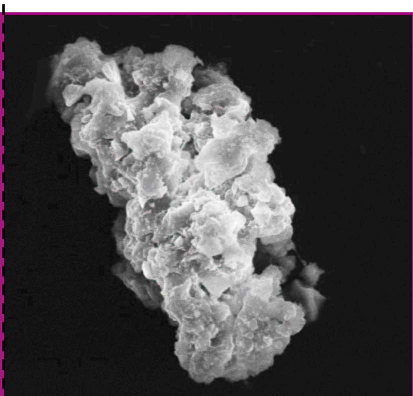
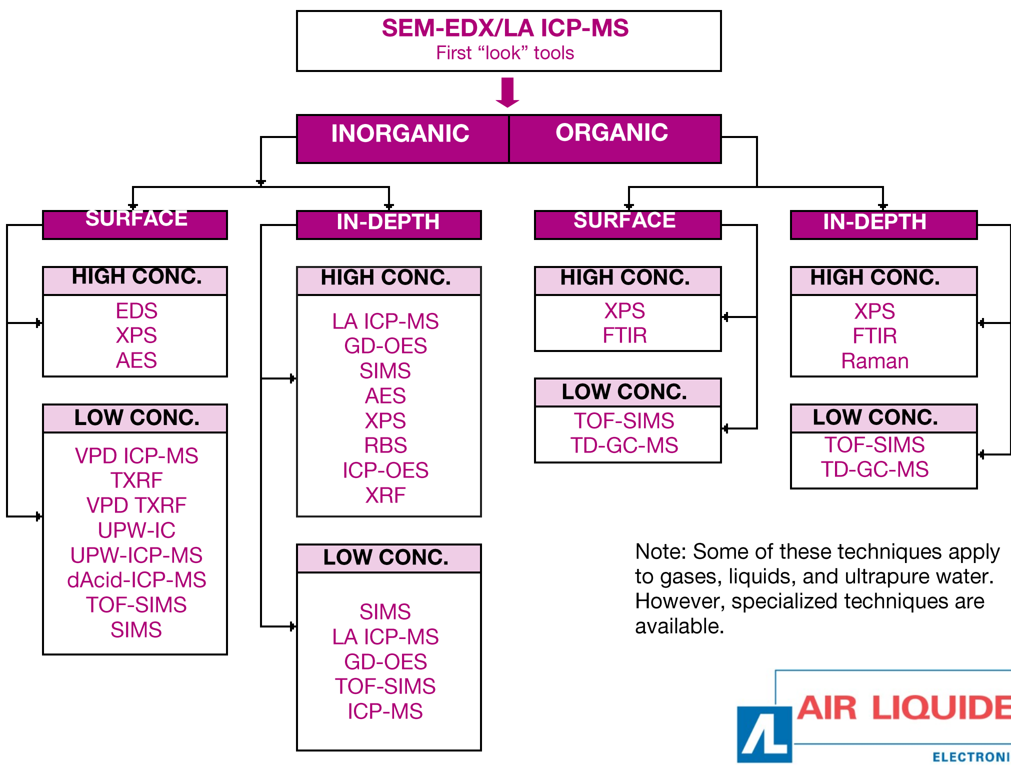
Contamination Identification



Key Enabler to Improving Process Materials and Manufacturing Yield

Reducing contamination is one of many key enablers to improving manufacturing yield and increasing profit margin. Contamination may arise from the facility, tools, process materials and excursions. It is important to develop individual contamination baseline and cleanliness specifications for the manufacturing facility and the processes especially when developing advanced technologies. For rapid resolution of a contamination escalation it is important to identify the contaminant and trace its root cause. A common mistake is to rely on familiar analytical techniques.

The technique selected should be based solely on the information required to definitively identify the contaminant or to verify a hypothesis or mechanism of the contaminant source. The following Analytical Decision Tree is a valuable tool for deciding which technique to select. This tree applies to all high technology industries including semiconductor, FPD, photovoltaic, optoelectronics, disk drives, aerospace, biomedical and pharmaceutical where reducing contamination is a priority.



Note: Some of these techniques apply to gases, liquids, and ultrapure water. However, specialized techniques are available.

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AIR LIQUIDE ELECTRONICS

How to Use the Analytical Decision Tree

Balazs™ NanoAnalysis has identified and resolved contamination escalations in high technology industries for over 30 years. This Analytical Decision Tree is deceptively simple but effective in guiding the selection of an appropriate analytical technique for all materials and contaminant types including particle, metal, ionic and organic. The following contamination parameters must be determined before an appropriate analytical test method may be selected.

Concentration	Detection limit
	Localized or average value
Feature Size	Spatial resolution, mapping
Depth of Analysis	Surface, near-surface or in-depth (bulk)
Chemical Species	Depth profile or total concentration
	Inorganic or organic
	Chemical state
Accuracy	Qualitative or quantitative
Precision	Low or high precision
Data Density	Analysis steps (small for thin film, large for bulk substrate)
	Data collection time

The first step is to determine if the contaminant or impurity is inorganic or organic. This is important because the subsequent test plan and root cause will differ accordingly. The second step is to determine if the contaminant or impurity is on the surface of the material or in-depth (and bulk). Aqueous solutions, chemicals and gases may be considered to be in-depth. The final decision to make is whether the contaminant or impurity is present at low or high concentration. This tree shows an analytical technique may be present in several categories. The reason is that different information will be gathered based on the instrumentation parameters.

Material and Contamination Characterization

Spectroscopy

- Glow discharge optical emission (GD-OES)
- Inductively coupled plasma optical emission (ICP-OES)
- X-ray photoelectron (XPS)
- Auger electron (AES)
- Energy dispersive (EDS)
- Fourier transform infra red (FTIR)
- Raman
- Atomic absorption (AAS)
- Graphite furnace AAS
- UV-Visible

Chromatography

- Anion ion chromatography (IC)
- Cation ion chromatography (IC)
- High performance liquid chromatography (HPLC)
- Gas chromatography and GC-MS

Mass Spectrometry

- Collision cell ICP-MS
- High resolution ICP-MS
- Quadrupole ICP-MS
- Vapor phase decomposition ICP-MS
- Drop scan etch ICP-MS
- Surface acid scan ICP-MS
- Bulk silicon etch ICP-MS
- Laser ablation ICP-MS
- Thermal desorption GC-MS
- Secondary ion mass spectrometry
- Time-of-flight SIMS
- Rutherford backscattering spectrometry
- GC-MS

Specialty Sampling

AMC and SMC sampling

Gas manifold