Nanotopography Effect of Improved Single-Side-Polished Wafer on Oxide CMP

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Wafering process to get better nanotopography has been developed and the wafer performance in oxide CMP was examined.
As for the manufacturing of wafers, six combinations were applied with processes as follows: (A)acid-etching, (B)alkali-etching, (C)acid&alkali etching, (1) SSP1: single-side conventional wax mounting polishing, (2) SSP2: improved single-side-polishing. Oxide films were grown by means of the PETEOS with the thickness of 7000Å. Polishing of the oxide films was done on a Strasbaugh Model 6EC Laboratory Planarizer with a single polish head and a polishing platen. An IC1000/Suba IV K-Grooved stacked pad from Rodel Co. and an SS12 slurry from Cabot Co. The polishing pressure applied as a down force was 7 psi and as backpressure was 0 psi. The rotation speeds of the head and the table were 50 and 30 rpm, respectively, where the relative velocity between the pad and the wafer was 106 fpm (feet per minute). The slurry flow rate was 100 cm^3/min, and the polishing time was set to 47 sec to control the target polishing depth at one time to be 1500Å. Polishing was reiterated on each identical wafer up to three times in order to investigate removal depth dependency of nanotopography effect. Oxide thickness before and after CMP was measured by Optiprobe 2600DUV, Therma-wave. Surface height change as nanotopography of wafer was measured by an ADE NanoMapper.
The height maps of six group wafers are shown in Fig. 1 and Power Spectral Density (PSD) of the height change profiles were calculated as drawn in Fig. 2. With this analysis, it was quantitatively that SSP2 wafers have lower nanotopography within the wavelength range from 2 mm to 50 mm. In Fig.3, the correlation between standard deviations of nanotopography profile and of film thickness variation pre/post CMP is plotted. Before CMP, film thickness variations were independent of nanotopography. However after CMP, the film thickness variation and nanotopography have positive correlation with the slope, which is reasonable because the film thickness variation dominantly results from nanotopography in this study. The PSDs of film thickness variation were also analyzed.
Through these results, it was concluded that SSP2 wafers provide the better performance in oxide CMP through the smaller variation of the post CMP film thickness as the impact of nanotopography.
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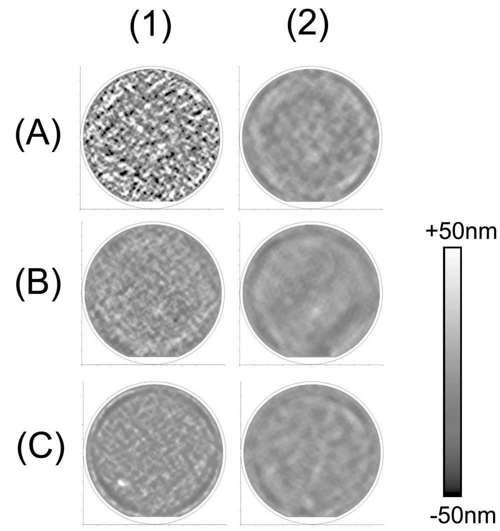

Fig.1 Nanotopography maps for the wafers manufactured with each different process condition; The darker region in the map corresponds to a lower height and the brighter region to a higher height.

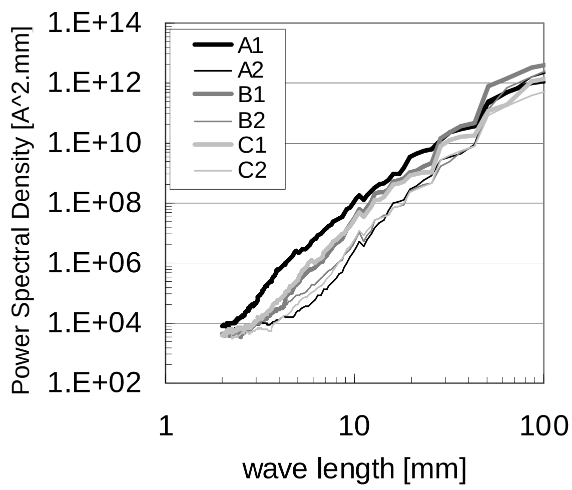

Fig.2 Power spectral densities of nanotopography profile on the wafers manufactured with each different process condition

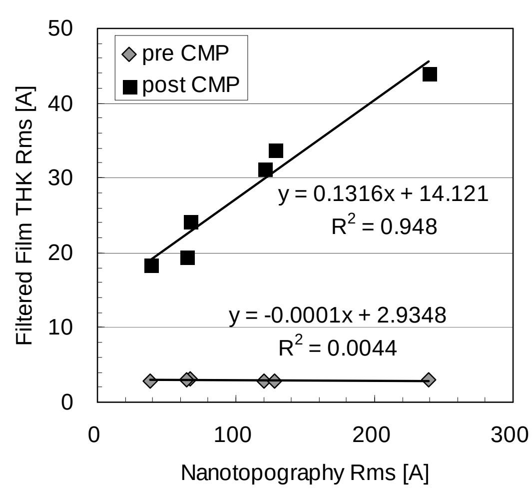

Fig.3 Correlation between standard deviations of nanotopography profile and of film thickness variation pre/post CMP