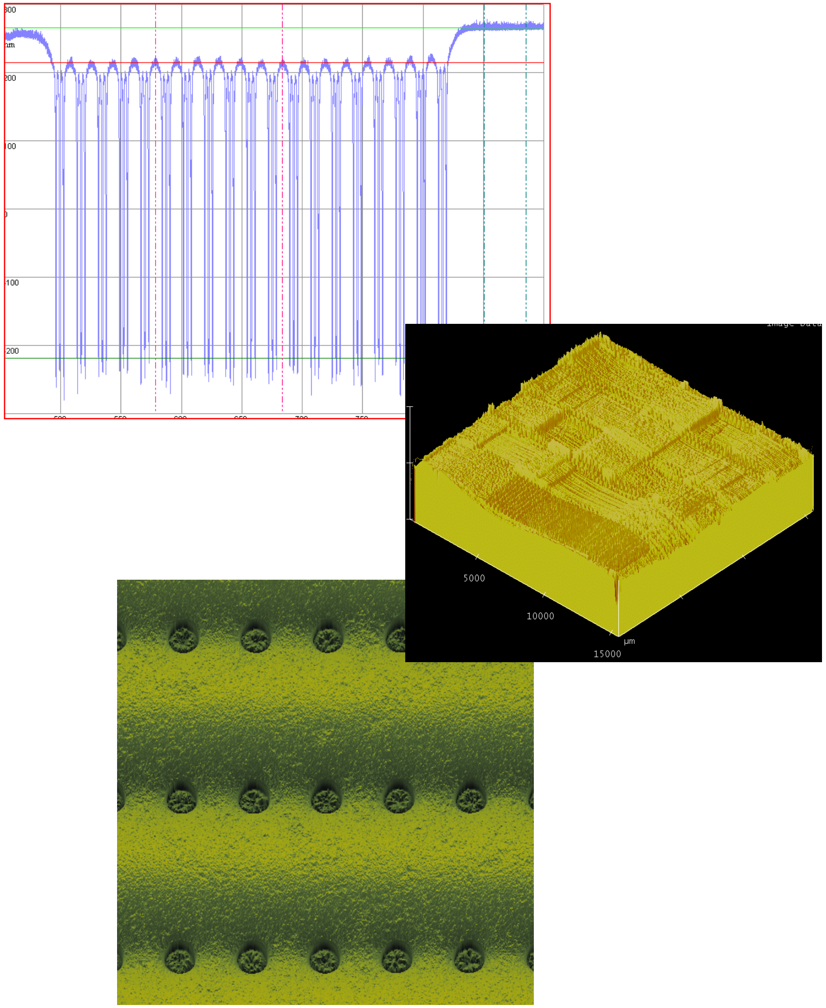
Dimension™ Vx
Atomic Force Profiler™



Advanced Metrology for CMP and Etch

Overview

- **Product and application overview**
- **Dimension Vx Atomic Force Profiler (AFP)**
  - Modes of operation
  - AFP for CMP and etch
- **CMP metrology**
- **Etch depth metrology**
- **FAB automation**
- **Summary**

Veeco Metrology

Semiconductor Product and Application Overview (200mm)

Wafer Size	**200mm**		
Product Technology	**Dimension AFM**	**Dimension AFP**	**Dektak Stylus Profiler**
Manual (F.A./Lab)	D8000 D8000-PM	Vx200	V200Si
Automated (Production)	D9000 D9000-PM	Vx210 Vx310	V200SL V300SL

Product Technology	**Dimension AFM**	**Dimension AFP**	**Dektak Stylus Profiler**
Applications	Etch depth Line depth Imaging Bare wafer roughness Photomask (PM) HSG	Etch depth Line depth CMP Imaging Profiling HSG	Long Scan Stress Step height Bump height Grating

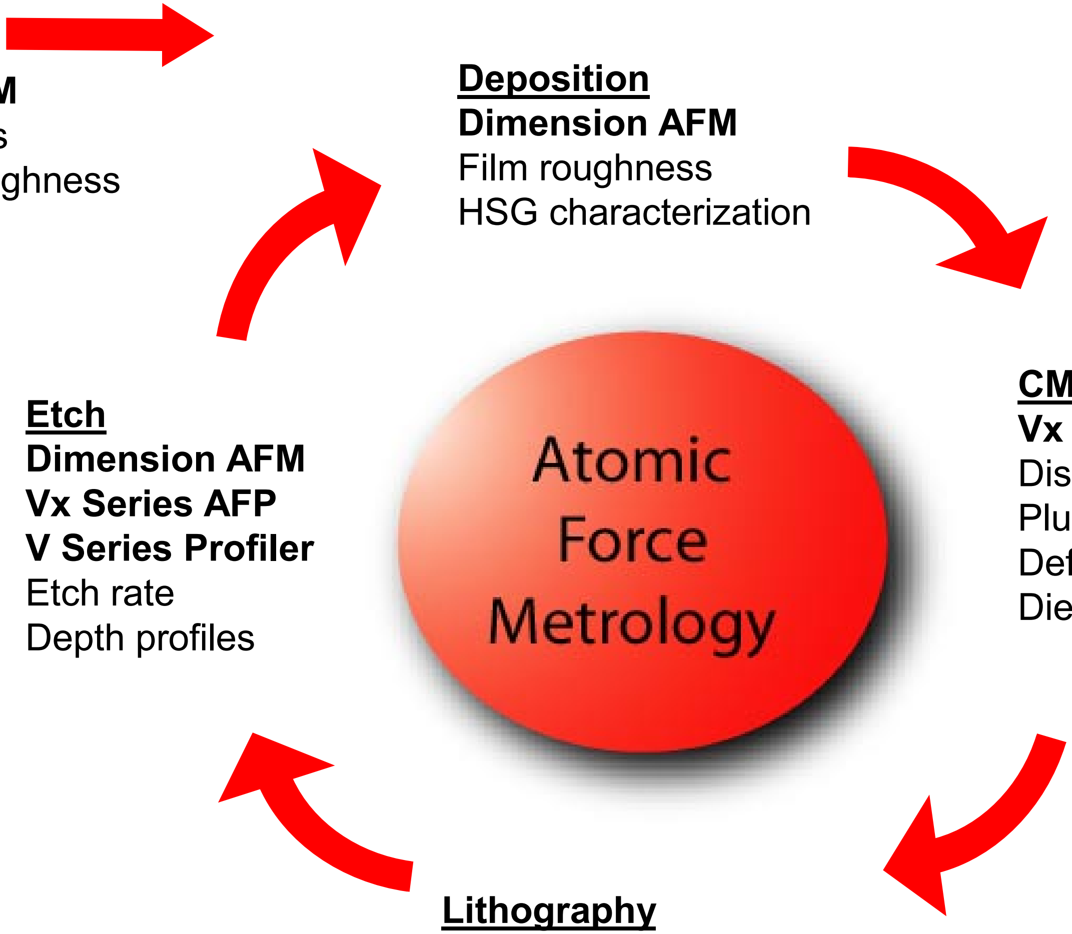
Veeco Metrology

Semiconductor Product and Application Overview (300mm)

Wafer Size	**300mm**		
Product Technology	**Dimension AFM**	**Dimension AFP**	**Dektak Stylus Profiler**
Manual (F.A./Lab)	D6300	Vx300	V300Si
Automated (Production) (i300i Dual FOUP)	D9300	Vx330	V330 Roadmap Q2 '01

Product Technology	**Dimension AFM**	**Dimension AFP**	**Dektak Stylus Profiler**
Applications	Etch depth Line depth Imaging Bare wafer roughness Photomask (PM) HSG	Etch depth Line depth CMP Imaging Profiling HSG	Long Scan Stress Step height Bump height Grating

Semiconductor Process Flow



Silicon
Dimension AFM
Epitaxial defects
Bare Silicon roughness

Deposition
Dimension AFM
Film roughness
HSG characterization

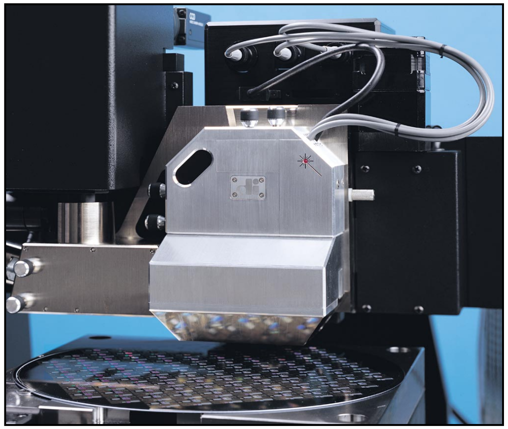
CMP
Vx Series AFP
Dishing and erosion
Plug recess
Defect review
Die imaging

Lithography
Dimension AFM Photomask
Etch depth
Defect review

Etch
Dimension AFM
Vx Series AFP
V Series Profiler
Etch rate
Depth profiles

Single Tool Solution

Series V platform and long scan capabilities



Dimension metrology TappingMode™ AFM and automation capabilities

Combining the proven technologies of

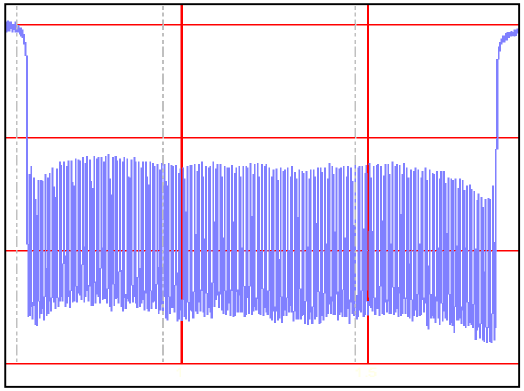
Profiling and AFM

Dimension Vx Atomic Force Profiler

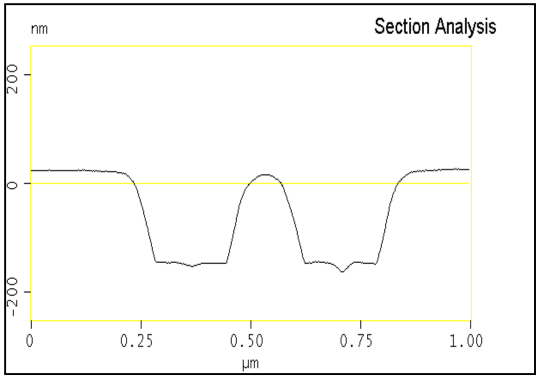
Unsurpassed repeatability
Highest profiling resolution
Highest scanning and 3D imaging speeds
Lowest contact forces and friction

…of any profiler!

…to create unsurpassed capability and flexibility



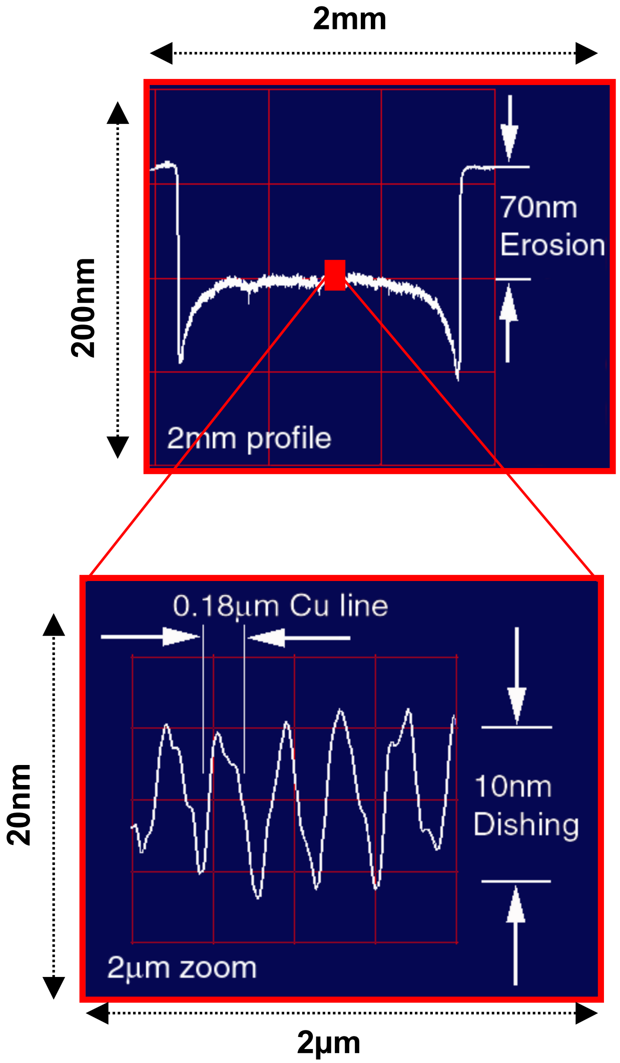
CMP profiling



Etch depth

True AFM Long Scan Profiling

- **Long scan profiles**
  - Die length (up to 100mm)
- **Superior step height repeatability**
  - <5Å - 0.1µm and 1µm steps (1σ); 20 traces at 20µm/sec scan speed
- **Unsurpassed lateral resolution**
  - Low force, small tip radius (<10nm nominal)
  - 262,000 data points/scan
- **True dishing and erosion analysis**
  - Dedicated measurement algorithm
  - Separates and analyzes dishing and erosion
- **No sample damage**
  - No lateral (friction) force with TappingMode AFM
  - Measure product wafers
- **OneScan™ Profiling**
  - Zoom in on long scans without loss of resolution
- **High speed profiling**
  - Up to 200µm/sec (application dependent)



Courtesy: SEMATECH

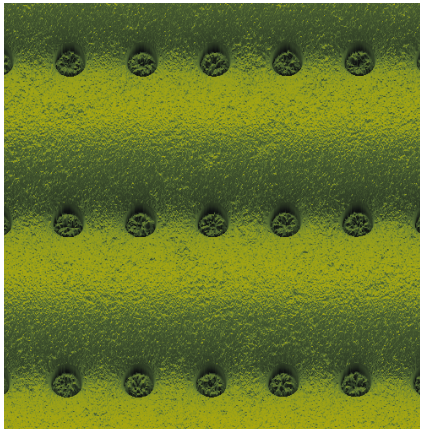
Depth Metrology

- **Depth measurement of high aspect ratio features >10:1**
- **Replaces costly, time-consuming cross-sectional SEM**
- **Non-destructive measurements**
- **High throughput, fast turnaround of results**

FEATURE DEPTH	**FEATURE WIDTH**				
	0.25µm	**0.18µm**	**0.13µm**	**0.10µm**	**0.07µm**
S.T.I. (0.5µm)	✓	✓	✓	2001 Program	
Contact/Via (1µm)	✓	✓	✓	2001 Program	
Resist Recess (2µm)	✓	✓	2001 Program 0.14µm x 2µm **depth capable**	Under Development	

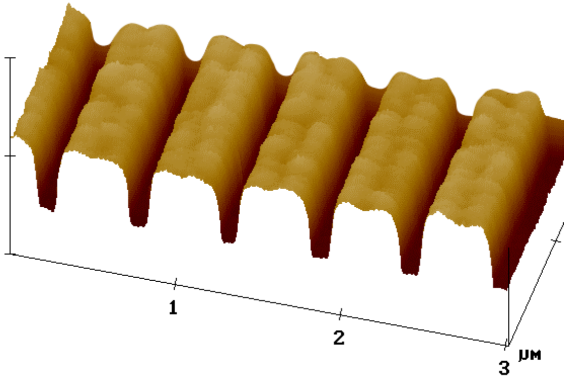
True AFM Imaging in Minutes

- **Unsurpassed resolution for sub-µm processes**
  - <5nm lateral resolution
  - 2Å RMS noise level
  - Sub-0.18µm plug, line and via features
  - Micro-roughness, micro-scratches and defects
- **AFM scans up to 65µm x 65µm**
- **Imaging in minutes**
  - 2µm x 2µm image, 512 x 512 data points, 2Hz scan rate, ~4 minutes
- **Excellent visualization and characterization capabilities**



W plug array with dishing

- Plug recess
- Vias
- Line recess

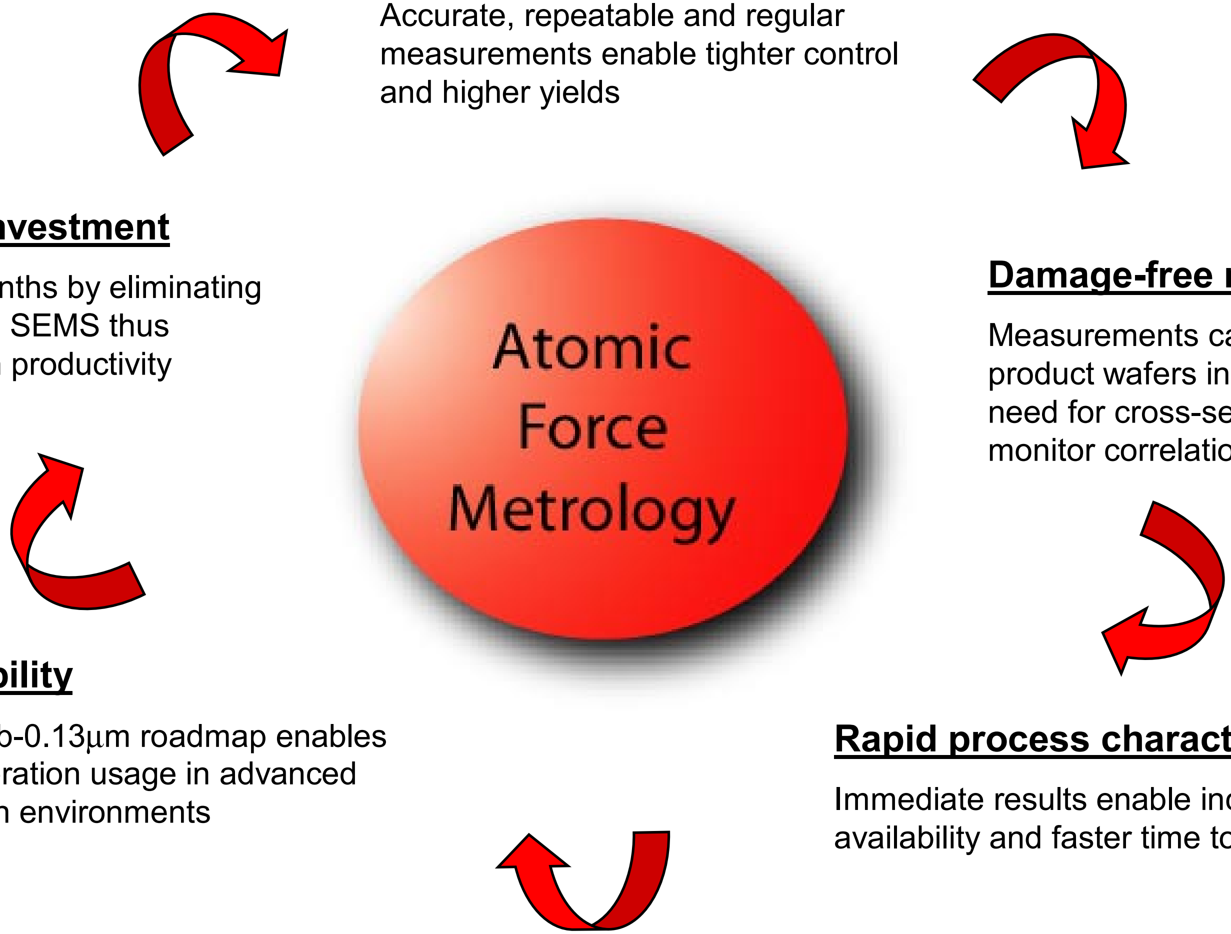


0.15µm line recess - 25nm depth

Atomic Force Metrology

Etch Processing

Yield and Productivity Enhancement



Superior process control

Accurate, repeatable and regular measurements enable tighter control and higher yields

Damage-free metrology

Measurements can be made on product wafers in-line to eliminate need for cross-sectioning SEM or monitor correlations

Rapid process characterization

Immediate results enable increased tool availability and faster time to production

Extendibility

Proven sub-0.13µm roadmap enables multi-generation usage in advanced automation environments

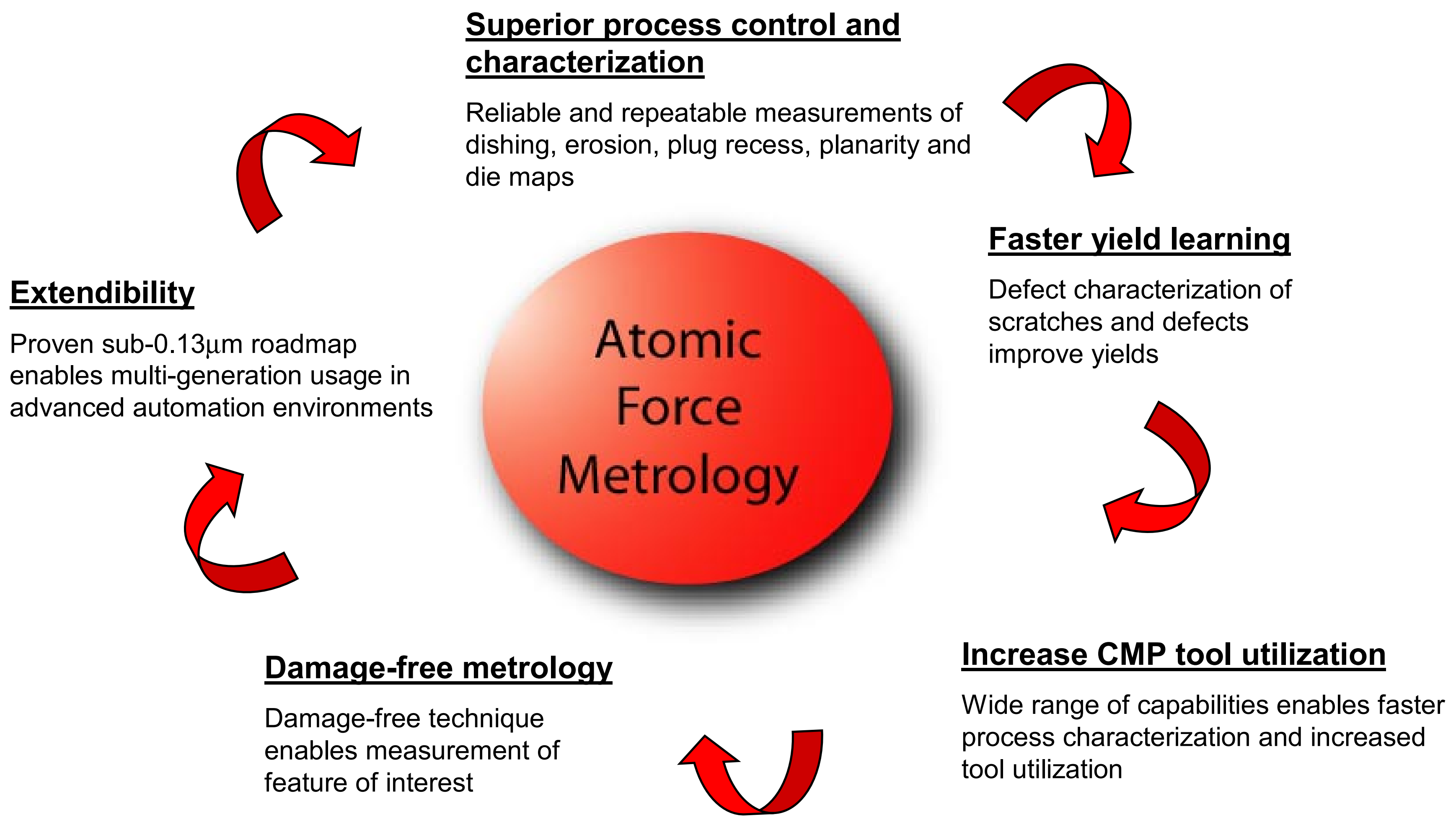
Return on Investment

Payback in months by eliminating cross-sectional SEMS thus increasing etch productivity

Atomic Force Metrology

CMP Processing

Yield and Productivity Enhancement



Superior process control and characterization

Reliable and repeatable measurements of dishing, erosion, plug recess, planarity and die maps

Faster yield learning

Defect characterization of scratches and defects improve yields

Increase CMP tool utilization

Wide range of capabilities enables faster process characterization and increased tool utilization

Damage-free metrology

Damage-free technique enables measurement of feature of interest

Extendibility

Proven sub-0.13µm roadmap enables multi-generation usage in advanced automation environments

Dimension Vx Series

Designed for Fab Operation

Dimension Vx210/310 AFP

Open cassette/SMIF option

Vx210 (200mm)
Vx310 (200mm/300mm)

Manual load option available

Micro-environment option for Class 1 tool operation

Dimension Vx330 AFP

Fully automated operation for 300mm fabs

Compliant to SEMI E40, E84, E87 and E94

200mm handling options

Typical 7wph throughput (5 sites)

Automated Tip Exchange and management

FeatureFinder™ sub-micron feature location

PatMax™ pattern recognition for post-CMP structures

Multiple security levels

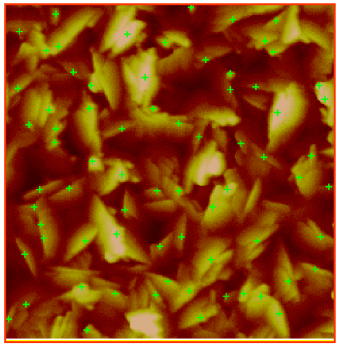
HSMS SEMI E30 GEM

CE/S2/S8 Compliant

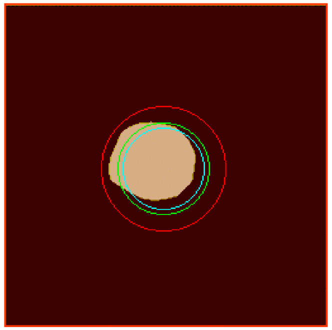
Defining New Dimensions

Automated Tip Evaluation and TipX™ Automatic Tip Exchange

- **Auto tip evaluation determines when tip requires changing**
- **Automatic exchange in ~4 minutes**
- **Automatic tip evaluation in ~4 minutes**
- **24 tips per cassette**
- **Dual cassette for different tip types**
- **No operator intervention required**
- **Eliminates operator-related variability**



⇐1) AFM images tip evaluation sample



⇐ 2) Estimates tip radius

Status: GOOD

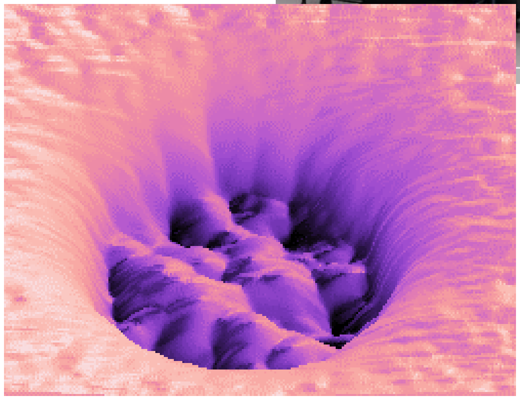
⇐ 3) Qualifies tip

⇑

4) If "Status: BAD", changes tip; continues measurement

Summary

- **Atomic Force Profiler**
  - The only tool that measures critical CMP and etch depth parameters for current and future generations
  - The *highest* resolution profiler
- **No sample damage**
  - TappingMode eliminates destructive lateral forces
  - Measurement on product wafer
- **Long scans, depth and 3D imaging**
  - Profile up to 100mm
  - High aspect ratio features >10:1
  - AFM imaging to 65µm x 65µm
- **Throughput**
  - 7wph (5 sites) for profiles
  - 5wph (5 sites) for images
- **Full automation for FAB production**
  - Proven technologies
  - Clean room engineering



Dimension Vx Key Specifications*

- **General specifications**
  - 100mm profile stage
  - 1µm X-Y axis repeatability
  - 6µm vertical range
  - <5Å static step height repeatability on 0.1µm and 1µm steps, (1σ); 20 traces at 20µm/sec scan speed
- **Profiler mode**
  - 262,000 data points/scan
  - up to 100mm profile length
  - up to 200µm/second scan speed
- **Imaging mode**
  - 512 x 512 data points
  - Up to 65µm square area scans
  - Die scale imaging
  - 3D visualization and analysis software
- **Optics**
  - Dual optics with 150µm and 600µm viewing area
  - Low magnification optics (3mm viewing area)

****Note: All specifications are subject to change***