Analytical Techniques to Identify Unexpected Contaminants On Electronic Assemblies

By: Kristi Freeman, Analytical Chemist

The presence of unexpected particulate or contaminants on an electronic assembly or its constituents can have detrimental affects on the functionality and/or long term reliability of the electronic system. It is critical that such contaminants be quickly isolated and identified so that possible sources can be traced and corrective actions applied to the process.

STI's Analytical Lab has a wide range of microscopic and analytical equipment available for the analysis of particulate and/or amorphous contaminants, including:

- Ion Chromatography (IC)
- Scanning Electron Microscopy with Energy Dispersive Spectroscopy capability (SEM/EDS)
- Fourier Transform-Infrared Spectroscopy (FTIR)

Ion Chromatography

Ion Chromatography is performed in accordance with IPC-TM-650, Method 2.3.28, "Ionic Analysis of Circuit Boards, Ion Chromatography Method". IC testing is able to detect and quantify cations, anions and weak organic acids to a high degree of accuracy, even when present in small amounts. IC testing is non-destructive in most cases. STI's recommendations for ionic contamination levels are given in Table 1. In addition to the ions listed, fluoride, malate, calcium, and magnesium can also be detected.

Anions	Washed Samples	No Clean Samples
Chloride	< 6	<3-5
Nitrite	< 3	<3
Sulfate	< 3	<3
Bromide	< 10	<10
Nitrate	< 3	<3
Phosphate	< 3	<3
Weak Organic Acids	Washed Samples	No Clean Samples
Acetate	< 3	<3
Formate	< 3	<3
MSA, Adipic, Succinic	Total < 25	<125
Cations	Washed Samples	No Clean Samples
Lithium	< 3	<3
Sodium	< 3	<3
Ammonium	< 3	<3
Potassium	< 3	<3

Table 1 – STI recommendations for ionic contamination levels in μg of ion per in^2 of surface area

STI Electronics, Inc.
102 Tribble Drive
Madison, AL 35758
(256) 461-9191 or (800) 767-4919
www.stielectronicsinc.com

Analytical Techniques to Identify Unexpected Contaminants On Electronic Assemblies

By: Kristi Freeman, Analytical Chemist

SEM/EDS

EDS analysis provides an elemental analysis of unknown contamination. This is often a useful first step in identifying the contamination. EDS can identify the elements present and the relative concentration by weight of each element. This analysis will indicate if the contaminate is metallic, a metal oxide, or an organic substance. Metals and metal oxides can usually be identified using only EDS, while organic substances undergo further testing using FTIR. An example EDS spectra is shown in Figures 1 and 2.

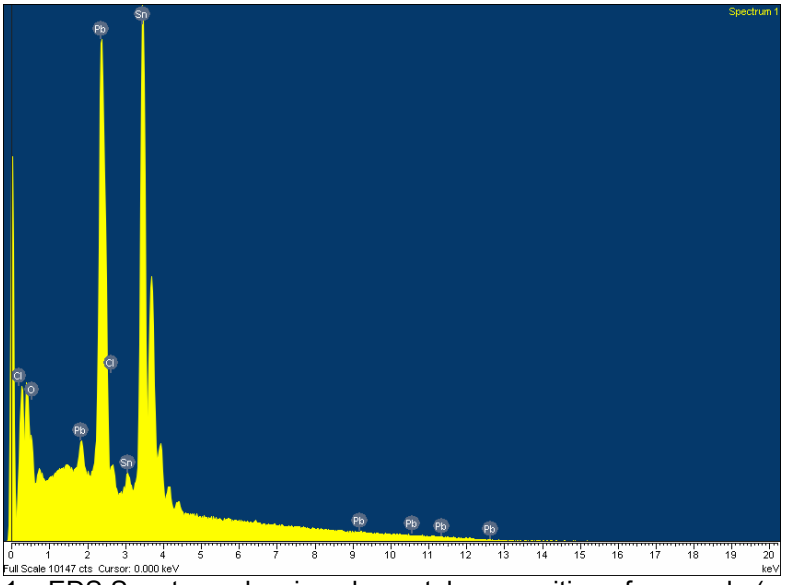

Figure 1 – EDS Spectrum showing elemental composition of a sample (metallic)

STI Electronics, Inc.
102 Tribble Drive
Madison, AL 35758
(256) 461-9191 or (800) 767-4919
www.stielectronicsinc.com

Analytical Techniques to Identify Unexpected Contaminants On Electronic Assemblies

By: Kristi Freeman, Analytical Chemist

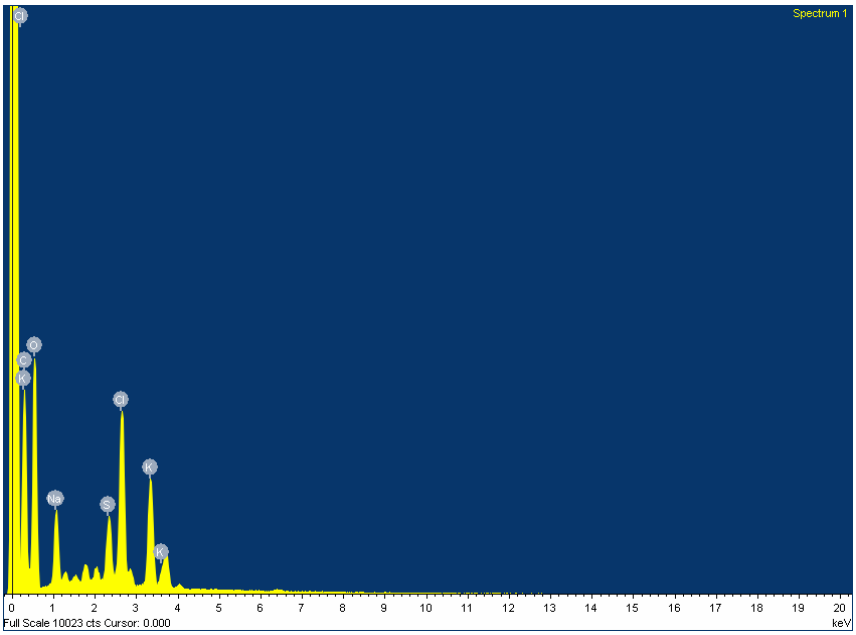

Figure 2 - EDS Spectrum showing elemental composition of a sample (Organic)

FTIR

While IC will give quantitative information on cleanliness, FTIR provides qualitative information on visible organic contamination. FTIR is also generally non-destructive. For FTIR testing, a spectrum is obtained of the unknown substance, and is then referenced against a database of spectra from known substances. An example is shown in Figure 3. Most of the time the comparison will give at least a general match (example - a flux, a cleaner, etc.) but often a much more specific match can be made (example – no clean flux, water soluble flux). Occasionally the contamination can even be matched to a specific brand and number of flux or cleaner. The unknown substance can also be compared to materials used on the PCB during the assembly process or to other materials used in the facility. This will often provide a definitive match that conclusively identifies the contamination.

STI Electronics, Inc.
102 Tribble Drive
Madison, AL 35758
(256) 461-9191 or (800) 767-4919
www.stielectronicsinc.com

Analytical Techniques to Identify Unexpected Contaminants On Electronic Assemblies

By: Kristi Freeman, Analytical Chemist

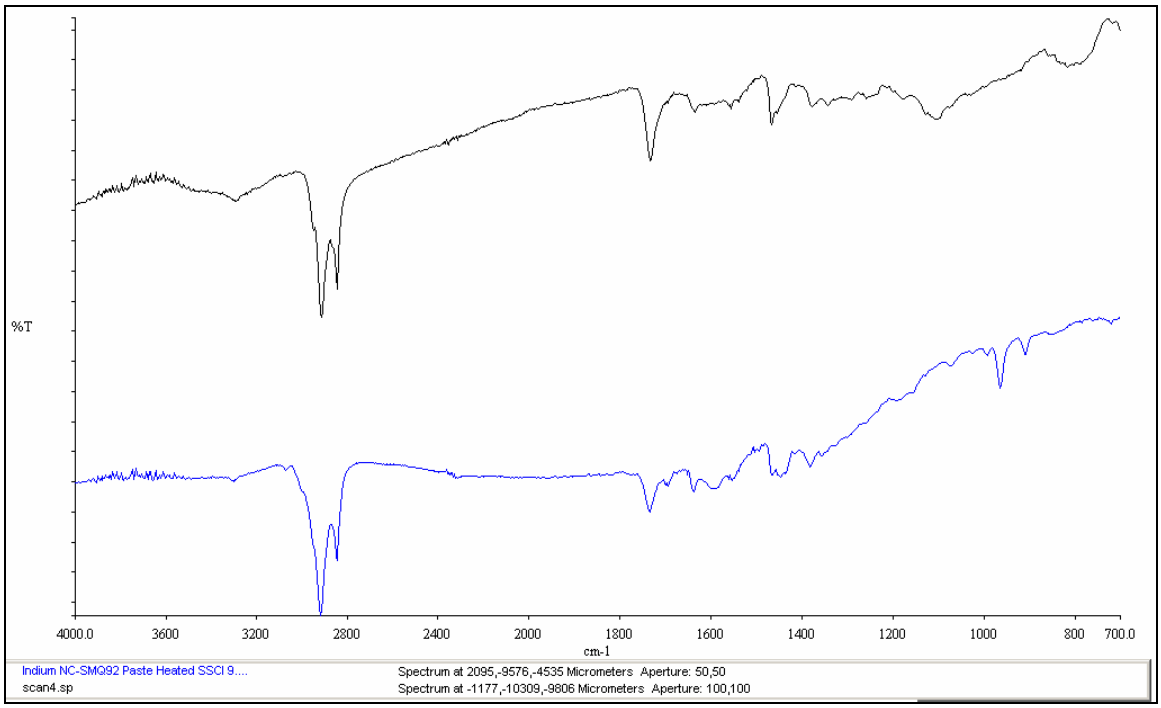

Figure 3 – FTIR Spectrum comparing an unknown sample (top) and a no-clean flux (bottom)

Many tools are available to determine contamination identity and source. IC testing can be used to determine overall board cleanliness and detect potentially damaging ions. EDS and FTIR can be used in combination to identify visible contamination and possible sources of the contamination. The ability to identify contamination and correct the source of the contamination can greatly increase the long-term reliability of an electronic assembly or its constituents.

STI Electronics, Inc.
102 Tribble Drive
Madison, AL 35758
(256) 461-9191 or (800) 767-4919
www.stielectronicsinc.com