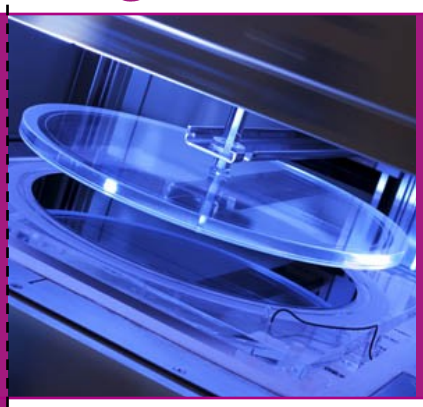
Organic Outgas Analysis



Finding the Root Cause of Yield Hits due to Organic Contamination

Organic compounds in cleanroom air can have a major impact on obtaining desirable yields. Organic contaminants find their way into the cleanroom either during construction as building materials or during manufacturing by way of chemicals, consumable, gases, makeup air, etc. Many processes have little tolerance to specific types of organics and it is important to understand if the building materials utilized in the cleanroom construction contain these compounds as well as monitoring cleanroom air and materials post construction for optimum manufacturing. Materials and components will be outgassed and cleanroom air will be sampled by specially developed methods that effectively capture target organic compounds.

Effects of Organics In Processing and On Wafers

- Amines and amides can affect deep UV lithography and increase linewidth
- Amines react with acid vapors creating haze on wafers or optics
- Organics adversely affect adhesion and conduction between layers and can form SiC
- Phthalates affect gate oxide reliability
- Silicones can interact with air ionizers to make particles
- Outgassed phosphorus compounds can cause n-doping of silicon wafers

Organics in Air

Air is sampled through an adsorbent tube typically for 6 hours. The tube is returned to the lab where it is thermally desorbed. The desorbed compounds are separated by gas chromatography and each compound is identified by mass spectrometry. For amines, ion chromatography is a preferred method and is also performed at Balazs™ NanoAnalysis. Gases such as nitrogen, helium, argon, oxygen, or compressed air can also be analyzed.

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Organics on Wafers

Organic-free wafers are exposed to cleanroom air for 24 hours. The wafers are shipped to Balazs™ in a proprietary organic-free container and are analyzed by TD GC-MS to identify trace organics.

Organic Outgassing

Outgas screening tests are often performed by heating small samples at 100°C for 30 minutes in an automated instrument. Alternatively, larger samples can be outgassed at room temperature or other selected temperatures. High-boiling compounds with low vapor pressures can outgas at low rates, but they will be swept continuously onto the adsorbent and concentrated. The outgassed compounds are identified and quantitated by TD GC-MS.

Components to be tested

- Adhesives, caulks, elastomers, epoxies, gel seals, sealants, silicones, paints
- Anti-Static Coverings, Bags, Foups, Gloves, Pods, Reactor Components
- Cables, Disk Drive Components, Light Fixtures, Electrical Fittings/Components, Equipment,
- Coatings, Fire Retardant Materials, Polyimides, Photoresists,
- O-Rings, Gaskets, Pipes, Tapes, Tubing, Labels, Floor Tiles
- Ductwork, Filters, HEPA Filters, Insulation, Plastic Curtains, Wall Coverings, Wet Bench Plastics

Case Study: Organophosphate Found to be Cause of Yield Loss

An example of solving an organophosphate contamination problem using TD-GC-MS at a semiconductor fab is shown on this page. This facility had >10% yield loss caused by an organophosphate.

Figures 1 through 3 emphasize tris(chloropropyl) phosphate, a flame retardant that outgassed from a HEPA filter potting compound into cleanroom air, and adsorbed onto wafer surfaces, causing the yield loss.

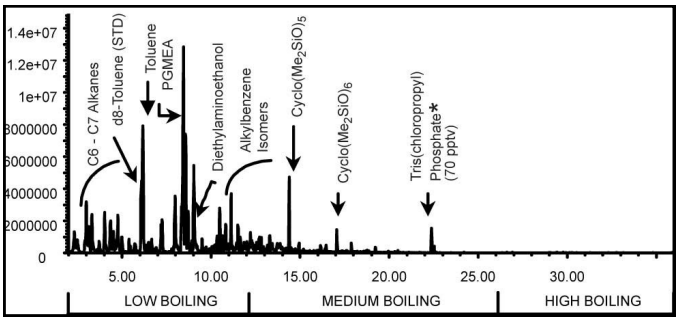
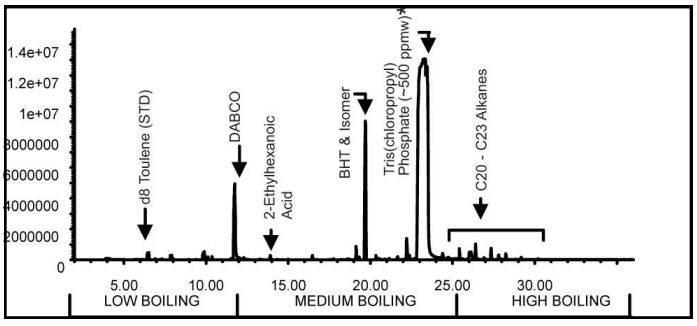


Figure 1. shows 70 pptv (parts per trillion volume) of tris (chloropropyl) phosphate detected in cleanroom air.



In Figure 2. A high level of tris(chloropropyl) phosphate is detected on the wafer surface.

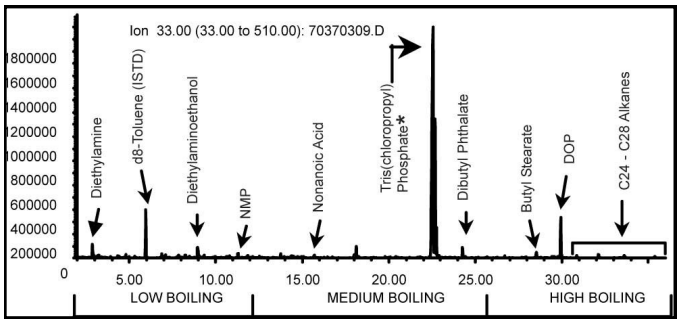


Figure 3. reveals the source of the phosphate was outgassing from a HEPA filter potting compound. Balazs will work with you to resolve organic contamination problems.