

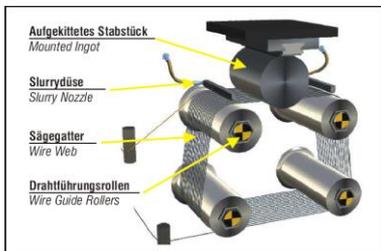


New wafer manufacturing process for cost reduction and quality improvement

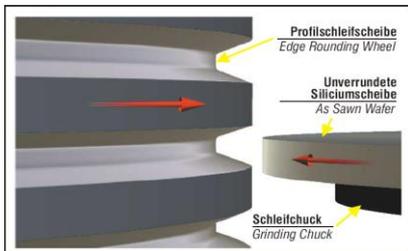
Contents

1. Replacement of process chemicals & Reduced process time for 300mm wafer
2. Summary of the improvement process step for 300mm wafer
3. Application of new etchant for 200mm wafer (substitute of MAE)
4. Wafer surface quality when applying the new etchant
5. Evaluation of results of substituting KOH etching, MAE etching, and grinding methods(1)
6. Evaluation of results of substituting KOH etching, MAE etching, and grinding methods(2)

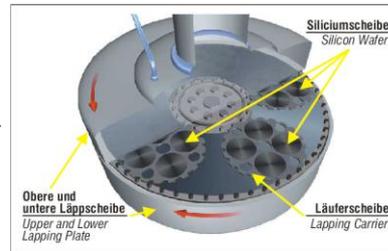
Replacement of process chemicals & Reduced process time for 300mm wafer



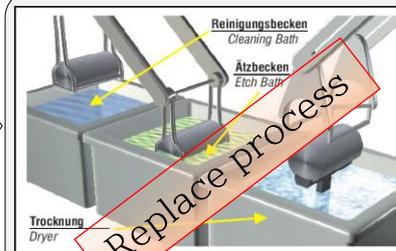
1. Multi wire sawing
(ingot block into single wafers)



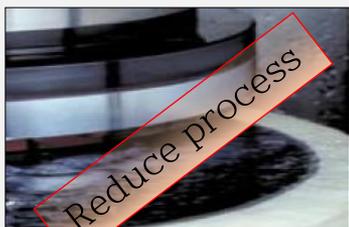
2. Edge grinding
(shaping the edge of the wafer)



3. Lapping
(smooth and flat)
Remove THK 20~25 μm



4. Chemical etching(KOH)
(eliminating process damages)
Remove THK 20~25 μm
Etch rate : 1.5 μm
Processing time : about 15min



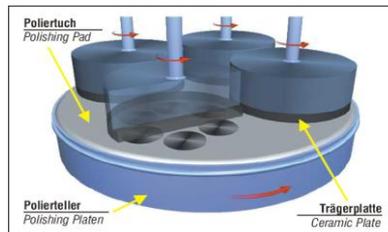
5. Double side grinding
(removing small bumps)

Remove THK 20~30 μm
Feed rate : about 10 $\mu\text{m}/\text{min}$

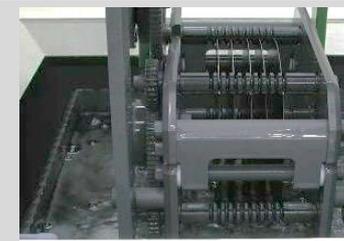


6. Slight etching(KOH)
(grinding damage relief)

Remove THK 3 μm
Etch rate : 1.5 μm
Processing time : about 2min



7. Polishing (3 step)
(removing fine bumps)
Remove THK 15 μm



4. Chemical acid etching
(Lapping damage relief)

Remove THK 10 μm
Etch rate : 10 μm
Processing time : about 1min



5. Double side grinding

Remove THK 5~7 μm
Feed rate : about 10 μm
Reduced removal time to 1/4



6. Chemical polishing(New etchant)
(Mechanical damage relief)

Remove THK 30 μm
Etch rate : 10 μm
Processing time : about 3min

Summary of the improvement process step

▷ Replace & Skip process step

No.4: Replace KOH with New etchant (Acid).

No.5: It shortens the process time by minimizing the grinding removal thickness.

No.6: Replace KOH slight etching process with chemical polishing process. Introducing a new chemical polishing process to remove lapping, grinding damage and wheel mark, resulting in a defect-free mirror surface.

** Features of new etchant: HF, HNO3 is not included
No toxic gas (NOx) occurs during chemical polishing

▷ Replace & Skip process step

No.4 : KOH를 New etchant(Acid)로 대체한다.

No.5: Grinding 제거 두께를 최소화하여 공정 시간을 단축한다.

No.6: KOH slight etching 공정 대신에 chemical polishing 공정으로 대체 한다. New chemical polishing 공정을 도입하여 lapping , grinding damage 및 wheel mark 를 제거하여 결함이 없는 mirror surface로 만든다.

** New etchant의 특징 : HF,HNO3를 포함하고 있지 않으며
Chemical polishing진행 중에 유독 gas(NOx) 가 발생이 없음

| Process step | Conventional methods | New methods | Benefits |
|--|--|---|---|
| No.4 chemical etching (Eliminating of Lapping Damage) | Remove THK 20~25 μ m Etch rate : 1.5 μ m Processing time : about 15min | Remove THK 10 μ m Etch rate : 10 μ m Processing time : about 1min | Processing time is reduced to less than 10% |
| No5. double side grinding (removing small bumps) | Remove THK 20~30 μ m Feed rate : about 10 μ m/min | Remove THK 5~7 μ m Feed rate : about 10 μ m/min | Processing time is reduced to less than 25% |
| No6.chemical etching (removing of grinding damage) | Remove THK 3 μ m Etch rate : 1.5 μ m Processing time : about 2min | Remove THK 30 μ m Etch rate : 10 μ m Processing time : about 3min | -No defects occurring when etched with KOH - Reduced metal contamination after polishing |

* Additional explanation of step No.4

When wrapping the wafer, some Al2O3 abrasive is pressed onto the surface by the lapping plate and embedded into the wafer surface.

Some embedded abrasives are removed through ultrasonic cleaning, but it is very difficult to remove all embedded abrasives.

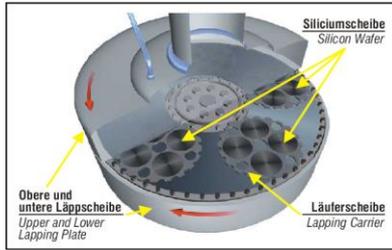
The chemical etching step is required to completely remove the remaining embedded abrasive and reduce pits and scratches.

SkpChem's new etchant replaces KOH and provides a wafer surface suitable for grinding and reducing process time significantly.

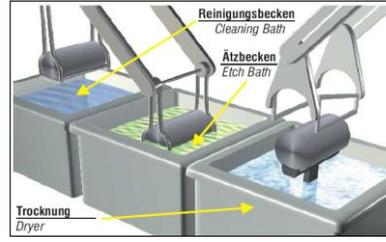
No4. step의 부가 설명

웨이퍼를 래핑 할 때, 일부 Al2O3 연마재는 래핑 플레이트에 의해 표면에 눌러지고 웨이퍼 표면에 매립됩니다. 일부 내장 된 연마재는 초음파 세척을 통해 제거되지만 웨이퍼 표면에 박힌 연마재를 완전히 제거하는 것은 매우 어렵습니다. 화학 에칭 단계는 세정 후 매립 된 연마재를 완전히 제거하고 pit와 스크래치를 줄이기 위해 필요합니다. SkpChem의 새로운 식각액은 KOH를 대체하여 연마에 적합한 웨이퍼 표면을 제공하고 공정 시간을 현저하게 단축합니다.

Application of new etchant for 200mm wafer



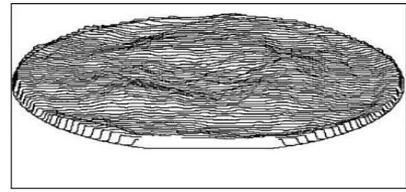
Lapping step (smooth and flat)
Remove THK 20~25 μ m



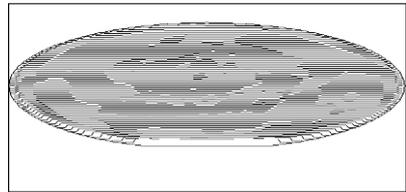
Acid etching(MAE) step (eliminating lapping damages)
Remove THK 25~30 μ m
Etch rate : 25 μ m



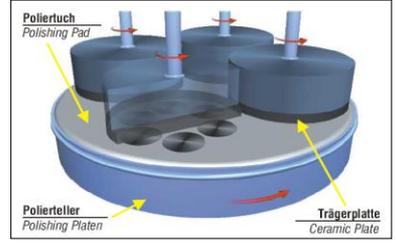
Chemical polishing(New etchant) (eliminating lapping damages)
Remove THK 25~30 μ m
Etch rate : 25 μ m



MAE에 의한 waviness 표면



New etchant에 의한 flat 한 표면

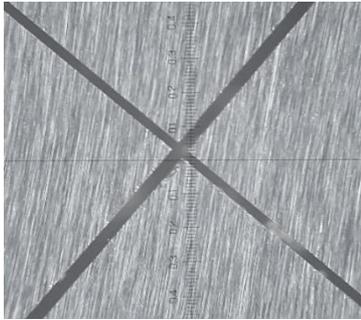


Polishing (step) (removing fine bumps)
Remove THK 15 μ m

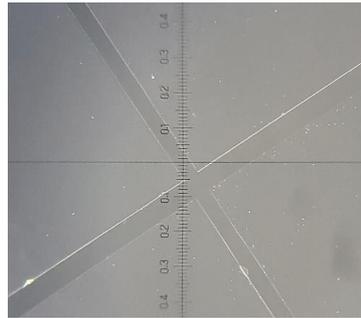
- ▷ Benefit when applying a new etchant
1. Wafer surface quality is improved
 2. Wafer flatness (TTV) and shape are improved
 3. No harmful gas (NOx) is generated
 4. Using a stable chemical that does not contain HF/HNO3 reduces the risk of accidents and facility maintenance costs.

- ▷ New etchant 적용 시 benefit
1. Wafer 표면 품질이 개선됨
 2. Wafer의 평탄도(TTV) 및 shape가 향상됨
 3. 유해 가스(NOx)가 발생하지 않음
 4. HF /HNO3를 함유하지 않은 안정된 Chemical을 사용하므로 사고위험 및 시설 유지 비용이 감소함

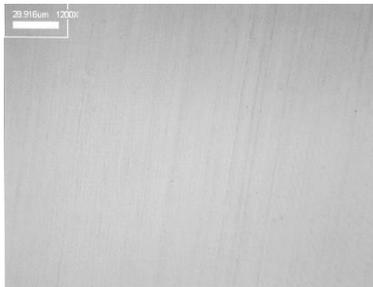
Wafer surface quality when applying the new etchant



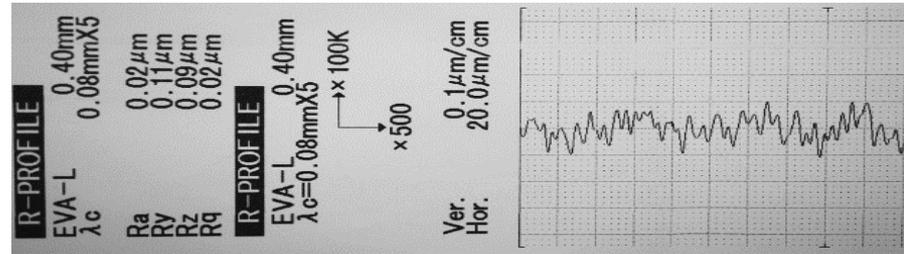
Surface shape of ground



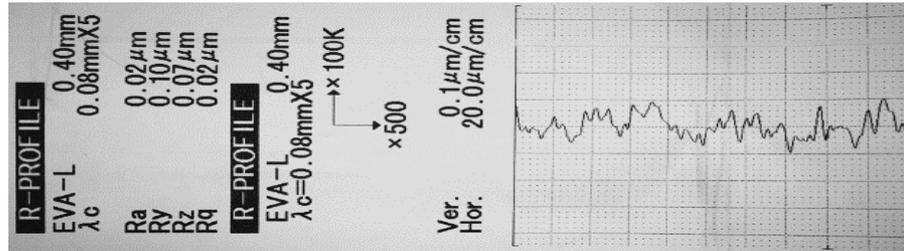
Surface shape of chemical polishing etchant



#2,000 grit grinding surface
(A fine wheel mark is visible)



▷ The surface of fine grinding (#2,000grit) contains grinding wheel mark and embedded abrasive



▷ When applying a new etchant, a mirror surface is obtained, it is possible to cope with the surface quality and metal contamination issues after polishing, and a high-quality wafer can be obtained.



KOH 40% @80°C , 3μm etching
(The fine wheel mark is expanded)



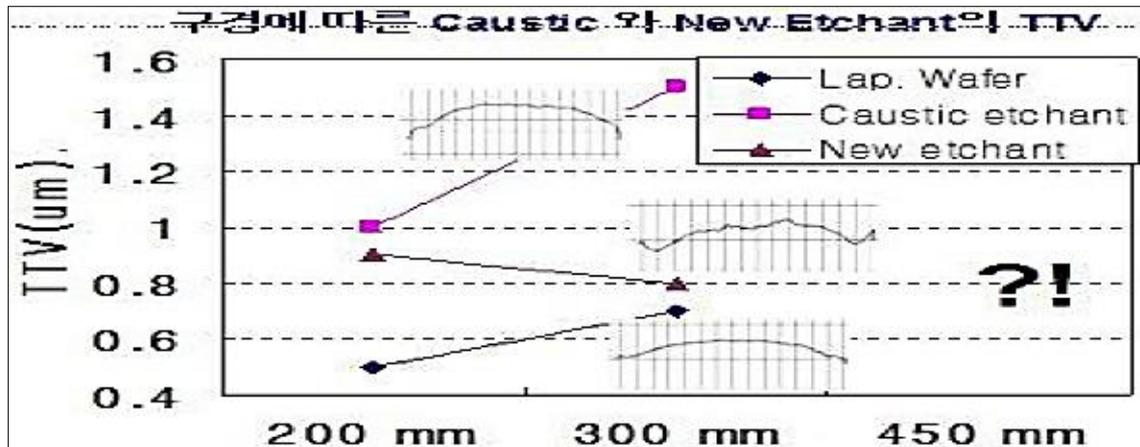
Slight etchant 25°C @120sec , 1μm etching
(The wheel mark is reduced)

SkpChem replaced KOH etching and carried out research and development to skip the grinding step and post up the results. Our goal was to improve the flatness and eliminate the risk of low etch rate and defects, which are the disadvantages of alkali etchants, and furthermore, skip the grinding step to shorten the process time and reduce production cost.

SkpChem는 KOH etching 을 대체하고, Grinding step 을 Skip 하는 연구개발을 실행하였으며, 그 결과를 게시합니다. 우리의 목표는 알카리 etchant의 단점인 낮은 etch rate 및 결함과 acid etchant의 위험성 배제 및 평탄도의 향상을 위함이며, 더 나아가 Grinding step을 skip하여 공정 시간의 단축과 생산원가를 감소시키는 것입니다.

New step for 200mm wafer : Lapping → New etchant etching (replaced MAE etching)

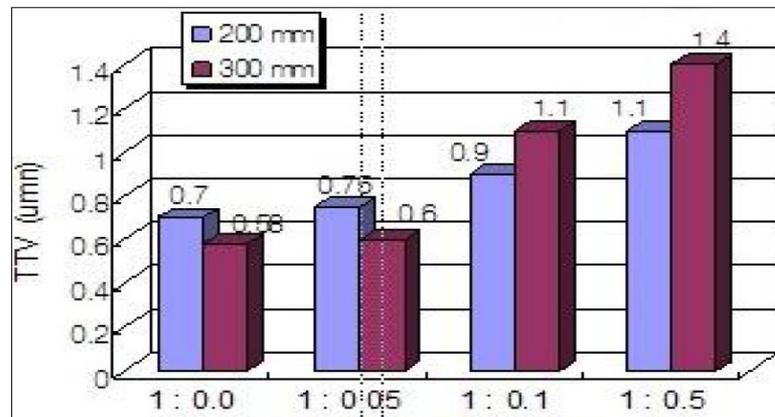
New step for 300mm wafer : Lapping → New etchant etching (Skip KOH etching + grinding + slight KOH etching)



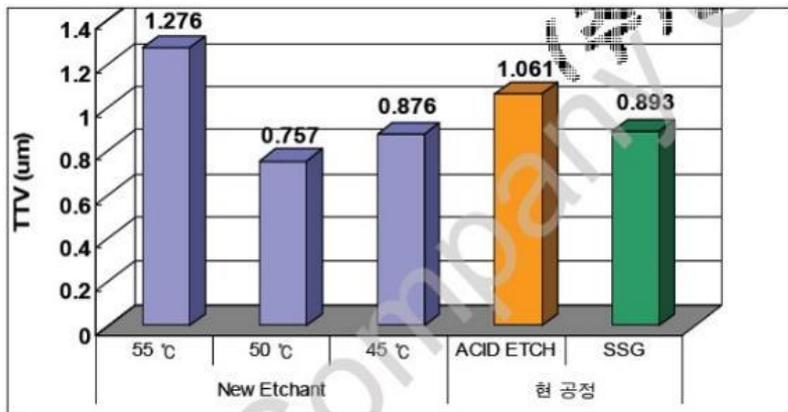
▷ When applying new etchant, flatness (TTV) of 200mm and 300mm wafers is less than $1\mu\text{m}$

| THK (after) | ttv | stir | rolloff | 온도 | Sample |
|-------------|-------|-------|---------|---------|-------------|
| 725.695 | 1.042 | 0.754 | -0.626 | 50 | New Etchant |
| 727.595 | 1.034 | 0.757 | -0.564 | | |
| 728.063 | 1.453 | 0.946 | -0.348 | | |
| 735.279 | 0.807 | 0.373 | -0.196 | | |
| 736.121 | 0.515 | 0.315 | -0.061 | 45 | Ref. |
| 736.182 | 0.788 | 0.484 | -0.260 | | |
| 728.094 | 1.007 | 0.369 | -0.366 | Acid | |
| 744.275 | 0.750 | 0.185 | -0.069 | Caustic | |

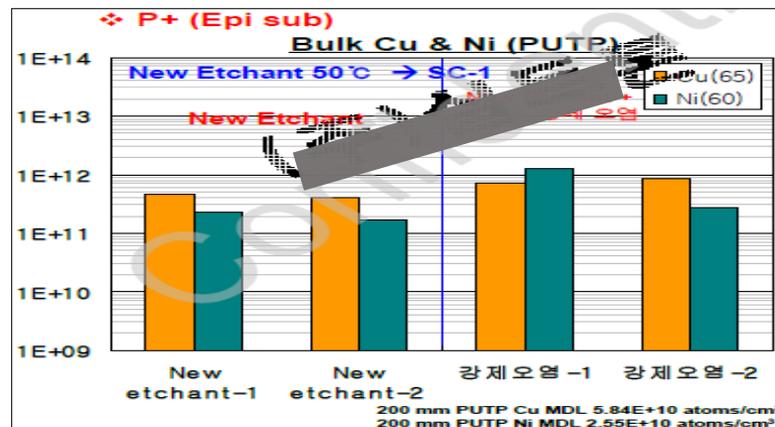
- ✓ As a result of applying the new etchant to a 200mm wafer, the wafer shape evaluation resulted in superior results compared to MAE in parameters.



- ✓ t is a result according to the composition ratio of the new etchant for each wafer size (200mm and 300mm), and when applied to a 300mm wafer, better results are obtained. (TTV allowable spec is less than 1.0um)



- ✓ The result of comparing the flatness (TTV) of the new etchant and MAE on a 200mm wafer



- ✓ Test and P + samples M / I As a result of metal reverse contamination test analysis, it was confirmed that there is no problem in application.