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STI CMP용 나노 세리아 슬러리에서 계면 활성제 분자량의 영향
Effects of molecular weight of surfactant in Nano Ceria Slurry on Shallow Trench Isolation Chemical Mechanical Polishing

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I. Introduction

Shallow trench isolation (STI) method used in advanced devices manufacturing requires the employment of chemical mechanical planarization (CMP) technique to planarize the gap-fill silicon-oxide (SiO2) layers deposited on the front-side surface of wafers. 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 in mass production. One way to increase the silicon oxide film-to-silicon nitride film selectivity is to add the surfactant to ceria slurry. In addition, controlling the surfactant characteristics is essential to improving ceria slurry performance for STI-CMP. In this study, we therefore investigated how the molecular weight and the concentration of surfactant affect the STI CMP process.

II. Experimental

Ceria powder was synthesized by the solid-state displacement reaction method. The crystal sizes of abrasives were controlled with calcination temperature (900 ℃) and mechanical milling process (40 hrs). We also added an anionic organic surfactant at concentrations up to 0.8 wt% with different molecular weight (Mw = 5000, 50000, 90000) of three level. The morphology of the abrasives was analyzed with high-resolution transmission electron microscope (HRTEM; JEOL JEM-2010). The secondary particle size in each slurry was measured with an acoustic attenuation spectroscopy (APS-100, Applied SC., Matec, U.S.A). The rheological behavior of the slurry suspensions was measured by a controlled-stress viscometer (MCR300, Paar Physica, Germany). 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).

III. Results and Discussions

The oxide removal rate markedly decreased as the surfactant concentration increased in case of the higher molecular weight of surfactant but for the case of lower molecular weight of surfactant slightly decreased. The nitride removal rate drastically decreased when the surfactant concentration was increased to approximately 0.20 wt %. In addition, the slurries with lower molecular weight of surfactant maintained a higher nitride removal rate with increasing surfactant concentration. These results can be qualitatively explained with the layer of surfactant adsorbed related to the oxide and nitride film surface.

IV. Acknowledgements

This work was supported by the Korea Ministry of Science & Technology through the National Research Laboratory (NRL) program, Hynix Semiconductor Inc. and Sumitomo Mitsubishi Silicon Corp. We are also indebted to Mr. Min-Seok Kim and Mr. Jin-Hyung Park, Sung-Jun Kim for assisting us in performing the experiments.

References

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