



AN 361

Residual Copper Analysis on CMP Wafers

May 7, 2007 (Version 3.0)

Discussion

The increasing use of copper in semiconductor devices requires changes in processing techniques and chemicals. Evaluating the effectiveness of these processes requires analytical approaches that can be used to determine the amount and distribution of residual copper present after removal steps such as CMP processing and post-CMP cleaning.

In work done in collaboration with OnTrak Systems, TOF-SIMS (Time-of-Flight Secondary Ion Mass Spectrometry) was used to measure Cu levels and distribution on the field oxides of two wafers processed by CMP and then treated using different cleaning mixtures. The wafers were patterned with test dies consisting of Cu line arrays of varying width and pitch. The table, which gives the calculated Cu concentrations in atoms/cm² at different points on the oxide of each wafer, indicates that cleaning process 1 (wafer 1) was less effective than process 2 (wafer 2) at removing Cu from the SiO₂.

Figures 1 and 2 show the Cu distribution on an array of 10 μm Cu lines that are 10 μm apart. The Cu levels on the oxide between the metal lines were determined to be in the mid E14 at/cm² range for wafer 1 and in the low E13 at/cm² range for wafer 2.

| | Wafer 1 | Wafer 2 |
|---------------------------|---------|---------|
| Away from Cu array | 1.0E13 | 1.4E12 |
| Near Cu array | 1.4E13 | 2.4E12 |
| Between Cu lines in array | 5.7E14 | 1.1E13 |

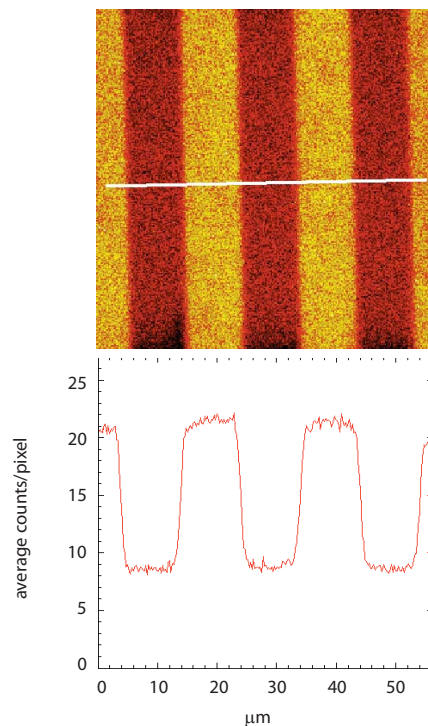


Figure 1. Cu ion image and line scan, wafer 1 (high Cu)

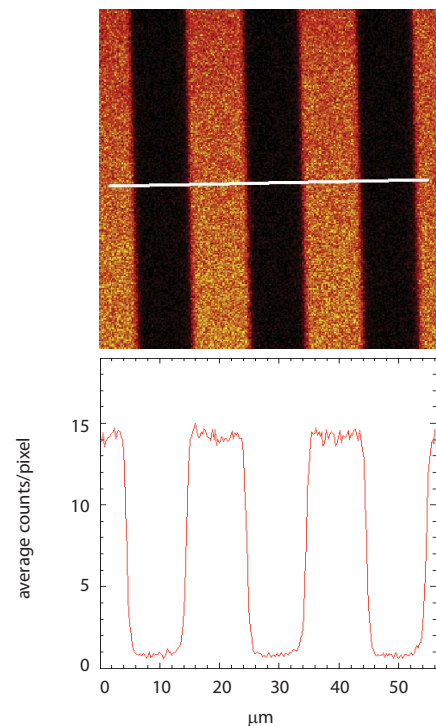


Figure 2. Cu ion image and line scan, wafer 2 (lower Cu)

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