SARIS™ - Better Near Surface Thin Film Profile Data than SIMS

Surface analytical techniques used in the semiconductor industry are critical for process problem solving, quality control, and product yield enhancement. Properties of interest commonly examined include film thickness, surface morphology, bulk composition, and surface impurities. It is important to note that no one single surface technique is appropriate for all of these properties, nor is one technique appropriate for all problem solving concerns.

An example of technique compatibility is the use of SARIS™ Laser Ablation Mass Spectrometry to complement Secondary Ion Mass Spectrometry (SIMS) thin film measurement data. SIMS is a wellknown and widely used tool for profiling dopant concentration in thin films. However, it is also known that SIMS' initial signal spike can mask results at near surface.

For example, a sample is a deposited copper film 1 micron in thickness with a proprietary metal additive co-deposited in the film with Cu.

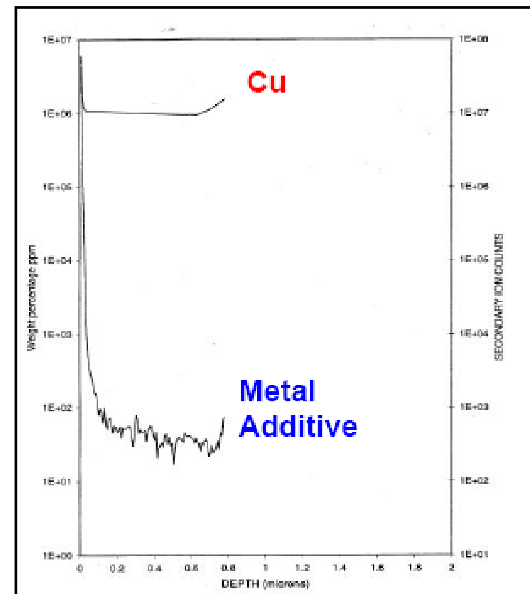
Both SARIS and SIMS analyses were performed to determine whether the copper and metal additives were deposited over the entire film with constant uniformity.

Secondary Ion Mass Spectrometry (SIMS) generated the data in Plot 1, while SARIS™ Laser Ablation Mass Spectometry generated the data in Plot 2. The two plots show the vast differences in the data generated by the two methods.

The sharp signal spikes beginning < 0.1 μm from both Cu and the metal additive are intrinsic signals for all SIMS analyses, and prevent the acquisition of information in the first 100 Angstroms of a film.

In addition, because the metal additive signal does not vary, it is unknown if the signal represents actual analyte signal or if this signal simply represents the background. Therefore, using the SIMS profile, it is not clear if the co-metal was truly deposited at all.

While SIMS can provide dopant information within the film, plot 1 shows its limitations in providing conclusive depth profiling information in the near surface.



Plot 1. SIMS Plot of same 1 micron thick Cu film with co-deposited metal additive

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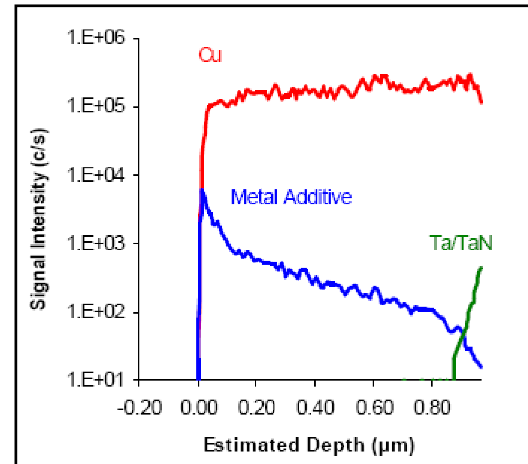
Using the SARIS™ technique; however, we can see very clearly the Cu film is indeed uniform over the desired 1 micron depth and the start of the Ta/TaN plug. The co-metal is shown as codeposited with Cu over the first 100-150 micron depth, but quickly drops off and is not uniform with copper. This lack of co-deposition uniformity is important data for the fab engineer.



Plot 2. SARIS Plot of 1 micron thick Cu film with co-deposited metal additive

While SIMS can provide valuable dopant information within the film, the appropriate analytical tool for this near surface problem was SARIS™ mass spectrometry. The SARIS™ analysis provides the conclusive information that SIMS could not for this sample.

SARIS analysis provides conclusive information that SIMS could not for this sample

As shown in this example, by using the appropriate technique or by using complementary techniques, comprehensive and accurate data is generated to better understand film properties and solve process problems.

For more information about near-surface film profiling by SARIS™, contact your local Sales Manager

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