Investigation of Ceria Abrasive Removal during Post Chemical Mechanical Polishing Cleaning

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**BACKGROUND AND OBJECTIVES**

- Device shrinkage → Requirements smooth surface
- Global surface planarization → CMP
- After CMP process → CMP contamination
- Post CMP cleaning is needed

**High cleaning performance is needed**

**EXPERIMENTAL METHOD**

**Table 1. CMP contamination**

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>CMOS CMP</th>
<th>Metal CMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate</td>
<td>Silica or ceria, fine fragments of films or pad</td>
<td>Alumina, or silica, metal hydroxide, precipitates, fine fragments of films or pad</td>
</tr>
<tr>
<td>Metallic</td>
<td>K+Ca2+</td>
<td>Cu2+Al3+Fe3+ etc.</td>
</tr>
<tr>
<td>Organic</td>
<td>Titanium oxide, zirconium oxide, butts, surfaces, additives</td>
<td>Buffers, surfactants, inhibitors</td>
</tr>
<tr>
<td>Other defects</td>
<td>Scratches, stress</td>
<td>Scratches, disbursing and stressful stress</td>
</tr>
</tbody>
</table>

**EXPERIMENTAL RESULTS**

**Fig 1. Experimental Setup: Polishing and Cleaning**

**Fig 2. Zeta potential: Ceria particle, PE**

- \( \zeta \) (zeta potential): Charge
- **Cleaner A**: EDTA, TMAH base
- **Cleaner B**: Acetic acid, TMAH base
- **Cleaner C**, **D**, **E**: Acetic acid, EDTA, TMAH base

**Fig 3. Amount of Ce ions after cleaning and repulsion**

**Fig 4. Relation between repulsion and Ce ions**

**Table 2. Polishing Conditions**

<table>
<thead>
<tr>
<th>Step</th>
<th>Solution</th>
<th>Stirrer rotation speed (RPM)</th>
<th>Pressure (ps)</th>
<th>Polishing/Conditioning time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DIW</td>
<td>0</td>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>Cleaner A</td>
<td>500</td>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>DIW</td>
<td>500</td>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>Cleaner A</td>
<td>500</td>
<td>5</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>DIW</td>
<td>500</td>
<td>5</td>
<td>300</td>
</tr>
</tbody>
</table>

**ICP-MS (PE-TEOS wafer)**

**ICP-MS (Nitride wafer)**

**CONCLUSION**

- 5 cleaners are developed for post CMP cleaning
- Zeta potential plays an important role in cleaning
- Zeta potential is related to repulsive force
- The larger repulsion, the better cleaning performance

**REFERENCES**