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Particle adhesion and removal for post-CMP applications

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Proposal # 6: Particle Adhesion and Removal for Post-CMP Applications

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Goals and Objectives:

- To determine the adhesion force for different particles on different substrates in different solutions experimentally.
- To understand and determine the onset of large adhesion force after polishing such as the development of covalent bonds.
- Study the removal and adhesion forces for alumina and silica slurry particles from silicon wafers (with different films, TOX, W, Cu, TaN, BPSG, etc.).
- Develop better cleaning guidelines and techniques to reduce surface defects after polishing.
- In addition, the effect of polishing pressure on the slurry particle adhesion force will be determined.

The study of the removal and adhesion forces for alumina and silica slurry particles from silicon wafers will be conducted using indirect adhesion measurement technique [1-3]. Conditions that give rise to large adhesion forces will be studied and determined to develop a better understanding of particle adhesion in post-CMP applications.

Project Description

Slurry particle adhesion in post-CMP clean processes is a serious problem in the semiconductor industry. The current CMP removal rates models do not account for plastic deformation or particle adhesion between the particle and the wafer. Models have been developed to account for these important effects on polishing and cleaning [4-7]. However, particle adhesion measurements are needed to verify these models. These models are expected to be more fundamental and accurate in predicting CMP removal rate and the effect of the polishing process on the post clean process. There is a need for an effective post-CMP clean that is independent of the polished film or one that involves very dilute or no chemistry. Busnaina et al [8-13] studied ultrasonic and megasonic particle removal and the effect of acoustic streaming. In addition of the physical megasonic effect in removing particles, the use of chemistry has shown a big improvements in cleaning efficiency especially in post-CMP cleaning. In addition, the use of basic chemistry, reduces the total adhesion force and prevents the redeposition and readhesion of the removed slurry particles. Gale and Busnaina indicated that SC1 removes more particles than DI water, particularly at lower megasonic powers. But they also demonstrated that it was possible to achieve 100 % removal in DI water using the optimum conditions. The industry is still having major difficulties in removing slurry particles. This is one of the biggest problems associated with the CMP process. This project will provide the conditions that give rise to large adhesion forces in addition to providing a better understanding of particle removal in post-CMP clean.

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