Non-contact Clean with Megasonic Nozzle for Post CMP Cleaning

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The CMP process leaves many slurry particles on the wafer. Post CMP cleaning technologies are evaluated for their ability to remove these particles without bringing additional defects to the wafer. A non-contact cleaning method being explored is delivering cleaning chemistry to the wafer using a megasonic nozzle. The mechanism behind cleaning particles with sonicated fluids is based on bubble cavitation and the subsequent shockwaves generated. As with any cleaning technology, the biggest challenge is maximizing the cleaning efficiency while minimizing defect adders from the cleaning. For contact cleaning methods such as brush scrubbing, the main source of defect adders is the brushes themselves. While this issue is designed out by nature in non-contact cleaning, megasonic cleaning introduces a different issue of damage to the wafer surface.

This study utilizes an experimental cleaning apparatus that features a megasonic nozzle to explore the different parameters that could affect wafer defect counts. These include megasonic frequency, RF power setting, cleaning chemical flow rate, and nozzle to wafer distance. Cleaning efficiency was studied using blanket oxide wafers measured with 35nm SP5 inspection recipe while defect adders are studied with bare silicon wafers measured at 23nm. For maximizing cleaning efficiency, the optimal settings are the ones that allow for the most energy to be delivered to wafer surface. As shown in Fig.1, this would include using lower megasonic frequency, higher RF power setting, lower chemical flow rate, and closer nozzle to wafer distance. These optimal cleaning conditions lead to higher amounts of damage on Si wafers as shown in Fig.2. Future studies may consider exploring the frequency region between 1 and 3 MHz. Other wafer types could also be tested to explore if there are films that can be cleaned without additional damage.

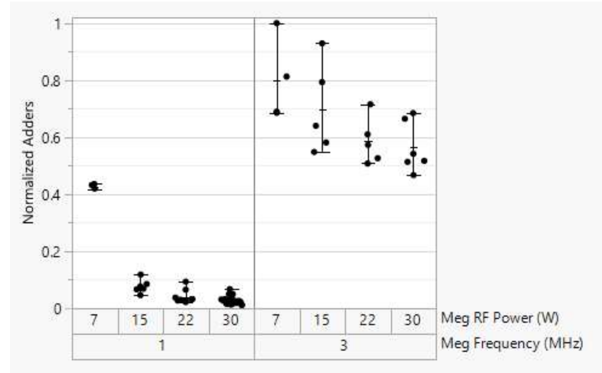

Fig.1: Normalized defect adders on blanket oxide for different megasonic cleaning processes after a silica slurry polish.

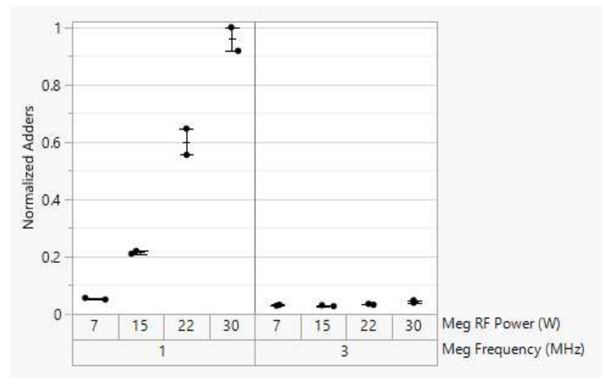

Fig.2: Normalized defect adders on Si for megasonic frequency vs. RF power

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