



## NANO WHEELS; MAXIMUM ADVANTAGES

### Diamond Wheels for Thin and Ultra-Thin IC Grinding Applications

Working with our Nano superior grinding wheels, Norton engineers can help you meet and exceed your quality targets and production goals in the manufacturing of thinner and larger-diameter semiconductor wafers, on a wide range of materials.

#### FINE FINISHES:

- Designed specifically for fine finishing
- **Nano wheel** abrasive grain sizes are #4000 and #5000 mesh
- **Soft Nano wheels** are available in #5000, #6000 and #7000 mesh abrasive grain sizes
- **Super Nano** #8000 mesh abrasive grain wheels can impart finishes  $<25 \text{ \AA Ra}$

#### EXCEPTIONAL PART STRENGTH:

- Reduction of sub-surface damage noticeably increases wafer and die strength in use vs. standard #2000 mesh abrasive grain wheels, which can easily create sub-surface damage

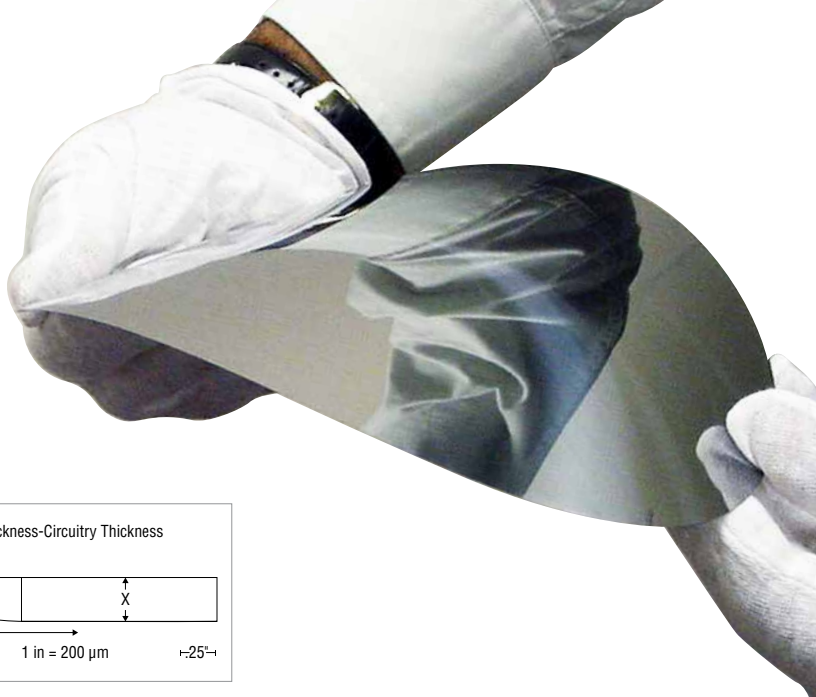
#### HIGHER YIELDS:

- Norton wheels “gently” grind hard brittle silicon wafers which can minimize breakage and improve yield

#### KEY APPLICATIONS

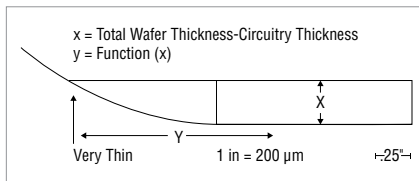
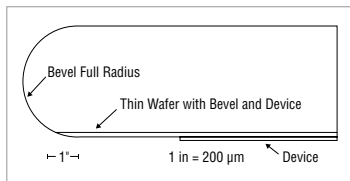
BACK GRINDING | WAFER THINNING

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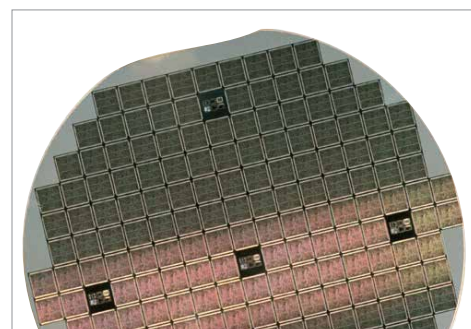
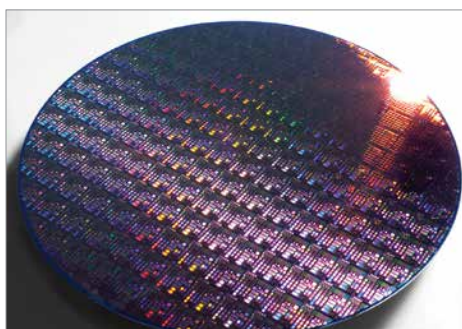
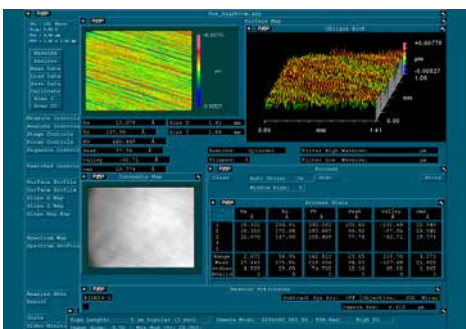


## THIN WAFER GRINDING CHALLENGES

- Wafer edge profile creates high-stress regions when thinning wafers below 100 μm
- Thin grinding of wafers with bumps and other artifacts makes it necessary for a gentle grind to prevent edge chipping and eventual failure
- Thin wafers cannot withstand high sub-surface damage and need finer abrasive grain wheels to increase wafer strength and prevent wafer and die breakage
- In some instances, finer abrasive grain wheels need to be able to remove >25μm



## THE NORTON NANO WHEEL SOLUTION



### Exceptional Part Quality; Ultra Fine Finishes

- Typically able to remove >25μm coarse sub-surface damage and, for specific applications Nano wheels can grind >50μm
- Reduced surface roughness; can impart finishes <25 Å Ra
- Reduced sub-surface damage noticeably increases wafer and die strength in use
- Stable grind; Nano wheels draw lower current and forces; less stress ensures consistent part quality preventing chipping/breakage
- Improved wafer geometry; reduced bow, TTV, and warp
- No scratches

### High Productivity

- Free cutting action
- Lower grinding cycle time
- Lower (optimized) number of wheel changes and wheel wear
- Reduced bow and warp increases ease of handling
- Possible reduction/elimination of stress relief operation
- Self dressing and consistent performance
- Low forces while grinding

### Flexible System

- Can be used for different backgrounding/thinning applications:
  - » Bumped wafer
  - » TSV (Wafers with Via's) ground very thin (<50μm)
  - » Mounted wafers on hard substrate
- Enhanced capability to grind thin wafers using existing systems



INTERNALLY-DEVELOPED  
NORTON BALL ON RING WAFER  
STRENGTH TEST BED

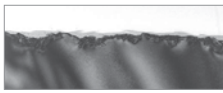
## CASE STUDIES

### Capability to Produce Super Finishes

Norton state-of-the-art R & D and manufacturing facilities have the engineering capability to develop highly porous wheels to grind silicon wafers to 20-30 Å Ra with minimum sub-surface damage.

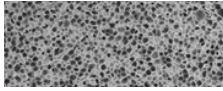
<b>APPLICATION:</b>	Backgrinding
<b>MATERIAL:</b>	Silicon wafer
<b>NORTON PRODUCT:</b>	8.22" (200mm) Norton Super Nano diamond #8000 mesh abrasive grain wheel
<b>COMPETITIVE PRODUCT:</b>	8.22" (200mm) super-finishing diamond #8000 mesh abrasive grain wheel

#### RESULTS:



#### Norton Super Nano wheels

Surface finish: Ra = 17.7 Å  
Average wheel wear = 0.63 μm/wafer  
Average peak current = 11 A

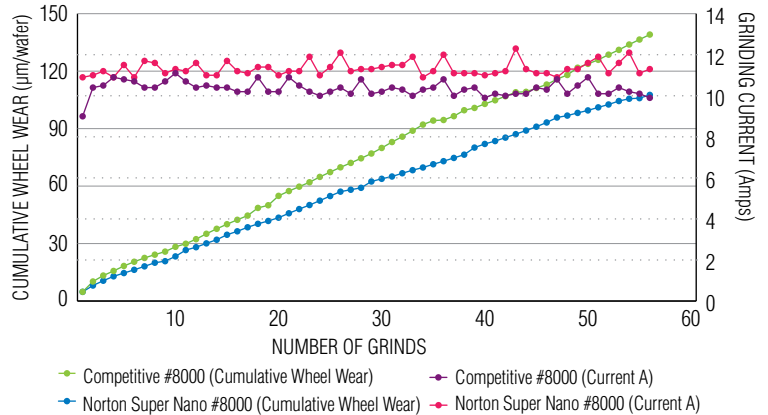


#### Competitive wheels

Surface finish: Ra = 16.8 Å  
Average wheel wear = 0.79 μm/wafer  
Average peak current = 10.8 A

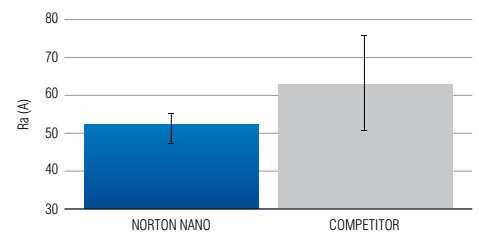
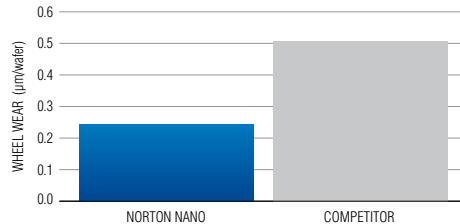
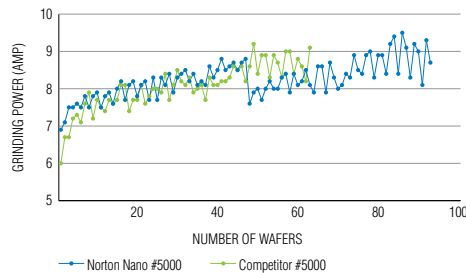
NORTON SUPER NANO WHEEL - UNIFORM MICRO-STRUCTURE

### Norton Super Nano vs. Competitive #8000 Wheel on 8" Surface Grinder



## Cost Reduction

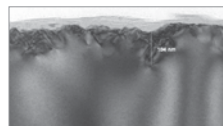
Reduced abrasive tool cost. Engineered bond system has very stable self-dressing action. Norton Nano #5000 mesh abrasive grain diamond wheels' grinding action shows controlled wear, resulting in long life and equivalent surface roughness.



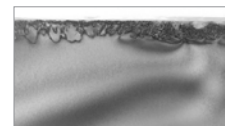
## Improved Die Strength

Norton Nano wheels reduce sub-surface damage and improve wafer and die strength. Norton best-in-class wheels:

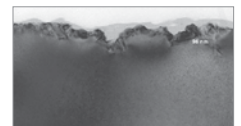
- Grind <50μm and reduce damage inflicted by coarse grind
- Help increase wafer and die strength especially for thin wafer grinding



COMPETITIVE #2000 MESH WHEEL  
SURFACE DAMAGE = 134 μm



NORTON NANO #5000 MESH WHEEL  
SURFACE DAMAGE = 104 μm



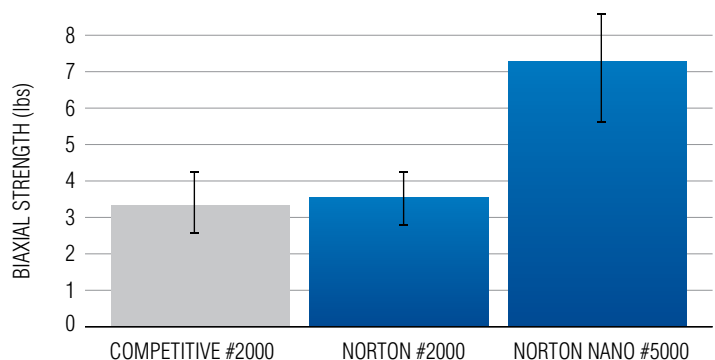
NORTON SUPER NANO #8000 MESH WHEEL SUB-SURFACE DAMAGE = 96 μm

## Surface Finish

Norton wheel engineering capability encompasses a broad range of abrasive grain sizes: #280, #320, #600, #800, #1000, #1200, #1500, #1700, #2000, #4000, Nano #4000 and #5000, Soft Nano #5000, #6000 and #7000, and Super Nano #8000 for application-specific best performance.



## Strength Measurement (25 data points)



**NORTON**  
SAINT-GOBAIN

**nano**™

DIAMOND WHEELS FOR  
THIN AND ULTRA-THIN  
IC GRINDING APPLICATIONS



IN-PROCESS SPC

#### State-Of-The-Art Manufacturing Facilities

- Worldwide multi-location facilities
- ISO 9001 and 14,001 certified
- State-of-the-art manufacturing set-up including class 100 and equivalent 100,000 clean spaces
- Trained and experienced manufacturing staff
- Special equipment for improved controls
- Periodic reviews and audits to establish and maintain best practices
- Stringent quality checks to ensure product consistency
- 100% product inspection

#### Dedicated Application Engineering With R&D Support

- On-site worldwide support with trained and experienced application engineers
- In-house process development capability – 3 latest-model backgrinding machines with state-of-the-art data collection and analysis capability
- Wafer characterization capabilities:
  - » Sub-surface damage analysis
  - » Surface finish measurement (contact/non-contact)
  - » Bow measurements
  - » Wafer and die strength measurements

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