BALAZS™ nanoanalysis

Qualification for Lithography Tools

Analysis of Cleanroom Air and Compressed Gases are Required to Maintain Lens Warranty

In order to maintain full warranty coverage for steppers/scanners, manufacturers require tool owners to meet explicit air and purge gas contamination specifications. Additionally, periodic analyses of refractory compounds are also required. In order to fulfill these requirements, Balazs™ NanoAnalysis offers stepper environment analyses to meet ITRS and OEM requirements.
Four types of molecular contaminants are evaluated: acids, bases, impurities in N_2 and organic compounds, including refractories. Results from any of these analyses can be used to correlate yield problems with contamination in air and gases exposed to the wafer during processing.

Highlights

- Current detection limits exceed equipment manufacturer and ITRS specifications
- Balazs™ offers methods to ensure optics warranty compliance
- Balazs™ analyzes organic refractory compounds (S, Si, P) by Gas chromatography - mass spectrometry (GC-MS)
- Sample collection bubblers have been studied and analyzed to optimize sample integrity and detection limits for fluoride and other ionics
- Related services ensure optimum performance and throughput
- Used to assess AMC filter or Purifier end of life for replacement

Analyte/test	Detection Limits	Equipment/Technique
Acids & Bases	Meets ITRS and stepper specifications; Fluoride reported to <10ppt	Bubblers, Ion Chromatography (IC), GC-MS for amides
SO_2	< 0.1 ppbv (for purge gases, to <10pptrv)	Proprietary bubbler and IC
Organic and Refractory Organics	< 0.1 ppbV	TD-GC-MS
Impurities in N_2 (CO, CO_2, H_2, O_2, CH_4 etc.)	Meets ITRS and stepper specifications	GC-MS, DID and specific tests

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AIR LIQUIDE ELECTRONICS

Acids and Bases

Contaminants from outside air and chemicals used in the fab can be present in air and contaminate wafers, ultrapure water sinks, chemical baths, and other areas within the fab. Acids can corrode metal and equipment or lead to hazing problems for wafers, reticles and optics. Bases, especially ammonia, amines and amides, may cause DUV resist "T-topping" and salicide defects. Some organic photoresist strippers are sources of amines. Monitoring chemicals is critical to reducing contamination on the wafers. Acids and bases are analyzed by ion chromatography (IC). Table 1 shows a list of applicable detection limits. In cases where hazed optics or masks are found, the surface can also be analyzed for contamination identification.

Analyte	Reporting limit	
	µg/m^3 in air	ppbv
NH_4^+	0.04	0.02
Br^-	0.04	0.01
Cl^-	0.02	0.01
F^-	0.01	0.01
NO_3^-	0.04	0.01
NO_2^-	0.02	0.01
PO_4^{3-}	0.04	0.01
SO_4^{2-}	0.04	0.01

Organic Compounds

Organic compounds in the cleanroom may adversely affect many processes in the fab, including cleaning, etching, oxide growth, high temperature processes and film deposition. Organophosphates in cleanroom air are known to counter dope silicon wafers. Identifying and monitoring sources of organics are becoming increasingly critical to yield enhancement. Balazs™ developed a method to trap and identify organic compounds, from C6 to C28. This method is useful for sampling air in makeup, recirculation, exhaust, and mini environments.

- Molecular condensables (plasticizers, oils, antioxidants, curing agents)
- Refractory organics (Si, P, S containing organics)
- Halogen organics (Cl, F and Br containing organics)

Sample Collection and Analysis

Cleanroom Air and Lithography Purge Gases

- For trace metals, acids, bases, and dopants, the Cleanroom Air Sampler is used. The Cleanroom Air Sampler is a modular unit manufactured using only cleanroom compatible materials. Purge gases are collected in a slightly different fashion since the gases are under pressure but the overall objective is the same.
- For organic compounds, special stainless steel sampling tubes containing distinct beds of proprietary adsorbent materials are provided by Balazs™ to trap organic compounds from the gas phase.
- A blank (another sampling module that is treated in the same manner as the sample) accompanies the sample. This ensures that only contamination from the air or gas is quantified, not contamination generated by sampling, shipping, or handling.

Additional Resources

Balazs™ also offers a cleanroom air classification program per SEMI F21-1102 guidelines (please ask for Application Note APP0355). AMC Guidelines Balazs™ also offers AMC Guidelines on CD, which define airborne contaminants, their sources and effects and recommend methods to identify and control them. The guidelines provide typical AMC levels in semiconductor cleanrooms for benchmarking, recommended testing by semiconductor process or environment, and a troubleshooting guide.

Witness Wafers

Balazs™ offers witness wafer analyses for correlating airborne contaminants to those that adhere to the wafer surface. Witness wafers are positioned for a defined period to collect a typical sample of contamination that adheres to the surface of the wafer. The wafers are packaged using a unique process to avoid contact contamination associated with shipping and handling. Upon arrival at the Balazs™ facility, the analysis for contaminants occurs in a wafer desorber. Wafers can be exposed to air, tools, stockers, FOUPs, compacts or shippers. Witness wafer programs also use blanks in order to confirm the integrity of the sample.

Balazs™ NanoAnalysis operates ISO 17025 certified laboratories that identify, analyze and resolve contamination issues for high-tech industries around the world. The Microcontamination Experts™ at Balazs provide rapid and accurate analyses and expertise for water, air, chemicals, process gases, components, wafers, consumables and any other contamination sources.

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