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Investigation of Ceria Abrasive Removal during Post Chemical Mechanical Polishing Cleaning

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Introduction

BACKGROUND AND OBJECTIVES

BACKGROUND

Contaminants	Nonmetal CMP	Metal CMP	Effects
Particulate	Silica or ceria, fine fragments of film or pad	Alumina, or silica, metal hydroxide precipitates. Fine fragments of film or pad	Shorts by conductive particles Cause local roughness
Metallic	K^+,Ca^{2+}	Cu^{2+},Al^{3+},Fe^{3+} etc	Many metals can form silicide and/or affect the oxidation
Organic	Tetramethyl ammonium salts, buffers, surfactants	Buffers, surfactants, inhibitors	Affect wettability and cleanability
Other defects	Scratches, stress	Scratches, dishing and erosion, stress	Non planar surface Weak sites

Table 1. CMP contamination

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

➡ **High cleaning performance is needed**

Experiment

EXPERIMENTAL METHOD

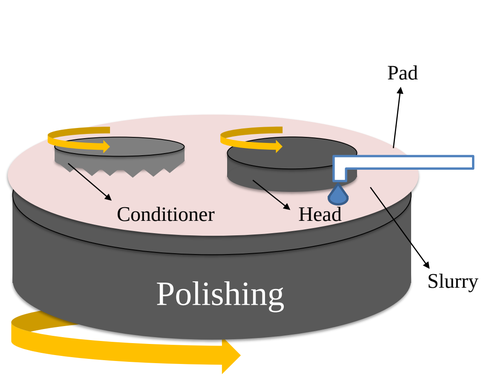

Fig 1. Experimental Setup : Polishing and Cleaning

Equipment	4 in wafer polisher
Wafer	PE-TEOS, Nitride coupon
Pad	IC1010
Slurry flow (ml/min)	80
Rotation speed - pad/head (RPM)	93/87
Pressure (psi)	3
Polishing/Conditioning time (s)	60/60

Table 2. Polishing Condition

Step	1	2	3	4	5
Solution	DIW	Cleaner	DIW	Cleaner	DIW
Stirrer rotation speed (RPM)	0	500	500	500	500
Time (s)	30	60	20	60	60

Table 3. Post CMP Cleaning Condition

Results

EXPERIMENTAL RESULTS

Zeta potential

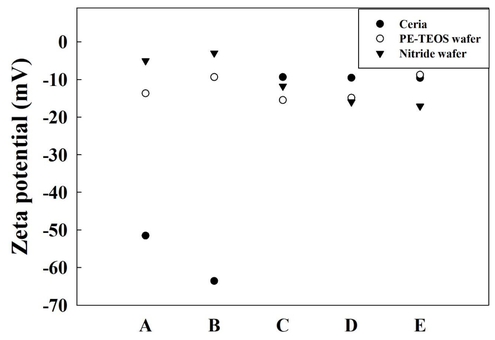

Fig 2. Zeta potential : Ceria particle, PE-TEOS and nitride wafer

※ Repulsion : ζ_1 X ζ_2 (zeta potential : ζ)

- Cleaner A, B : EDTA, TMAH base
- Cleaner C, D, E : Acetic acid, TMAH base
- EDTA : Chelating agent (prevents re-adsorption)
- TMAH : Make hydrophilic surface (prevents re-adsorption)
- Fig 2 shows that the zeta potential differs depending on the cleaning solution
- Cleaner A and B show better cleaning performance than others
- As increase of repulsion, amounts of Ce ions decrease

ICP-MS (PE-TEOS wafer)

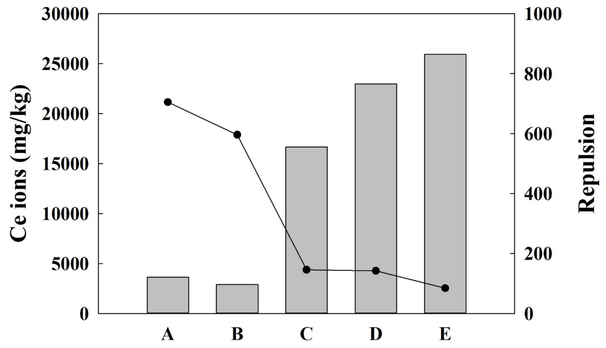

Fig 3. Amount of Ce ions after cleaning and repulsion

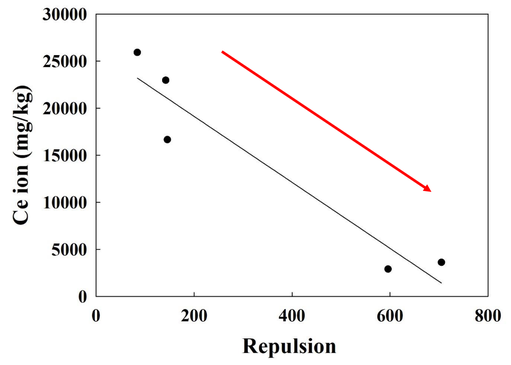

Fig 4. Relation between repulsion and Ce ions

ICP-MS (Nitride wafer)

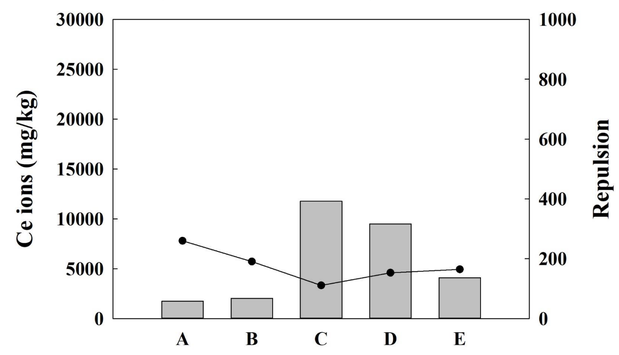

Fig 5. Amount of Ce ions after cleaning and repulsion

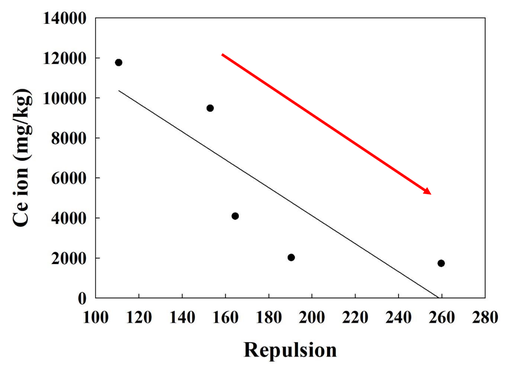

Fig 6. Relation between repulsion and Ce ions

Conclusion

SUMMARY

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

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