NANO-STRIP™ THE UNIVERSAL STRIPPER AND CLEANER

Stable and consistent chemistry. The present and future solution for substrate cleaning.

THE FACTS : THE BENEFITS

- Reduce chemical consumption and cost by up to 70%
- Increase wet bench utilisation from 60% to 100%
- Reduce particles added by conventional wet stripping and cleaning methods by 80%

NANO-STRIP™

STABLE STRIPPING

SPECIALITY

NANO-STRIP™ and NANO-STRIP™ 2X

Nano-strip™ comprises a stabilized formulation of Sulphuric Acid and Hydrogen Peroxide compounds.
It removes positive and negative resists and other organic materials used in various applications in addition to general substrate cleaning.
It contains high purity reagents required for high yield Sub 0.35 micron semiconductor manufacturing.

FEATURES	ADVANTAGES OVER OTHER METHODS
INCREASED STRIPPING CAPACITY AND BATHLIFE	Nano-strip™ has a bathlife which may be extended up to a week depending on the nature of the photoresist and the conditions of the process.
BATCH TO BATCH CONSISTENCY	Nano-strip™ is a single and stable solution, ready to be used directly out of the container. There is no need to use additional chemicals. Since no mixing is required, potential errors and further chemical handling are eliminated. Its performance is consistent and stable.
SAFE AND EASY TO USE	Nano-strip™ strips and cleans organic and inorganic contamination effectively at room temperature or may be used at elevated temperatures to promote more effective stripping . It contains no phenols, chlorinated solvents, and toxic fumes that can endanger operators or damage process equipment. Nano-strip™ can be used in recirculating filtration tanks to prevent particle build-up, promote agitation, resulting in a longer bathlife.
HIGH PURITY	Nano-strip™ is filtered to 0.1 micron. Each bottle is double-bagged. High Purity chemicals are used in its manufacture. This results in lower device defect levels. Several grades are available including one with a 1 ppb metal specification.
LOW AND CONTROLLED RATE OF METAL ATTACK	Deterioration of metal surfaces during stripping is negligible compared to other acid stripping formulas. Corrosion of aluminium layers is minimal, and Nano-strip™ leaves no organic residues.
REDUCED WASTE	Nano-strip™ has a long extended bath life compared to standard Sulphuric Acid/Hydrogen Peroxide baths. Hazardous acid waste is minimised and the cost of waste treatment is dramatically reduced. Nano-strip™ may reduce chemical volumes and therefore waste by as much as 70%.

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Applications

Nano-strip™ is an effective stripper and cleaner of organic and inorganic compounds. It replaces most Sulphuric Acid/Hydrogen Peroxide strippers used in photoresist stripping, pre-diffusion clean, pre-metal dip, and photomask/LCD cleaning. Nano-strip™ consistently meets or exceeds the typical requirements established for Capacitance vs. Voltage plots, particle count and electrical test specifications. In addition, for certain applications Nano-strip™ can be used over metal layers without corrosion.

A. PRE-METAL RESIST STRIPPER / CLEANER

Data proves Nano-strip™ is more effective than conventional in Fab prepared Sulphuric Acid/Hydrogen Peroxide Mixtures.

REDUCING PARTICLE CONTAMINATION AT 0.3 MICRON

CHEMICAL	APPLICATION	PARTICLES ADDED AT 0.3 MICRONS
● H_2SO_4 / H_2O_2	Post Plasma ETCH/ASH	20
● NANO-STRIP 2X	Post Plasma ETCH/ASH	3
● H_2SO_4 / H_2O_2	PRE METAL DEP CLEAN	5
● NANO-STRIP™ 2X	PRE METAL DEP CLEAN	0

* Featured Nano-strip™ 2X at 60° C

CAPACITANCE/VOLTAGE

CHEMICAL	VOLTAGE SHIFT
● NANO-STRIP™	0.07
● H_2SO_4 / H_2O_2	0.42

* Featured Nano-strip™ at 25° C

A1. PRODUCT EFFECTIVENESS AND CONSISTENCY

Stripping and cleaning effectiveness is determined by the concentration of Caro's acid in solution. Caro's acid is depleted at a rate proportional to the amount of organics and inorganics introduced in the solution (see Figure 3). The concentration of Caro's acid in Nano-strip™ is consistent compared to solutions of Sulphuric Acid and Hydrogen Peroxide mixed in-house (see Figure 4). Nano-strip™, as a result shows many process benefits and cost savings.

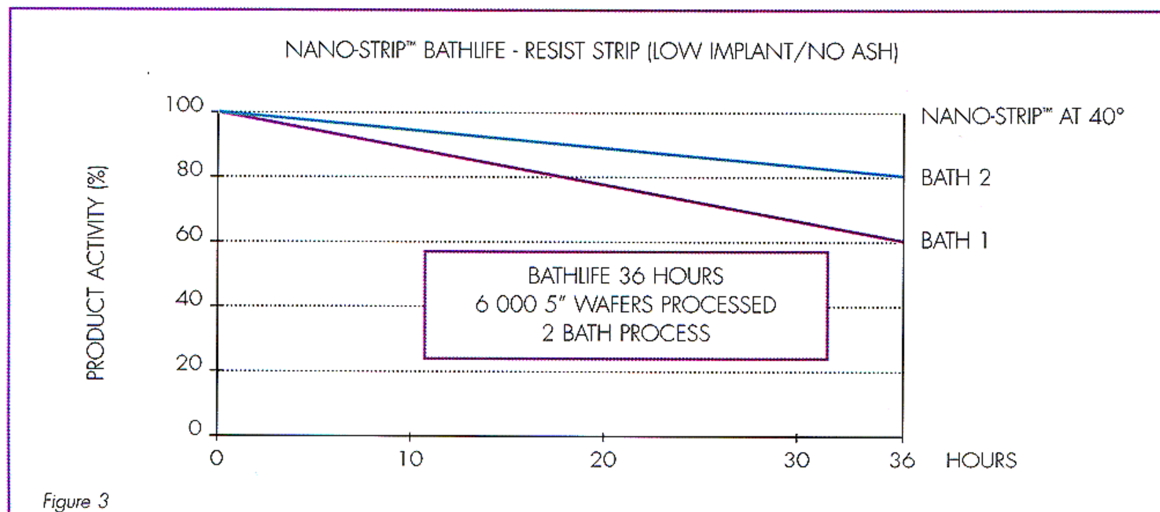

Figure 3

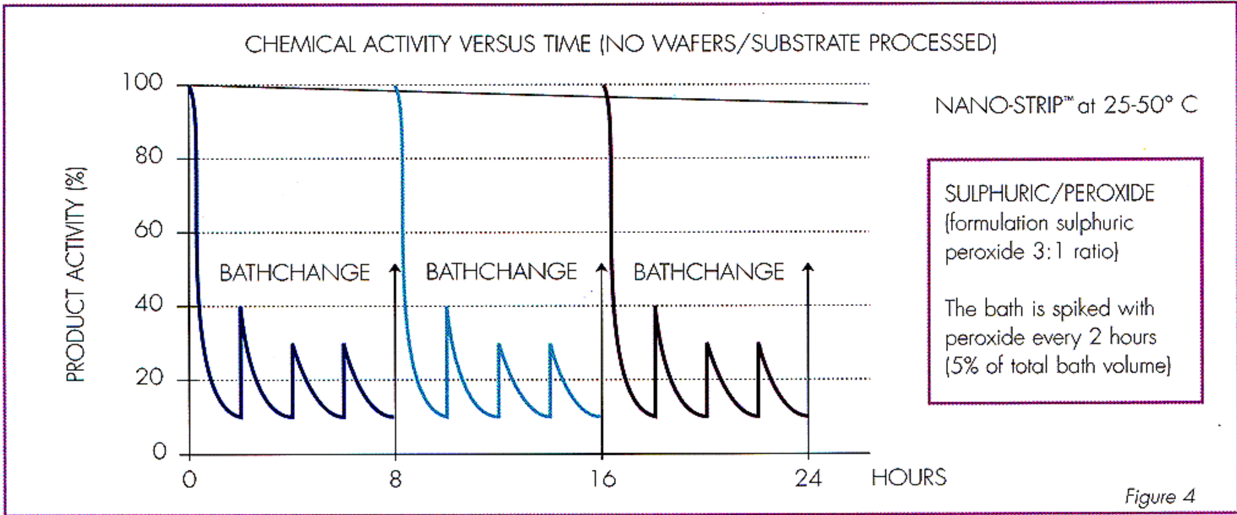

Figure 4

A2. BATH EFFECTIVENESS AND LIFETIME

The activity of Nano-strip™ depends on the temperature of the bath and the length of time the bath is used.
The bathlife can be characterised analytically for different processes.
Bathlife is typically 24 hours under the harshest conditions, and it may be as much as one week depending on temperature and the length of time the bath is used. Figure 5 and 6 illustrate the effect of temperature for Nano-strip™ and Nano-strip™ 2X respectively.

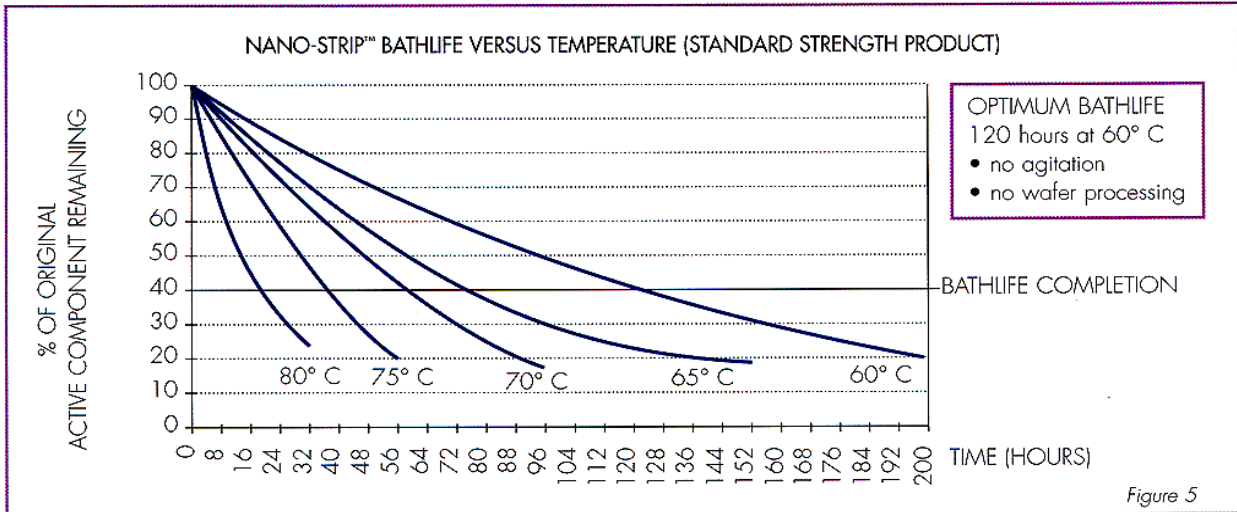

Figure 5

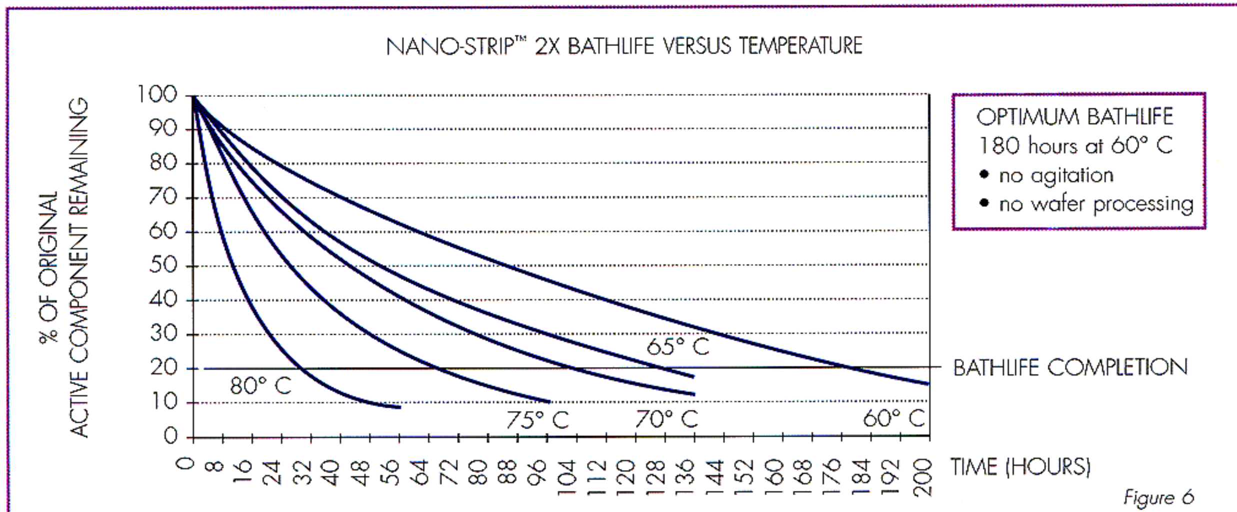

Figure 6

A3. WAFER STRIPPING CAPACITY

The following wafer stripping capacity figures were obtained using 4-inch wafers coated with 1.0 micron layer of unpatterned photoresist.

- Negative photoresist, wafers / gallon: 3800
- Positive photoresist wafers / gallon: 3000

These have been extrapolated for 6-inch and 8-inch wafer applications. (see figure 7)

WAFER STRIPPING CAPACITY

Conditions: 100% wafer covered in resist, with bath temperture at 25° C standard strength Nanostrip™ and one process.

RESIST THICKNESS (microns)	WAFER SIZE 4"	5"	6"	8"
1	1 000	640	440	250
4	250	160	110	60
6	170	110	75	40
10	100	65	45	25

In reality resist would cover 20 - 40% of the surface and two acid baths would be used at 40 - 60° C. Nano-strip™ 2X will exhibit 50% additional capacity.

Figure 7

A4. PROCESS COST SAVING

Nano-strip™ will reduce direct chemical cost, operator labour, chemical waste volume and effluent treatment costs. In addition, the up time and utilisation of wet benches is improved substantially. These case studies illustrate the benefits:

CUSTOMER CASE STUDY - 1

Nano-strip™ (standard strength) replaces Sulphuric Acid and Hydrogen Peroxide (S/P) used for resist strip. As a direct replacement with recirculation filtration added to the second process tank. Nano-strip™ bathlife is 24 hours for tank 1 and 48 hours for tank 2, this lifetime should be compared to 12 hours for S/P.

Chemical usage reduced by 67% from 24 gallons per wet bench to 8 gallons per 24 hours. Chemical cost and inventory reduced from 40 bottles to 12 in 24 hours. Wetbench utilisation increased from 60% to 100%

CUSTOMER CASE STUDY - 2

Nano-strip™ 2X replaces S/P used for post plasma clean and premetal deposition clean.
The added particles were reduced at each stage by 85 and 100% respectively with Nano-strip™ 2X at 60° C.
Uptime for process tanks was increased such that wafers processed per hour increased from 70 to 120.
Chemical cost for these processes was reduced by 65% per wet bench.

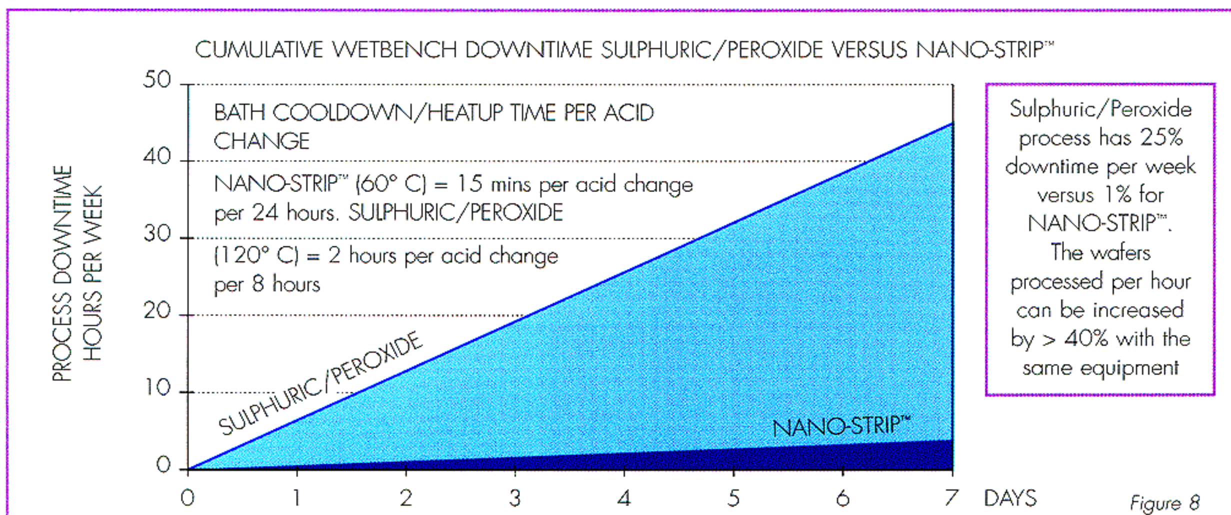

Figure 8

A5. SURFACE CORROSION

Nano-strip™ will not attack chrome, chromium oxide, gold, silicon or silicon dioxide. It has a minimal effect on tantalum silicide, titanium tungsten, ITO, aluminium and aluminium alloys. (See section B, below).

B. POST METAL STRIPPER OVER ALUMINIUM LAYERS

Nano-strip™ will etch Aluminium at a rate of 35 Angstroms per minute at 20° Centigrade. After processing 1000 4-inch wafers the etch rate increases to 45 Angstroms/minute.
It is recommended that process characterisation is carried out to minimise the process time required and therefore the total metal attack. Most positive/negative resists are removed in a maximum of 5 -10 minutes.

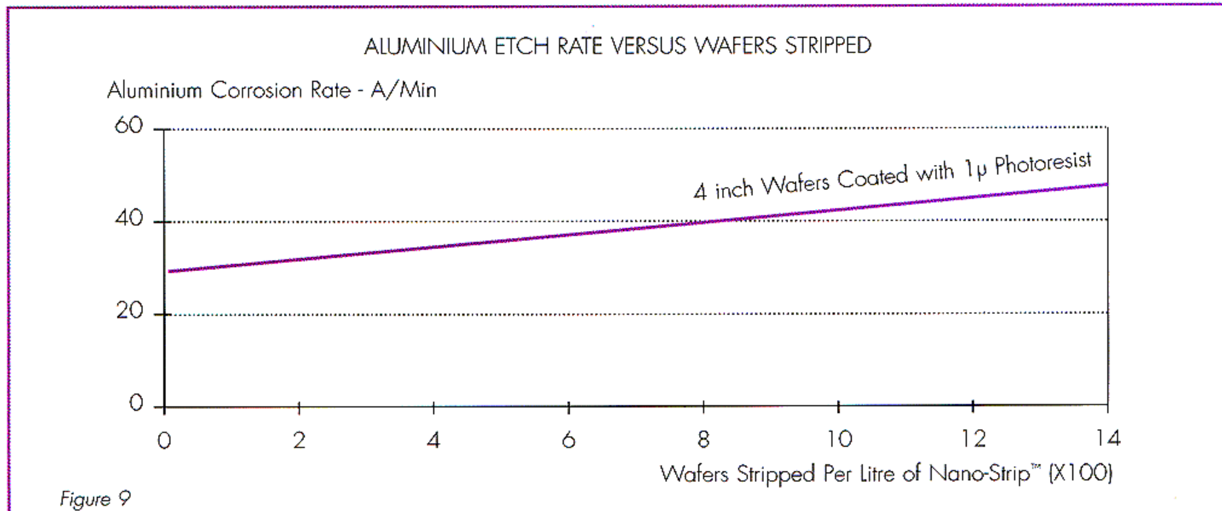

Figure 9

When used in this application precautions must be taken to avoid gross contamination of the Nano-strip™ tank with water:

- Cover the process tank when not in use
- Optimum bathlife is 8 hours in large scale production
- Wafers must enter Nano-strip™ dry
- Mild agitation is recommended

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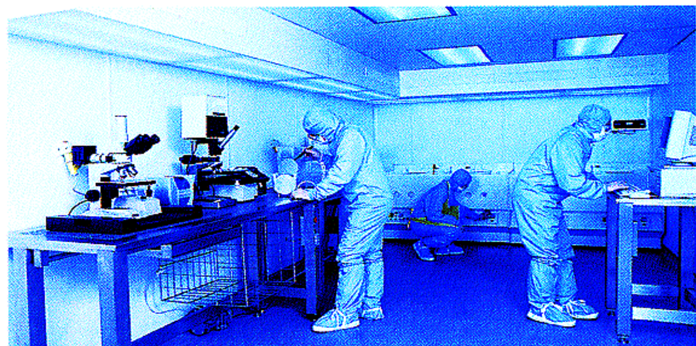
C. OTHER APPLICATIONS

Nano-strip™ has many other applications within process areas of the wafer fab, mask shop, silicon production, LCD and equipment manufacturing companies.

Nano-strip™ will replace other oxidation cleaners such as fuming Nitric, Nitric/Sulphuric and Persulphate/Sulphuric as well as solvents like TCE and amines.

Applications include:

- Quartz and glass cleaning
- Wax removal
- Probe ink removal



Process Recommendations

1. WAFER RESIST STRIPPING / CLEANING PRE-METAL LAYERS

- **Number of baths** — 2 recommended with 0.1 micron recirculation - filtration in the second tank (first tank also if possible). Nitrogen agitation in the first tank.
- **Temperature of bath** — Nano-strip™ is effective from 20 - 80° C. For optimum performance operating temperatures between 40 - 80° C are recommended. Guildlines for Nano-strip™ and Nano-strip™ 2X bathlifes are indicated in figures 5 and 6.
- **Total process time** — 10 -15 minutes in total.
- **Quick dump rinse** — 8 cycles.
- **Rinse cascade overflow** — Minimum 15 minutes followed by Spin/dry rinse.

Note: *When stripping photoresist previously treated with deep UV, high dose/high current implant, plasma etch, or any other process that can harden the resist surface it is recommended to carry out a short plasma ash process prior to the use of Nano-strip™. Current plasma strip times used for standard Sulphuric/Peroxide processes will be acceptable.*

2. WAFER RESIST STRIPPING - FROM METAL LAYERS

- **Number of bath** — 2 as above
- **Temperature of bath** — This must be maintained, not to exceed a maximum of 25° C
- **Total process time** — 5 - 10 minutes in total
- **Rinse** — 8 cycles in QDR or 15 minutes
- **Dry** — Standard spin-dry rinse process

3. CHROME MASK CLEANING AND STRIPPING

Type	Number of Baths	Temp	Mild Agitation	Total Time (Min)	Rinse Quick Dump	Rinse Cascade Overflow (Min)	Dry
Optical Resist	1 - 2	Ambient	Required	10 - 15	8 Cycles	15 Minimum	Standard
E- Beam PBS	1 - 2	60° C	Required	15 - 20	8 Cycles	15 Minimum	Standard
Pellicle Glue	1 - 2	60° C	Required	10 - 15	8 Cycles	15 Minimum	Standard
Re-Clean All	1 - 2	60° - 70° C	Required	4 - 6	8 Cycles	15 Minimum	Standard

Product Characteristics

MATERIAL COMPATIBILITY

Nano-strip™ is compatible with the following: (below 25° C)

- High density polyethylene
- Teflon PTFE
- PVDF (Ambient temperatures)
- Glass
- Quartz

Nano-strip™ is not compatible with the following:

- Polypropylene
- Most metals (including Silver, Ag)
- HDPE (above 25° C)

PRODUCT SHELFLIFE, STORAGE AND HANDLING PRECAUTIONS

The normal shelf life of Nano-strip™ is 6 months after it has been manufactured. Storage temperature is 10 - 25° C, 50 - 77° F. Do not expose Nano-strip™ to direct sunlight, store it in a cool, well ventilated area. Never add any chemical or water to this acid as a strong exothermic reaction may occur. Never store it near combustible and organic materials or other materials that are easily oxidised. Containers must be stored upright and tightly closed to prevent leakage. Safety showers and eye baths should be available in case of accidental contact. For further details see the product MSDS sheet.

PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE	Clear, viscous liquid	COLOUR	Colourless
ODOUR	Mild odour	BOILING POINT	> 212° F, 100° C
FREEZING POINT	< 0° F, -17.8° C	SOLUBILITY	Completely miscible with water
pH	< 1	SPECIFICATION	See separate sheets

CAUTION

Liberation of oxygen is a normal occurrence for Hydrogen Peroxide products. Nano-strip™ containers and equipment used for transferring Nano-strip™ must be equipped with pressure venting devices to avoid excessive pressure build up.

Technical Support

A fully equipped cleanroom application laboratory with trained engineers is available to support process development. This facility includes class 10 wet benches with heated recirculation filtration baths capable of processing up to 8-inch diameter wafers and other substrates. In addition various analytical and microscope inspection tools are available to support customers setting up Nano-strip™ processes or developing/testing new applications.

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