Cerium Oxide Slurries in Chemical Mechanical Polishing: Silica/Ceria Interactions

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Cerium oxide, ceria (CeO_2), has been widely used as an abrasive in glass polishing and in semiconductor fabrication. A considerable amount of research has been done to understand the polishing mechanism of silicon dioxide-type substrates with cerium oxide slurries[1]. Despite this effort, the details of the polishing mechanism remain unresolved.

In earlier work[2-4], we focused on the surface chemistry of abrasive particles. In the present work, we further examine the mechanism of polishing by investigating the interaction between ceria particles and silicate ions through zeta potential, adsorption and polishing experiments.

Zeta potential and adsorption studies (Figures 1 and 2) indicated that there is a significant uptake of silicate ions by ceria particles. Both the adsoption (figure 2) and silica removal rate (figure 3) showed maximum as pH increased.

A possible correlation between the adsorption and the removal rate is examined, and the implications of these, as well as other results, on ceria based CMP will be addressed.

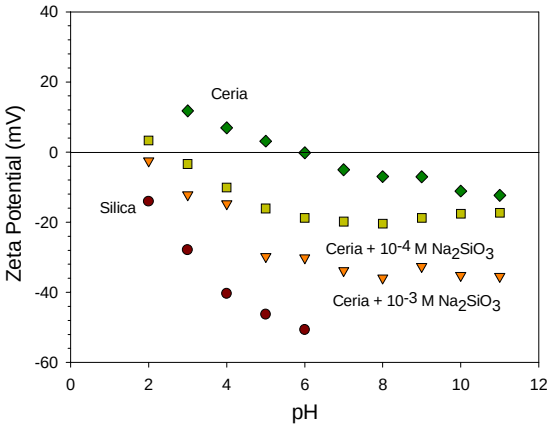

Figure 1. Effect of pH on the zeta potential of ceria particles in the absence and presence of silicate ions

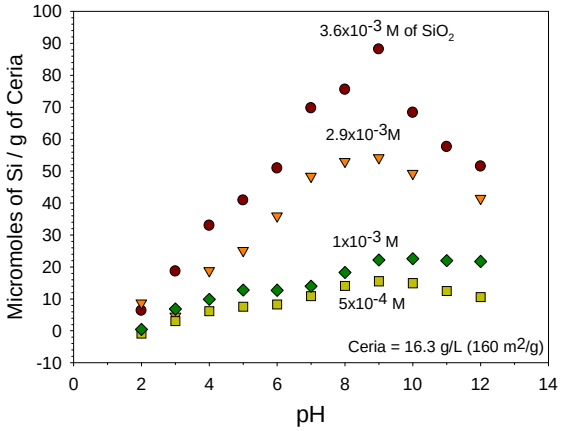

Figure 2. Effect of pH on the adsorption of silicate ions on ceria

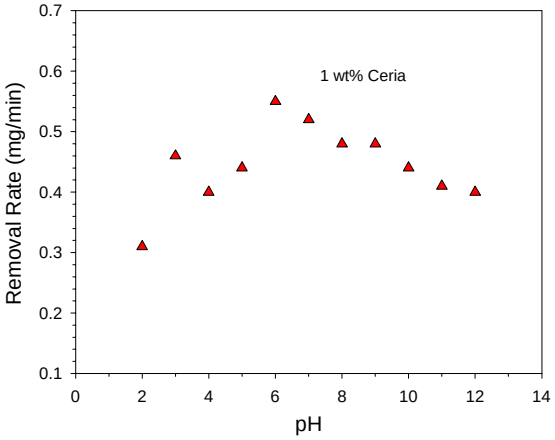

Figure 3. Quartz glass removal rate as a function of pH in ceria slurry

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[4] K. Osseo-Asare and P. Suphantharida, *in Chemical Mechanical Planarization IV*, R. L. Opila, C. Reidsema-Simpson, K. B. Sundaram, and S. Seal, eds., Electrochemical Soc., PV-2000-26 (2001), p. 222.