Application of hydrogen-reduction to improve ceria slurry performance on chemical mechanical polishing process

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Ceria slurry is widely used in the dielectric CMP (chemical mechanical polishing) process due to its advantages of high polishing performance and selectivity. Ce^{3+} ions on the ceria surface form a Ce-O-Si bond with the SiO_2 wafer, which contributing to polishing performance [1]. In this study, we increased the Ce^{3+} concentration by using the hydrogen-reduction method and performed CMP evaluated using the reduced ceria slurry.

Figure 1 shows the process of ceria reduction in a high-temperature hydrogen atmosphere. Hydrogen-reduction begins with the penetration of hydrogen into ceria and adsorption to oxygen to form hydroxyl. The generated hydroxyls react with hydrogen to induce H_2O molecular desorption, and which generates oxygen vacancies. In this study, we optimized the hydrogen-reduction conditions and evaluated the reduced ceria slurries according to the reduction temperature.

Figure 2 shows the Ce^{3+} concentration and polishing performance according to the reduction temperature. It was evaluated that the reduction of ceria was not sufficiently performed under a relatively low temperature condition. The hydrogen-reduction reaction increased significantly with a constant temperature, and the same tendency was observed in the polishing performance. Based on the above, it was evaluated that the concentration of Ce^{3+} increased as the reduction temperature increased, and which had a direct effect on the increase of polishing performance.

Fig.1 Schematic of ceria hydrogen-reduction.

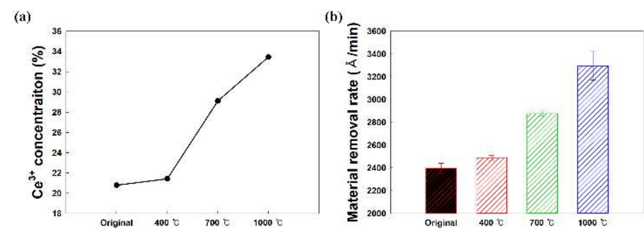

Fig.2 Ce^{3+} concentration and polishing performance of ceria slurries.

Reference

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