STI CMP용 나노 세리아 슬러리에서 연마입자의 결정특성에 따른 평탄화 효율의 의존성

Dependency of Planarization Efficiency on Crystal Characteristic of Abrasives in Nano Ceria Slurry for Shallow Trench Isolation Chemical Mechanical Polishing

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Chemical mechanical polishing (CMP) is one of the most important processes in recent ULSI (Ultra Large Scale Integrated Circuit) manufacturing technology. Recently, ceria slurries with surfactant have recently been used in STI-CMP,[1] because they have high oxide-to-nitride removal selectivity and widen the processing margin. The role of the abrasives, however, on the effect of planarization on STI-CMP is not yet clear. In this study, we investigated how the crystal characteristic affects the planarization efficiency of wafer surface with controlling crystallite size and poly crystalline abrasive size independently.

The slurries were prepared by using eight kinds of high-purity ceria abrasives with different crystal sizes. The crystal sizes of abrasives were controlled with calcination temperature (400 to 900 ℃) and mechanical milling process (8 to 40hrs). The morphology of the abrasives was analyzed with high-resolution transmission electron microscope (HRTEM; JEOL JEM-2010) and the abrasive size was measured with Acoustosizer II (Colloidal Science). Crystal structure and crystallinity of the abrasives was examined with powder X-ray method (XRD; RIGAKU RINT/DMAX-2500). The oxide and nitride films were polished on a Strasbaugh 6EC with a single polishing head and a polishing platen. The oxide film thickness variation of the wafer before and after CMP was measured with a Nano-spec 180 (Nanometrics) and a spectroscopic ellipsometer (MOSS-ES4G, SOPRA).

The average size of the crystallite size composing the abrasive is similar for slurries of the changed milling time from 8 to 40hrs. But the average size of the poly-crystalline abrasives decreases with increasing the mechanical milling time. And, the average size of the crystallite size composing the abrasive increases with calcination temperature. The oxide removal rate increased with increasing the calcination temperature. However, the oxide removal rate drastically decreased with increasing the mechanical milling time. The standard deviation of oxide thickness after CMP decreased with the poly crystalline abrasive size changed by mechanical milling process. But, it is independent of the crystallite size changed by the calcination temperature.

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References

[1] K. Hirai, H. Ohtsuki, T. Ashizawa and Y. Kurata: Hitachi Chemical Tech. Report No. 35 (2000) 17