

Clarkson University
Department of Chemical and Biomolecular Engineering
SEMINAR

Towards Understanding Smaller Ceria Particles for SiO₂ Removal Rates during Chemical Mechanical Planarization

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Ceria particles have been widely used as abrasives in the semiconductor industry to planarize the uneven surfaces of silicon dioxide film layers on silicon wafers in a process called Chemical Mechanical Planarization. They play a vital role in achieving desirable CMP performance metrics, including high silicon oxide removal rates, desired removal selectivity, and targeted surface roughness. Advanced particle technologies have driven innovation in CMP slurry development, enabling the fabrication of smaller geometries and complex schemes. The use of smaller abrasive particles is a viable approach to achieve surfaces free from defects. However, utilizing smaller colloidal ceria particles presents a challenge due to their lower SiO₂ removal rate. One way to achieve higher oxide rates is to develop more chemically reactive colloidal ceria particles by controlling various synthesis parameters, doping them with lanthanide ions, or coating the particles with reactive layers. We believe in increasing the chemical reactivity of smaller ceria particles by controlling the combination of multiple synthesis parameters.

Our study investigates the influence of Ce precursor types, precipitation agent amount, reaction pH, reaction time, and reaction temperature on the physicochemical properties of smaller ceria particles and their impact on the oxide removal rate. To obtain further insights into the underlying mechanism of SiO₂ film removal using smaller ceria particles, we conducted computational simulations based on density functional theory. We believe that our comprehensive understanding of smaller ceria growth in solution and its impact on CMP performance is crucial in optimizing synthesis methods and guiding the design and fabrication of smaller ceria particles for CMP applications.

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Ravitej Venkataswamy is a Ph.D. student in Materials Science and Engineering at Clarkson University under the supervision of Dr. Jihoon Seo. Prior to joining Clarkson University, he received his Bachelor of Technology in Electrical and Electronics Engineering from PES University. His research focuses on designing nanoparticles for planarizing silicon wafers. He is particularly interested in STI-CMP Ceria Oxide polishings.