Chuck Cleaning Wafer (CCW) to remove dusts / particles on wafer chuck (Electrostatic, Vacuum, Mechanical) to be cause of machine troubles.
About Chuck Cleaning Wafer (CCW)

A cleaning wafer to remove dusts or particles on wafer chucks. A polymer pasted on the surface of a silicon wafer absorbs dusts or particles when it contacts with the chuck. Customers can realize the effect of the performance of the CCW by carrying it like as same as production wafers.

Put the polymer surface of the CCW on the chuck surface where particles exist

The polymer is absorbed onto the chuck surface by the vacuum absorption effect of the chuck. The polymer has elasticity

Particles stick to the polymer and removed
Chuck Cleaning Wafer (CCW) shows superior effect in the following points:

- The number of dummy wafers to be run after chamber cleaning (after PM / trouble occurrence) is greatly reduced. (e.g. before CCW use: 50pcs ➔ after CCW use: 2-3pcs)

- **Photolithography**: It solves the problem of hot spot which causes focus defect.

- **Etching**: It solves the Helium leak problem caused by dust on the chuck.

- **Sputtering**: It solves the Helium leak problem caused by dust on the chuck. It also contributes to improvement of thin film uniformity.

- CCW for etching and sputtering process can be recycled more than once by using Particle Removal Film (PRF).
As a result, manufacturing loss at downtime is greatly improved: Case-1

In **Photolithography**

【Assumption / trial calculation】
- Hot spot occurred 4 times / month for each equipment
- Set the throughput to 130 wafers / hour
- Set the occupancy rate to 80%
- Includes equipment startup time in downtime

【Estimate of the amount lost in an hour】
In the case of 300mm: @250,000/Hr
In the case of 200mm: @90,000/Hr
(Depréciation, labor costs, utilities, parts for wet clean, downtime etc.)

【Estimate the number of wafers that were not processed during that time】
In the case of 300mm: 104 wafers
In the case of 200mm: 104 wafers

**With CCW operation,**

- CCW usage times: 50 times
- Remove 75% of hot spot

【In the case of 300mm】
- Cost reduction of ¥ 3,300,000 / batch
- Throughput improvement for 3,900 wafers

【In the case of 200mm】
- Cost reduction of ¥ 3,300,000 / batch
- Throughput improvement for 3,900 wafers
As a result, manufacturing loss at downtime is greatly improved: Case-2

**In Etching**

【Assumption / trial calculation】
- Helium leak occurred 2 times / month for each equipment
- Necessity for outsourcing to replacement parts and external cleaning occurs
- Set the throughput to 37 wafers / hour
- Set the occupancy rate to 80%
- Includes equipment startup time in downtime

【Calculate the amount of loss that will be lost in 8 hours downtime 】
In the case of 300mm : ¥750,000 (Depreciation, labor costs, utilities, parts for wet clean, downtime etc. )

【Estimate the number of wafers that were not processed during that time 】
In the case of 300mm : 240 wafers

**With CCW operation,**

- CCW usage times : 20 times (100 times possible with PRF)
- 75% reduction in Helium leak generation

【In the case of 300mm】
- Cost reduction of ¥ 11,100,000 / batch
- Throughput improvement for 3,600 wafers

⇒ You can extend the interval of wet cleaning
As a result, manufacturing loss at downtime is greatly improved: Case-3

In Sputtering

【Assumption / trial calculation】
- Helium leak occurred 2 times / month for each equipment
- Necessity for outsourcing to replacement parts and external cleaning occurs
- Set the throughput to 37 wafers / hour
- Set the occupancy rate to 80%
- Includes equipment startup time in downtime

【Calculate the amount of loss that will be lost in 8 hours downtime】
In the case of 300mm: ¥1,100,000
(Depreciation, labor costs, utilities, parts for wet clean, downtime etc.)

【Estimate the number of wafers that were not processed during that time】
In the case of 300mm: 224 wafers

With CCW operation,

- CCW usage times: 20 times (100 times possible with PRF)
- 75% reduction in Helium leak generation

【In the case of 300mm】
- Cost reduction of ¥16,000,000 / batch
- Throughput improvement for 3,360 wafers

➤ You can extend the interval of wet cleaning
CCW product introduction
(Material, Optional processing)

CCW was developed by International Test Solutions (ITS), USA

Silicon-based polymer
For (Etch, PVD)

Polyimide-based polymer
For (Photo-litho)

Appearance of standard product
(Silicon-based polymer)

Appearance of 3D processed surfaces
(Only available for Silicon-based polymer)

3D processing of polymer to be tailored to chuck shape is available

PDMS
= Poly(dimethylsiloxane)
= R2SiO

Chemical structure of the silicone polydimethylsiloxane (PDMS).

POLYIMIDE

General chemical structure of a polyimide.
## CCW product introduction (Type)

### Size and rate of dust captured by CCW
- 1μm: 99.7%
- 0.5μm: 75%
- 0.5～0.2μm: 50%

### Types of viscosity of CCW
- 0.1, 0.2, 0.5, 1.0
  - Weak ← → Strong

<table>
<thead>
<tr>
<th>Type</th>
<th>Cleaning side</th>
<th>Process</th>
<th>Available wafers (mm)</th>
<th>Heatproof temperature</th>
<th>PRF utilization</th>
<th>Recyclable times (ref)</th>
<th>3D process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coat</td>
<td>Polyimide</td>
<td>Photolitho</td>
<td>200, 300</td>
<td>-50～200℃</td>
<td>×</td>
<td>15 times (approximate)</td>
<td>×</td>
</tr>
<tr>
<td>Silicon</td>
<td>Etching/Sputtering</td>
<td>200, 300</td>
<td>-50～300℃ (customizable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paste</td>
<td>Silicon</td>
<td>Etching/Sputtering /Photolitho</td>
<td>100, 125, 150, (200, 300)</td>
<td>-50～200℃ (300℃)</td>
<td>✓</td>
<td>15 times (approximate) MAX100 times (with PRF)</td>
<td>✓</td>
</tr>
</tbody>
</table>
CCW product introduction
(Advantages against for competitors’ products)

* It has stronger adhesiveness
* It has options of stickiness selection
* The polymer has elasticity related to the surface and the layer thickness
* 3D processing is possible
* Operating temperature range is -50 °C to 200 °C (For sputtering, there are also options up to 300 °C)
* By using PRF (Particle Removal Film), it is possible to use CCW repeatedly by removing dusts and particles from the polymer surface captured by CCW (Estimated extend life with PRF : 100 times)

Explanation in page 11
**CCW product introduction (Quality)**

- It is possible to use CCW in customer's existing wafer processing environment / equipment
- We manufacture CCW in the clean room environment
- There is no transfer from polymer to chuck during usage (Except in case of polymer breakage due to excessive use)
- It does not cause heavy metal contamination (TXRF = Total reflection fluorescent X-ray analysis)
- There is no release of gases from the polymer within the operating temperature range (Confirmation with NASA standard ASTM E595)
- The shelf life (shelf life) is 2 years after production
About Particle Removal Film (PRF)

For Etching and Sputtering process

It is a cleaning sheet to use CCW repeatedly.
You can reuse CCW up to ~ 100 times.

- Can be used for Silicon pasting type only
- 13,9,7 inch size
- 10 pcs 1 set

1. Remove protection film of PRF
2. Crimp PRF on CCW surface with roller
3. Remove PRF from CCW surface
4. Transfer of dusts from CCW surface to PRF
5. Discard PRF sheet
Effect of CCW utilization

(Photolithography: ①)

It solves the defective focus due to dusts on the chuck and contributes to the improvement of yield.

Vacuum Chuck + PM type CCW (Polyimide-based)

Remove alien matters without opening chamber

200 nm focal defect location by alien matters

200 nm removal of focal defect location by using CCW
When dusts/particles larger than 120 nm are detected, CCW performs well. It is also effective for removing dusts/particles smaller than 100 nm - successful rate is approximately 80% -
Effect of CCW utilization (Etching : ①)

It solves the problem of Helium leakage caused by dusts/particles on the chuck and contributes to improvement of yield. It also omits the extra wet cleaning process. Customers can head off the loss of dummy wafers to a minimum level after PM.

Surface SEM observation before and after cleaning

Result:
After cleaning with CCW (Etch Clean), 99% or more particles were removed.
200mm LOGIC – Metal Etching
- HE flow rate observation during 3 months before and after CCW (Etch Clean) in 3 chamber · environment:
  \[ \text{sccm} = \text{standard cubic centimeter per minute} \]

Wet cleaning is necessary
Effect of CCW utilization
(Etching: ③)

- 200mm LOGIC – Metal Etching
- CCW (Etch Clean) Recovery with 1 to 3 pouring,
  Dummy wafer - Recovery with 50 pouring = Shorter
  rise time / Operating time Up
Because of the dust on the chuck, deposition uniformity > 5.2% 

Deposition uniformity <2.5% by dust removal on the chuck by CCW

Chamber opening not required

Surface SEM observation before and after cleaning

Remove alien matters without opening chamber

It solves the problem of Helium leakage caused by dusts/particles on the chuck and contributes to improvement of yield. It also omits the extra wet cleaning process. Customers can head off the loss of dummy wafers to a minimum level after PM.
Effect of CCW utilization

(Sputtering : ②)

PVD - ESC Backside Pressure

Pressure
Before Etch Clean

Pressure
After Etch Clean
Summary

- The number of dummy wafers to be run after wet cleaning is greatly reduced. Reference: 50 wafers → 2 to 3 wafers
- **Photolithography**: It improves the problem of focus defect caused by hot spot by automatic conveyance.
- **Etching**: It improves the problem of Helium leakage error caused by dusts / particles on the chuck by automatic conveyance. It also contributes to improving in-plane uniformity.
- **Sputtering**: It improves the problem of Helium leakage error caused by dusts / particles on the chuck by automatic conveyance. It also contributes to improving in-plane uniformity.
- As a result, customers can eliminate production loss due to equipment downtime occurred in each process.
- CCW can be reused by using in conjunction with PRF. CCW: 15 times use ➔ With PRF use: 100 times possible (Silicon type for etching and sputtering only)