기계·화학적인 연마에서 슬러리의 특성에 따른 나노토포그래피의 영향과 numerical 시뮬레이션

Effect of Slurry Characteristics on Nanotopography Impact in Chemical Mechanical Polishing and Its Numerical Simulation

Takeo Katoh, Min-Seok Kim, Ungyu Paik*, Jea-Gun Park
Nano-SOI Process Laboratory, Hanyang University, *Department of Ceramic Engineering, Hanyang University
(KFF00642@nifty.com)

The nanotopography of silicon wafers has emerged as an important factor in the STI process since it affects the post-CMP thickness deviation (OTD) of dielectric films. Ceria slurry with surfactant is widely applied to STI-CMP as it offers high oxide-to-nitride removal selectivity. Aiming to control the nanotopography impact through ceria slurry characteristics, we examined the effect of surfactant concentration and abrasive size on the nanotopography impact.

The ceria slurries for this study wereproduced with cerium carbonate as the starting material. Four kinds of slurry with different size of abrasives were prepared through a mechanical treatment. The averaged abrasive size for each slurry varied from 70 nm to 290 nm. An anionic organic surfactant was added with the concentration from 0 to 0.8 wt %. We prepared commercial 8 inch silicon wafers. Oxide films were deposited using the plasma-enhanced tetra-ethyl-ortho-silicate (PETEOS) method. The films on wafers were polished on a Strasbaugh 6EC. Film thickness before and after CMP was measured with a spectroscopic ellipsometer, ES4G (SOPRA). The nanotopography height of the wafer was measured with an optical interferometer, NanoMapper (ADE Phase Shift)

Under the condition of a fixed removal depth, the magnitude of post-CMP OTD due to nanotopography increased with an increased surfactant concentration in case of the smaller abrasives but for the case of larger abrasives was almost independent of the surfactant concentration. This demonstrates that the impact of nanotopography can be controlled using slurry characteristics. The experimental result was qualitatively explained using the model based on non-Prestonian behavior of the slurry with surfactant [1]. Through a CMP test with varying polishing pressure, it is confirmed that the non-Prestonian behavior depends not only on the surfactant concentration but also on the abrasive size.Taking account of this non-Prestonian behavior, a numerical simulation of nanotopography impact has been done through wear-contact model [2]. The result coincided well with the experimental result.

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