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Custom-Designed Abrasive Particles to Minimize Cleaning Following Chemical Mechanical Planarization

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Background

Semiconductor devices are manufactured on semiconductor wafers through a number of thermal, chemical, and physical processes. One such process is known as chemical mechanical planarization or polish (CMP). The CMP process uses chemical reactions and mechanical polishing to remove excess material. As the critical dimensions of the transistors built on the wafer die have decreased in size, the importance of the CMP has increased. Manufacturers must address a significant concern of particles contamination on semiconductor wafers and integrated circuits.

The CMP process removes the excess material but leaves behind surplus particles. These unwanted particles will cause defects, reducing production yield. The particles stick to the surface of the semiconductor wafer primarily by one of four methods: chemical bonds, nature of being suspended in cleaning solution that remains on the wafer surface, Van Der Waals forces and electrostatic forces. The Van Der Walls force works on particles that are 30nm or less from the surface. Electrostatic forces are induced by charges on the particles and the wafer surface and cause the particle to either adhere to the semiconductor wafer or repel from the semiconductor wafer.

Invention Description

This invention modifies the shape of the abrasive particles used in the CMP process. The result is a reduction in the strength of the Van Der Waals force on the CMP particles. Also, by changing the pH of the slurry containing the particles, the electrostatic forces can be reduced. Therefore the particles are easier to remove from the semiconductor wafer surface. The invention involves making improved abrasive particles used in the slurry solutions for chemical mechanical polishing (CMP). Said particles are designed to allow Van der Waals (VDW) forces to predominate at the surface to be polished and electrostatic forces on other regions of the particle. By changing the ionic strength and pH of post-polish rinsing solutions, electrostatic forces can be reduced, hence making the removal of abrasive particles from the polished surface considerably more effective.

Potential Applications

- CMP
- Wafer Cleaning

Benefits and Advantages

- Increased yield
- Lower die cost
- Cleaner wafers