

MATERIALS AND TECHNOLOGIES

Providing Wet Processing Solutions to Since 1992





WAVEETCH

Single-sided Etching, Thinning, Cleaning, Texturing, and Wet Processing Systems





CORE BUSINESS

Semiconductor Wet Processing

"True single sided etching, thinning, cleaning, texturing, and wet processing."

• Leading edge expertise in advanced materials etching, processing, lithography and microfabrication



KEY TECHNOLOGIES

- Single Sided Thinning and Wet Processing
 - 30+ patents on various systems and technologies
 - WaveEtch[™], RotoEtch[™], and Optical 3D Shaping families of systems
 - Dynamic Confinement[™] and
 - Linear Scan[™] Technologies
 - Non-contact CAT[™] chuck technologies
 - Megasonics Linear Scan Wet Processing
 - High Throughput Single-sided Wet Processing
- Chemical Handling and Metering
 - Aeris[™] Chemical Pumping and Metering Systems



"MATECH was responsible for the

technology behind the x-ray optical

elements in nine NASA missions."

fabrication equipment and

CUSTOMERS

3M

- NREL
- Infineon
- Motorola
- MIT
- Tencor
- NASA
- Cornell University
- Lousiana State University
- Vitrum Photonics
- Optimax
- U.S. ARMY, DOE, DoD, NSA, DARPA, Air Force and NAVY
- Northroup Grumman
- Boeing
- Applied Materials
- Telecom World's Fortune 50's fabs
- • • •







WAVEETCH

Precision Thinning and Etching System



LINEAR SCAN THE TECHNOLOGY

"MATECH's patented key technologies of Linear ScanTM and Dynamic ConfinementTM are embodied in its WaveEtchTM family of wet processors and etchers."

Intrinsically Highly Uniform

- Substrate is scanned over a line of reactants thus eliminating transport and centro-symmetry contributions to non-uniformity.
- Reactants and byproducts reach and exit the process zone immediately and homogeneously across the wafer, thus making the system intrinsically uniform (as opposed to spin, spray and fountain etchers).
- Large amounts can be removed with extreme uniformity.

- True Single Sided Wet Processing
 - Non-process side is unaffected by etch process making new manufacturing processed viable
 - Reduce manufacturing steps
 - Save money
- All members of the WaveEtch[™] family are:
 - 50-300 mm capability
 - Fully Automated
 - Cassette to cassette
 - Dry-in-dry-out
 - And include a built-in "Chemistry on The Fly" chemical handling sub-system



LINEAR SCAN



Fig. 2. WaveEtch Linear Scan Process Schemcatic



Fig. 1. WaveEtch Linear Scan schematic







50URUT THICKNESS VARIATION IN CONVENTIONAL PROCESSES



Convective Flow



Centripetal Boundary Layer Non-uniformity

Spray Pattern-induced Non-uniformity



$\mathbf{W}_{\mathbf{A}\mathbf{V}\mathbf{E}\mathbf{F}\mathbf{C}\mathbf{H}^{\mathsf{T}\mathsf{M}}} \mathbf{P}_{\mathbf{R}\mathbf{O}\mathbf{C}\mathbf{E}\mathbf{S}\mathbf{S}} \mathbf{F}_{\mathbf{L}\mathbf{O}\mathbf{W}}$



LOAD

Substrate is delivered to *load station* by EFEM, operator, or other suitable means. It is picked up here by the process head.



Substrate is scanned over chemical meniscus as long as required by process.



PROCESS FLOW





PROCESS FLOW



DRY

Substrate is dried by gas pseudo-marangoni (air, N₂, etc.) and vacuum peripheral nozzle



UNLOAD

Substrate is picked up from *load station* by EFEM, operator, or other suitable means



LINEAR SCAN

ADVANTAGES

- **Decouples** chemistry from transport (LinearScan[™])
- Virtually size independent TTV specifications (2-12")
- Superior wafer and wafer-to-wafer uniformity (0.1-0.2% on typical patterning applications, <u>1-3% in</u> <u>blanket thinning applications</u>)
- Increases overall yield by reducing breakage, expecially on fragile materials (InP, Ge, GaAs, etc.)
- Tight process control and larger process window. Order of magnitude less chemistry use allows for ±0.1C temperature control of chemistry.



WaveEtch™ 112G





THE FAMILY







WE112G

WE112G-me





WE112G-2me







WE812-1



Materials and Technologies Corp. 182 Old Rt 9 Ste 1, Fishkill, NY 12524





WE812-2







WE812-3





WE108





APPLICATIONS



WAVEETCH Thinning

- Replacing grinding on most thinning operations
- Thinning (ASIC, SOC, SOI, 3D Integration, Memory, Smartcards, smartlabels, CCD, focal plane arrays and other imaging devices, memory, solar, Si, Ge, InP, GaAs)
- Stripping (SiO2, SiN, etc.)





WAVEETCH Stress Relief & Other

- Subsurface damage removal/stress relief after grinding
- Pattern Etching (InP, GaAs, Si)
- MEMS release (HF, BOE)
- **Die etching/thinning** (focal plane arrays, CCD)
- Universal wet processing: strip, rinse, develop, plate







WAVEETCHTM SURFACE TEXTURING

LinearScan[™] processes can yield a wide variety of surface textures in many different materials: from nm-level to multi-micron "super-rough," and a continuum in between

WaveEtchTM Super Rough





WaveEtchTM Micro-Rough





WAVEETCHTM SURFACE TEXTURING

Impeccable edge integrity and single-sidedness. The WaveEtch™ LinearScan™ and Dynamic Confinement ™ technologies enable a superior single-sided process with impeccable edge integrity (i.e. no wrap-up, creep, or "saw-tooting") to yield smooth edges and higher effective strength die, with no damage to the non-process side.



Process-side facing down. Notice lack of "wrap-around" and chemical creep onto the top surface. Material is silicon.



WAVEETCHTM SURFACE TEXTURING

Features

- Wide roughness range (nm to tens-of-micron levels)
- Able to superimpose multiple surface textures (nm texture on top of multimicron texture)
- Simple, inexpensive chemical mixtures
- Fast: most texturing process are 60-120 sec long
- Cost effective: very small chemical consumption
- Low Cost of Ownership (COO)
- Impeccable edge integrity and single-sidedness
- Texturing of Ge, Si, Poly-Si, and many other materials, square and oddshaped substrates



WAVEETCHTM SURFACE TEXTURING

Applications

- Improve adhesion (i.e. metallization)
- Reduce delamination failure
- Improved device/package reliability
- Electrical contact engineering
- Thermal management
- General packaging application
- Tailor surface optical/scattering properties
- Increase surface area
- Silicon surface engineering (optical, electrical, quantum, solar)



WAVEETCH OTHER APPLICATIONS

- Universal wet processing: strip, rinse, develop, plate
- Electro/Electroless-plating
- **Cleaning** (organic/inorganic)





PERFORMANCE



WaveEtch[™] Thinning





WaveEtch[™] Thinning





WaveEtch[™] Thinning



Thickness of Silicon Nitride Film on 75mm Wafer



FIGURE 1

Nitride Film Statistical Analysis

MEAN	2141	Angstroms	
STDEV	16	Angstroms	
MAX	2168	Angstroms	
MIN	2114	Angstroms	
RANGE	54	Angstroms	
			-

Extreme Uniformity On thinning fragile materials

WaveEtch[™] Thinning

Thickness of SiO₂ Film on 75mm Wafer



FIGURE 1

OXIDE FILM STATISTICAL ANALYSIS

MEAN	4461	Angstroms
STDEV	26	Angstroms
MAX	4509	Angstroms
MIN	4425	Angstroms
RANGE	84	Angstroms

Extreme Uniformity

On thinning fast etching materials

Normalized Thickness of SiO2 Films on 75mm Wafer Before and After Etching



PROCESS STATISTICAL ANALYSIS OF ETCHED DISTANCE

AVG.MEAN	1183	Angstroms
AVG. STDEV	25	Angstroms
AVG. MAX	1232	Angstroms
AVG.MIN	1138	Angstroms
AVG. RANGE	94	Angstroms





AUTOMATION



WAVEETCH

AUTOMATION

- **Robust** fully automated: dry in-dry-out cassette-to-cassette
- State-of-the-Art process control system
- WaveEtch Soft: powerful and simple
- Flexible: virtually unlimited process flexibility
- Rugged: modular, fail-safe, easy repair, fast TAT
- GEMS/SECS II





WAVEETCH

AUTOMATION

- Operator friendly: touch screen, simple syntax, multilevel operator clearances
- Chemistry-on-the-fly subsystem: extreme flexibility in chemical management, full program control, metering, mixing, temperature control.
- Accepts chemicals from bottles, tanks, or bulk





SUPPORT





WAVEETCH Service and Support

- U.S.
 - Installation
 - Service
 - Support
 - Maintenance
- In-the-field tool uptime 96%+ (including PM)
- Custom Service/Support
 packages





IN SUMMARY



WAVEETCH

DELIVERS...

- State of the art technology
 - Better uniformity
 - Tighter process control
 - Higher yields -
- Significant cost advantage
 - Lower capital cost
 - Lower cost of ownership

Replaces grinding in most thinning operations, especially those involving fragile materials or delicate structures (i.e. III-V, etc.)

Gentle process. Does not subject wafer to the stresses of a mechanical process (i.e. grinding) resulting in virtually no breakage.

- Reduced Chemical and DI Water Usage
 - Order of magnitude reduction possible



WAVEETCH

DELIVERS...

- Greater flexibility in process choices
- True single sided
- Safe handling of thin substrates
 - Cassettes or flatpack
 - Taped or tape-less
 - Custom

- State of the art, robust automation
- Safety: enclosed tanks, double walled confinement, fail-safe interlocks and limits, multi-level access





The Next Step in Thinning and Wet Processing





Authorized Representative

For Additional Information, Quotes, Power Points, and Specifications contact:

SEMICONDUCTOR SMART SOLUTIONS, LLC

Bright Technologies Today

4937 W. Diana Ave Glendale, AZ 85302 Ph: (602) 870-6677 E-mail:PAAvila@flash.net

Pete Avila III, President – (602)870-6677, (602)321-3334 Cell, <u>PAAvila@flash.net</u> Corporate Office, Glendale, AZ, <u>www.SemiSmartSolutions.com</u> –website

Michael Lamb, Technical Director – (512)268-9266, (512)922-8288 Cell Texas Office, Kyle (Austin), TX, <u>MLamb-SSS@Austin.RR.com</u> – E-mail

Elizabeth Hodges, Application Specialist – (480)600-2716 Oregon Office, Albany, OR, <u>ehodges10@gmail.com</u> – E-mail

David Lamb, Sales Engineer – (512)632-5077 Cell Texas Office, Dallas, TX, <u>DavidALamb@outlook.com</u> –E-mail

Josie Avila, Marketing Manager Arizona Corporate Office, Glendale, AZ, <u>JosieAvila2008@yahoo.com</u>

