Automating America and the World
Engineering Wet Processing Equipment for the Semiconductor Industries future and beyond
Standard Products
Megasonic Units
Custom Designed Products
Spin Process System
CNC Routing Capabilities
Neutralization Systems
Sub Contract Manufacture
Field Service
Repairs to existing equipment

6387 San Ignacio Ave. San Jose, Ca. 95119

23000 sq. ft. Facility, 1000 sq. ft. Clean Room
Megasonic Background

• Megasonics have become an important and widely accepted cleaning method for contamination-sensitive products.
• Most manufacturers in the integrated circuit, hard drive, raw silicon, mask, flat panel display, and other industries affected by contamination have turned to megasonic cleaning to help meet stringent cleanliness requirements.
• Megasonic cleaning uses the piezoelectric effect to enable removal of sub-micron particles from substrates.
Cleaning is accomplished by several mechanisms:

- Acoustic Streaming
- Microstreaming
- Microcavitation
- Chemistry
- Acceleration Forces
- Standing Waves
- Radiation Pressure Force
- Resonance Cleaning

Note: Some are more important than others
Benefits of reducing the Boundary Layer

- Increased removal of sub 0.5µ particles
- Increased particle removal overall
- Increased transport of removed particles through increased acoustic streaming
- Higher chemistry refresh rate at the substrate surface resulting in faster cleaning
- Increased chemical access to small surface features for enhanced etch or strip applications
- More uniform oxide growth in SC1

Note: This Boundary Reducing Effect is especially important in removing small particles and accessing small surface features.
Megasonic Background

- Five key variables when using megasonics:
  - Chemical concentration
  - Temperature
  - Exposure time
  - Megasonic power
  - Flow dynamics

- Typical exposure times
  - 5 to 15 minutes for batch processing
  - \( \frac{1}{2} \) to 2 minutes for single wafer
Megasonic Background

- Chemistry - Zeta Potential

- A measure of the repulsive force between a particle and a substrate
  - Both positive
  - Both negative
  - One positive, one negative

- Chemistry (pH) and surfactants can change the surface charge of a material. Different materials may react differently as pH is changed.
Megasonic Power Coupling

Direct  Indirect  Bonded
Modutek Corporation
Kaijo Transducers

- High Frequency 2 MHz, 950 kHz,
- Better Efficiency
- All Transducers fire simultaneously, therefore covering a larger area.
- Sub-micron Cleaning 0.20µm
Megasonic Theory

• Reduces thickness of the hydrodynamic boundary layer near wafer surface

• Micro-cavitation and micro-streaming dislodge particles from the surface

• Acceleration force scrubs off particles

• Acoustic Streaming carries off dislodged particles and prevents reattachment
Megasonic Testing

Constants:
- Silicon Nitride Contamination
- 300mm Bare (non-patterned) Silicon Wafers
- 52 wafers - ½ pitch
- 4 Quick Dump Rinses
- Surface Tension Gradient Dry
- Sensor Scan @0.12-0.20µ & 0.21-0.40µ

Variables:
- Continuous power
- Process times – 3, 5, 7, 10 & 12 minutes
- 35°C & 45°C– dilute SC1 – 50:2:1
Megasonic Results

Cleaning Efficiency on 300mm Wafers
½ pitch / with Dilute SC-1 (50:2:1)
3, 5, 7, 10 & 12 minutes / 2.76 cm² / 35°C / 4 QDR / STG Dry

Cleaning Efficiency %

- 93.5% for 3 min
- 97.1% for 5 min
- 99.2% for 7 min
- 99.5% for 10 min
- 99.6% for 12 min

0.12-0.20μ
0.21-0.4μ
O’All
Megasonic Results

Cleaning Efficiency Across the Cassette
Dilute SC-1 (50:2:1) / 300mm Wafers / ½ pitch
3, 5, 7, 10 & 12 minutes / 2.76cm² / 35°C / 4 QDR / STG Dry

All Particle Sizes (<0.121μ)

- 100%
- 98%
- 96%
- 94%
- 92%
- 90%

- 3min
- 5min
- 7min
- 10min
- 12min

◆ Slot 5  ▼ Slot 26  △ Slot 50
Test Conclusions

• Cleaning Efficiencies of ≥97% at 0.12μ were achieved in all testing with cleaning times ≥5 minutes

• No appreciable improvement in cleaning ≥7 minutes

• Even with 35°C and shorter than industry standard times, cleaning efficiencies of ≥99% can be achieved (spec >97% @0.12μ)
Test Conclusions

- Cleans 300mm wafers with
  - Higher efficiency
  - In shorter times
  - Lower temperatures
  - Lower chemical concentrations

- Highest power is not always the answer
- Bounce Technology works
- In-Direct systems perform well with short times
- Reduces cleaning times with increased efficiency
Megasonic Cleaning System

• Applications: pre-diffusion, pre-EPI, monitor wafer clean, post laser scribe clean, side-wall polymer removal

• Cleaning efficiency: >97% @ .12 um

• Wafers: 150/200/300mm, Single, Dual, 52 wafer

• Substrates: Flat Panel Displays, Photo Mask, Rigid Disks, Optics and other
Halar Megasonic
Quartz / PVDF Quick Dump Rinser

- All Quartz Dump Rinser
- PVDF Housing Material
- Dual High Flow Dump Valves
- Indirect Megasonic Plate 950 kHz, 2mHz
- Direct Megasonic Plate 950 kHz, 2 mHz
Quartz Megasonic

- Quartz with circulation
- Indirect design
- Uniform up flow
- Designed for high temp
- Easy installation
- All Teflon or quartz flow path