AN 344
Micro-Analytical Evaluation of Via Etch Processes and Post-Etch Cleaning Procedures

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Discussion

The micro-analytical evaluation of via sidewall contamination and the chemical characterization of residues inside of vias is of critical importance for the evaluation of via etch processes and post-etch leaning procedures. With critical dimensions shrinking typical via diameters are now at and below 0.25 µm. Etch residues may be in the order of 100 nm in size or less. The spatial resolution and sensitivity required for an analysis of such residues poses a major challenge for advancements outlined in the semiconductor roadmap.

Traditional EDS (Energy Dispersive X-ray Spectroscopy) typically lacks surface sensitivity to analyze sidewall deposits that are in the order of a few atomic layers thick or less. Even for residues with nanometer thickness a high level of ambiguity exists on whether a signal arises from the actual residue or whether it is from layers underneath the residue. FE-AES (Field Emission-Auger Electron Spectroscopy) has a sampling depth of only ~20 to 40 Å providing a tremendous advantage over EDS for the analysis of sidewall contamination and via residues.

In the example presented a copper layer at the bottom of a via was opened by etching through a silicon carbide layer that was on top of the copper. An AES copper linescan along a via cross section showed that copper is present on the via sidewall and (preferentially) accumulated towards the via opening (Figures 1 and 2). An AES copper map acquired from the top surface also indicates that Cu accumulated at the via opening (Figure 3).

AES is uniquely suited for via analyses in that it is fast, inexpensive and reliable. Alternative methods include electrical testing and TEM/EELS. Electrical testing requires fabrication of a test structure which is time consuming and expensive. In addition data interpretation is highly ambiguous. TEM/EELS lacks sensitivity for monolayer contamination levels.

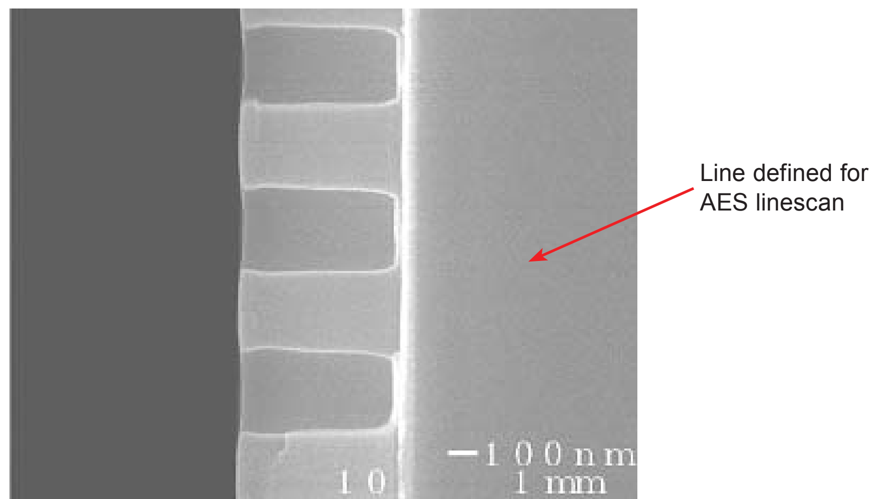

Figure 1. SEM image of via cross section

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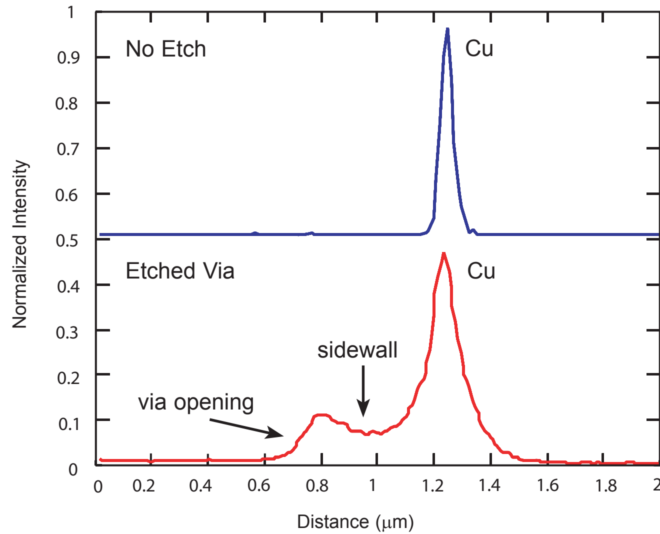

Figure 2. Cu linescans along via cross sections

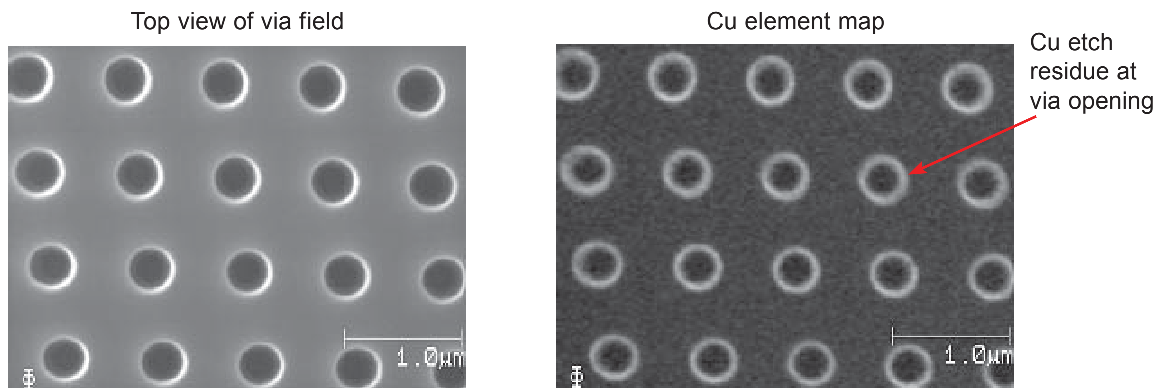

Figure 3

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