Analysis of CVD/ALD Precursor Compounds

Advanced Precursors Require the Ultimate in Purity

High Performance Analyses Guarantee the CoA

Advanced CVD (chemical vapor deposition) and ALD (atomic layer deposition) techniques require stringent requirements of thickness, film uniformity, thermal budget and high step coverage over aggressive advanced IC device structures. Balazs™ NanoAnalysis has developed advanced methodologies to characterized a variety of precursors used for sub-130 nm semiconductor device manufacturing and sub-20 nm R&D products. In addition, we can analyze the precursors as processed films on a wafer for trace impurities in the bulk and in-film distribution by depth profiling.

*Table 1. Advanced Precursor Families Supported by Balazs™ NanoAnalysis**

High-k / Metal (Al, Ti, Zr, Hf, Y, Ru, Ba, Sr, Co, Lanthanides)	TBTDET
	$TiCl_4$
	TMA: $(CH_3)_3Al$
	TEMAH, TDEAH, HTB, $HfCl_4$
	TEMAZ, ZyALD
Low-k	3MS, 4MS
	DMDMOS, HMDSO, TMDSO
	TMCTS, OMCTS
SiN/SiO/Si	3DMAS, 4DMAS
	AHEAD
	TSA, HCDS
	DCS, TCS

** Balazs can also analyze other groups of materials*

Methods

Balazs™ provides a complete spectrum of analysis ranging from contamination analysis in the chemical precursor to in-depth compositional analysis in the deposited films. Balazs™ provides services to identify, analyze and resolve contamination issues and to support development of new chemistries and processes.

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Analytical Techniques

- Inductively coupled plasma mass spectrometry (ICP-MS): trace metal measurements for accurate quantification of impurities in the ppb range
- Ion chromatography (IC): measurement of chloride content in the low ppm range
- Gas chromatography mass spectrometry (GC-MS): assay of the primary compound
- Gas chromatography pulsed discharge ionization detector (GC-PDID): measurement the purity of the precursor in the percent to hundredths of a percent range
- Characterized materials in deposited films or films stacks: fourier transform infrared spectroscopy (FTIR), inductively coupled plasma optical emission spectroscopy (ICP-OES), glow discharge optical emission spectroscopy (GD-OES), secondary ion mass spectrometry (SIMS), laser ablation ICP-MS, XRF, XPS for materials in deposited films or film stacks.

Table 2. Concentration range for standard analytical techniques

Precursor Family	Trace Metal by ICP-MS	Chloride by IC	Assay by GC-MS, GC-PDID
High-k / Metal	5 - 200 ppb	1 - 10 ppm	99 - 99.99 %
Low-k	1 ppb	1 - 10 ppm	99 - 99.99 %
SiN/SiO	1 - 10 ppb	1 - 10 ppm	99 - 99.99 %

Improving Precursor Performance

Balazs™ recently completed studies to reliably identify and quantify elemental microcontamination in a variety of precursors such as transition metal complexes (Hf, Zr, Ti, Ru, etc.) and lanthanides.

These provide vital analytical information that can be valuable in determining electrical performance at device levels and potential sources for defects. Additionally, Balazs™ has overcome the barriers of traditional analytical techniques created by these new materials.

The techniques were developed based on extensive studies that demonstrated how sample preparation, detection limit determination, and ICP-MS analysis errors due to mass interferences and space charge effects lead to incorrect certificate of analysis information from material manufacturers.

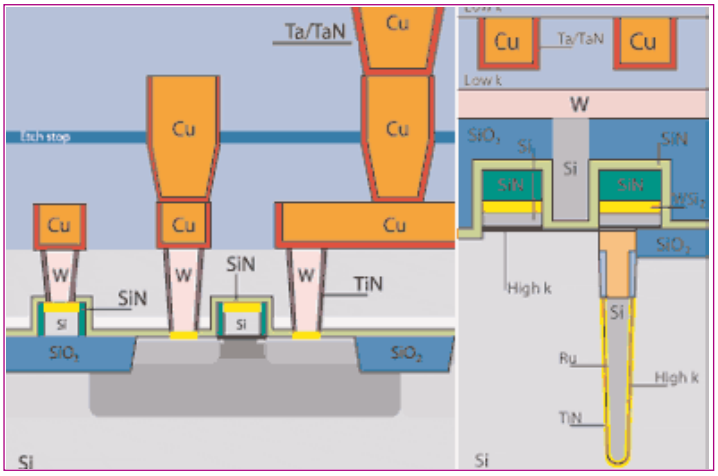

Figure 1. Balazs evaluates material contamination and in-depth compositional analysis of deposited films