PLASMA ETCH
PROGRESS THROUGH INNOVATION

3 Ways to Increase Plasma Uniformity

The key to successful design and implementation of plasma etching systems is simultaneous control of several factors. Optimum etch rate and throughput can only be achieved by careful control of all plasma parameters and system designs, including process temperature, electrostatic shielding, R.F. power, gas distribution, vacuum, and electrode layout.

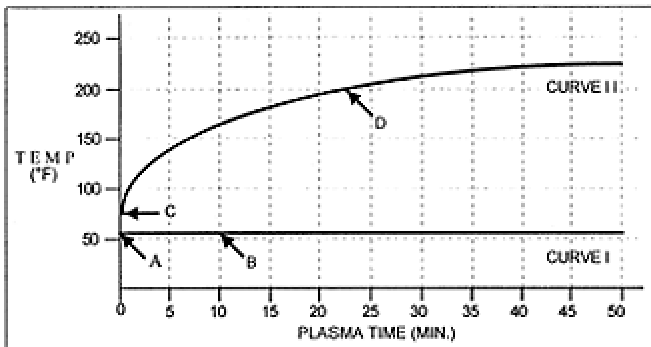
Lack of proper control of any of these interactive parameters and system designs will have a detrimental effect on system performance.

Temperature Control

Process temperature is the single most important parameter in the plasma process. Process temperature has primary control over etch rate and has a secondary effect on etch uniformity. The higher the process temperature, the faster the processing rate becomes. Process temperature control is mandatory when processing temperature sensitive devices. Uncontrolled process temperatures can cause distortion, de-lamination, and discoloration, and can chemically modify the properties of temperature sensitive devices.

Temperature Control Advantages

- Temperature control is independent of the plasma process
- Process temperature is constant throughout the plasma sequence. No ramping of temperature occurs during the plasma process. (See graph below)
- Etch rates are predictable and repeatable, due to steady state process temperature
- Etch rates are accelerated by using elevated process temperatures
- No throughput limiting temperature stabilization sequencing ("dummy plasma cycling") is required
- Start and stop system operation requires no throughput limiting temperature stabilization cycle



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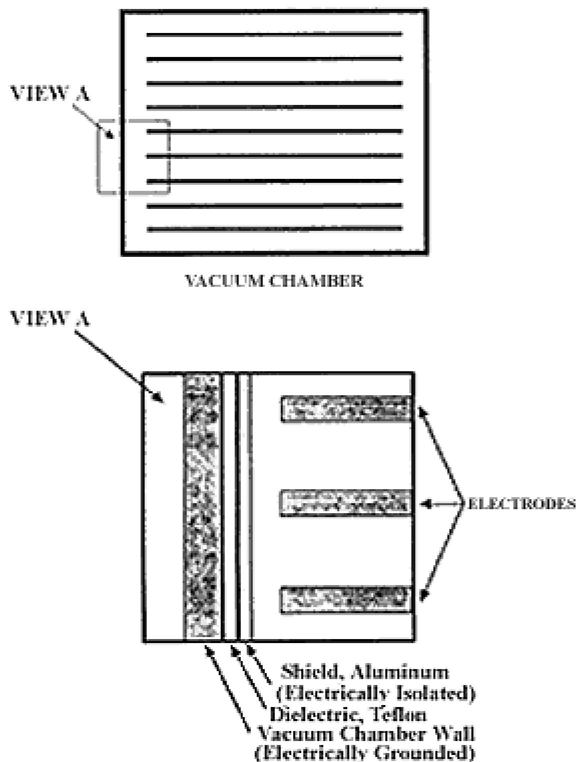
Electrostatic Shielding

The plasma process generates high energy plasma fields at the edges of the electrodes, which causes accelerated etching at these edges. These localized high energy plasma fields are caused by the plasma reacting with the vacuum chamber walls.

The overall effect is higher etch rates at the electrode edges, with a gradual reduction in the etch rate as it approaches the center of the electrode. This can be viewed as a target or bull's eye effect, which results in severe process non-uniformity. If unchecked, this non-uniformity will cause parts positioned at the periphery of the electrode to etch more severely than those positioned at the center of the electrode. To obtain uniform etch rates the high energy edge effects must be minimized or eliminated.

In Plasma Etch systems, all vacuum chamber internal surfaces are electrostatically shielded to eliminate plasma reactions with the chamber walls. (See diagram below.) These electrostatic shields are a patented feature, unique to the Plasma Etch product line.



Electrostatic Shielding Advantages

- Plasma activity is uniform across the electrode surface, thereby creating a uniform etch profile.
- Results are controllable and repeatable.
- Surface treatment of individual parts is independent of location and orientation on the electrodes.
- Some plasma equipment manufacturers attempt to minimize the bull's eye effect by distancing the electrodes from the vacuum chamber walls. This somewhat improves the uniformity of etch, but does not eliminate the problem. It has the added negative effect of increasing the internal volume of the vacuum chamber and thereby increasing pump down time.

High Frequency R.F. Power

The use of high frequency (13.56 MHz) R.F. power is instrumental in creating a high efficiency plasma. High frequency plasmas produce greater process uniformity and improved throughput.

- The physics of high frequency R.F. plasma is very different from low frequency R.F. plasma. The high frequency generates more reactive plasma.
- The high frequency plasma tends to be isotropic (etches uniformly in all directions).
- Nominal R.F. power levels (watt densities) are required to generate an optimum etch rate.
- R.F. power is held constant throughout the plasma process, and is independent of all other plasma parameters on all Plasma Etch systems.
- High frequency RF power requires an active matching network along with greater care in initial system design. Though these factors increase up-front costs, the system yields superior processing results.
- Plasma Etch systems use proven commercially available R.F. generators. This technology is extremely reliable and uses a high power tube as the final amplifier.

High Frequency RF Power Advantages

- The more reactive plasma generated by high frequency has a faster etch rate.
- The isotropic nature of high frequency plasma allows for the processing of three dimensional objects.
- Competitors' systems may use much higher R.F. power levels (watt densities) in an attempt to overcome the restricted etch rates associated with low frequency R.F. power. The higher power levels also compound the problem of temperature control, as they introduce more heat into the system.
- Constant RF power produces maximum and predictable etch rates.
- The "bullet proof" R.F. generators used in Plasma Etch systems have proven very reliable.

Plasma Etch, Inc. builds and services first class plasma systems with patented features that none of our competitors offer. Every system includes lifetime email and phone support. We have a team of dedicated professionals available for on-site support and training, as well as new equipment start up.

Plasma Etch offers a full line of cleaners and etchers from R&D scale bench top units, to production scale desmear and etch back systems. Industry leaders such as NASA, Boeing, Honeywell, Motorola, Bayer and Lockheed-Martin, have entrusted our plasma technology again and again with optimum results. Our customers know they are receiving excellent products and quality services for the lifetime of their Plasma Etch systems.