

## SEA no.29 Measurement of trace Lead in Sn Plating

Aug. 2006

### 1. Overview

Trace lead in Sn plating is monitored in accordance to RoHS/ELS regulations. This application brief introduces an example of measuring Pb within Sn plating using three instrument models, the SEA2210A, SEA1000A, and SEA5120A.

### 2. Measurement

Sn plating over copper was measured by the Film Analysis (FP) method using the SEA2210A, SEA1000A, and SEA5120A. Results of these measurements are shown below in Table 1.

Table 1

	SEA2210A		SEA1000A		SEA5120A	
	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2
Time (sec)	500	100	500	100	500	100
Collimator	10.0mm		5.0mm		1.0mm	
Voltage (kV)	31	50	31	50	30	50
Current (μA)	720	4	300	35	1000	32
Filter	For Pb	blank	For Pb	For Cd	For Pb	blank
Atmosphere	Air		Air		Air	

### 3. Results

A 5μm Sn plated sample that contains 2500 ppm Pb was measured by each instrument. (The concentration of Pb was also measured by atomic absorption.)

The Pb fluorescent X-ray spectrum for each instrument model is shown below in figures. Trace Pb can be accurately detected by all three instruments.

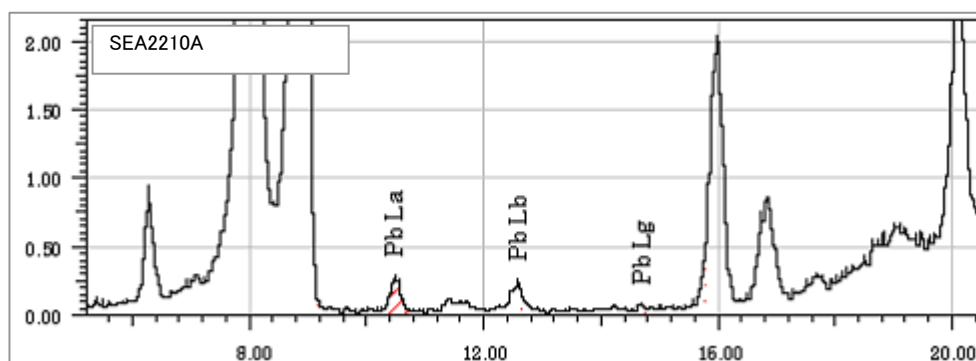


Figure 1

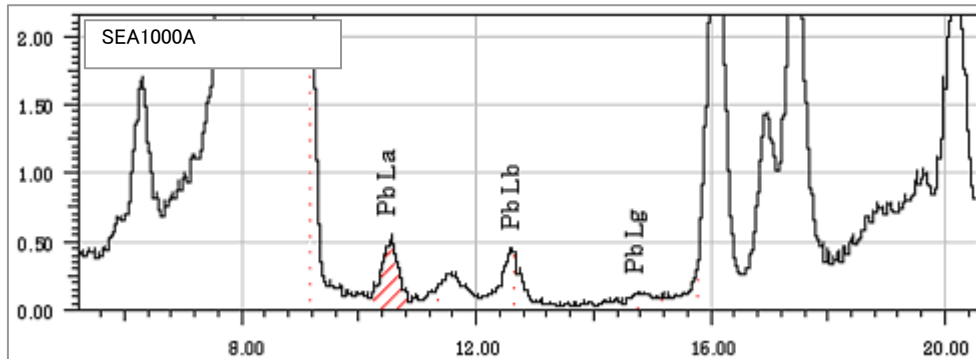


Figure 2

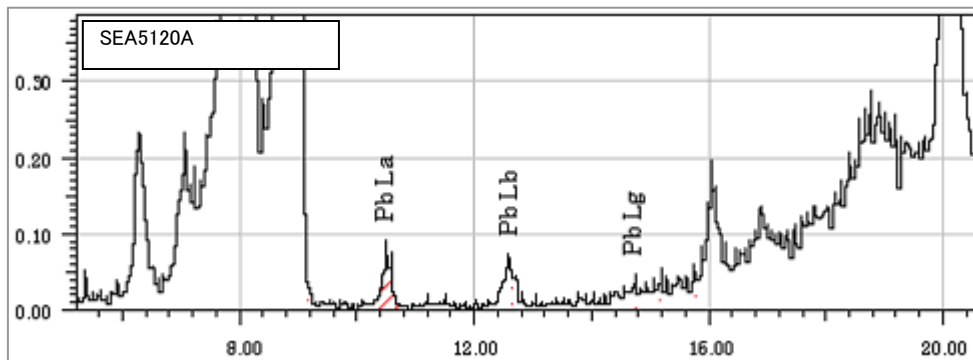


Figure 3

Each instrument measured the identical sample 10 times. Results are listed in the table below.

Table 2

		AVE	SD	Max	Min	Range	CV (%)
SEA2210A	Thickness (um)	2.73	0.046	2.78	2.63	0.15	1.676
	Pb(ppm)	2743	192.6	3002	2503	499	7.02
SEA1000A	Thickness(μm)	2.58	0.007	2.60	2.58	0.02	0.271
	Pb(ppm)	2696	75.1	2829	2576	253	2.78
SEA5120A	Thickness(μm)	2.63	0.026	2.67	2.59	0.08	0.979
	Pb(ppm)	2613	215.8	2895	2205	690	8.26

The calculated Pb compositions match the value obtained by atomic absorption. Also shown for reference are results of measurement by the bulk FP method of similar samples.

Sn	Cu	Pb
6.94 (wt%)	92.94 (wt%)	1282 (ppm)

We see that the composition of Pb differs when measuring a plated sample using a bulk method. Thus, the Film Analysis (FP) method should be used to measure Pb within plating. The detection lower limit of Pb for this sample can be found by using a blank sample that does not contain Pb. Detection lower limit is defined as 3 times the statistical variation of the Pb background intensity when a blank sample is measured.

	SEA2210A	SEA1000A	SEA5120A
Detection LL (ppm)	91.9	70.6	151.6

#### 4. Conclusion

From the information above we realize that the concentration of Pb within Sn plating can be measured by using the “Film Analysis (FP)” method. Nonetheless, the following restrictions apply for using the Film Analysis (FP) method.

- X-ray beam size must be smaller than the measured area
  - All structures of plating including the base must be known
  - Accurate measuring cannot be done when the same element is included in both the base and plating or if the composition of the base is known and does not meet these restrictions.
- Pay attention to these points when they apply.