etching with magnetically enhanced plasma in a multi-chamber architecture.

The benefits of low-pressure RIE are well-established in the semiconductor industry as the preferred means of achieving precise, fine-line geometries for high-density semiconductors with line widths down to 1 micron and below. Low-pressure operation is the key to anisotropic etching with tight CD control and high uniformity. Low pressure (<100mTorr) correlates with improved CD control, because the density of reactive neutrals decreases with pressure, permitting the anisotropic ionic component to dominate the process. In addition, the angular distribution of ions at the wafer surface becomes more anisotropic as pressure is reduced, because less ion scattering occurs in the low-pressure sheath.

The increased anisotropy resulting from the angular distribution of ion trajectories at low pressure also reduces the need for thick sidewall-polymer producing chemistries. This results in lower residues and cleaner operation.



Low pressure RIE provides anisotropic submicron polysilicon features.



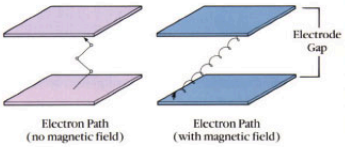
Low pressure operation reduces ion scattering in the sheath and reduces the density of neutral etch species. These effects increase the efficiency of thin sidewall passivation, permitting CD control and cleanliness to be maintained.

The 5000 Etch Advantages

MAGNETICALLY ENHANCED PLASMA

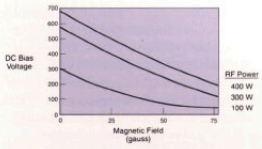
The application of a magnetic field to low-pressure RIE technology in the Precision 5000 Etch increases both the ionization and dissociation efficiency of the plasma. The magnetic field improves the ability to control the etch process without excessive heating of the wafer surface, which can occur in conventional diode and triode systems when RF power is increased to achieve higher etch rates.

Combining a magnetic field with a plasma reduces the DC bias voltage for a specific level of power. This decreases the energy of ions incident on the wafer surface, which is often associated with silicon lattice damage.

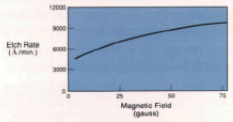


In the presence of a magnetic field electrons travel a larger distance across the electrode gap, so that more collisions with gaseous species occur. This produces greater ionization and dissociation efficiency without increasing power.

To understand the results achieved by the 5000 Etch, it is necessary to review how ions are created in a plasma. Ions result from the collision of electrons with neutral species as they travel within the plasma. In the presence of a magnetic field, the electrons travel a greater distance, so that more collisions occur. This produces greater ionization and dissociation efficiency with no increase in RF power.



Effect of Magnetic Field on DC Bias



Effect of Magnetic Field on Silicon Etch Rate
(Single Crystal Silicon Etch Process)

The addition of a variable magnetic field produces numerous benefits:

- Etch rate increases while DC bias voltage decreases for a specific level of power.
- Selectivity to hard mask is improved.
- The variable magnetic field allows processes to be optimized to specific customer requirements.
- In-situ cleaning of the individual chambers is provided. The field is generated by varying current to the four electromagnetic coils. By rotating the field, the 5000 pushes a cleaning plasma around and throughout the chamber. This in-situ process reduces the need for open-chamber wet cleaning and associated requalification.

The 5000 Etch Advantages

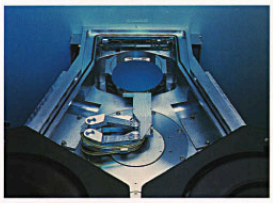
MULTI-CHAMBER ARCHITECTURE

The multi-chamber architecture of the Precision 5000 Etch was initially developed by Applied Materials for the Precision 5000 CVD system. When combined with magnetically enhanced plasma technology, this concept has proven to be equally practical for low-pressure RIE. The major advantage of the multi-chamber configuration is the ability to run the individual chambers in parallel, which allows the user to obtain high throughputs without sacrificing results on the wafer for etch rates. This typically provides the user with a wider process window and more repeatable processes.

The system design of the 5000 Etch provides processing with two or more modules in each system. Each etch module is self-contained and includes a self-aligning, bolt-on chamber assembly.

- Independent modules provide inherent production backup plus easy expansion for increased throughput or process capability.
- The system has the wafer capability for 100mm to 150mm and (optional) 200mm.

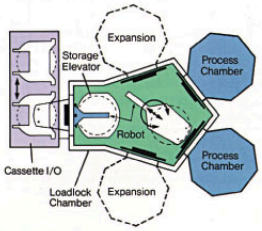




Centrally positioned robot serves up to 4 chambers (load lock cover removed.)

Inherently clean operation also is part of the multi-chamber 5000 design, which maximizes uptime and minimizes particulate generation.

- In-situ plasma cleaning, which is part of the 5000 process, helps to ensure repeatability and minimizes downtime resulting from system requalification.
- Slow pump and vent through low turbulence diffusers minimizes airborne particulates.
- Load lock protects the process modules from atmospheric contamination, resulting in improved particulate control and process repeatability.
- Flush-mount cleanroom interface reduces floor space and places all maintenance outside the cleanroom.



The 5000 Etch Advantages

AUTOMATION FOR THE FUTURE



The semiconductor world has come to realize that wafer fab equipment must meet today's needs while also being extendable well into the future. The Precision 5000 Etch was designed with this in mind. It provides the reliability, flexibility and contamination control needed to produce current advanced semiconductors. At the same time, it incorporates the broad process capabilities and advanced automation features that make it extendable for the future.

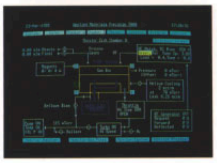
Factory automation was designed into the 5000 Etch so that it is ready when you are. All operations can be controlled by a host computer in conjunction with an external robotic cassette exchange for hands-off operation.

- SECS I and II interfaces to a host computer are designed into the 5000 Etch.
- Simple cassette input/output allows reliable robotic cassette exchange.

Only four push-button commands are needed to operate the Precision 5000 Etch: LOAD/UNLOAD/GO/STOP. The powerful microprocessor allows real-time control of up to four process modules.

- All programming is accomplished via light pen CRT or directly from the host computer.
- Full recipe creation, editing and storage are provided, as is real time reporting of process and machine status.
- Built-in automatic calibration and set-up service programs simplify maintenance and troubleshooting.





The 5000 Etch Advantages

WORLDWIDE SUPPORT

The Precision 5000 Etch represents a totally new concept in the dry etching of semiconductors. But it is based on Applied Materials' years of experience in low-pressure reactive ion etching and supported by a knowledgeable worldwide organization that assures our customers of maximum system performance.

Our large installed base of etch systems in major wafer fabrication lines around the world is your assurance of skilled help when you need it. Our record for meeting delivery and service commitments is one of the best in the industry.

With the Precision 5000 Etch, you get a package of support that includes an exclusive one-year full service warranty with these features:

- A one-year warranty on non-consumable parts.
- A one-year warranty on labor, backed by our worldwide field engineering organization.
- A full year of monthly preventive maintenance to help avoid potential problems and maintain the system at peak performance.
- The same coverage can be provided for the life of the system under a Full Service Agreement.
- Complete technical assistance, from comprehensive documentation to training programs, is available when and where you need it.

With the Precision 5000 Etch, you get more than just the strength of an important new leading edge technology – you get the strength of an industry leader ready to stand behind the product. It's one more reason Applied Materials technology is what the world is coming to.



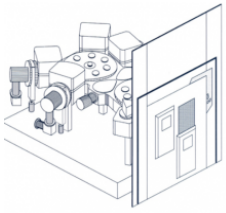
APPLIED MATERIALS

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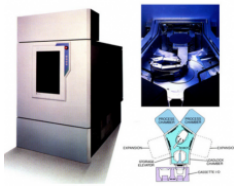
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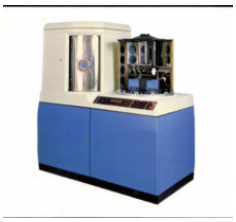
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