Application Brief

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Sn-Bi Coating measurement using a new feature in the Film Analysis (FP)

1. Introduction

Application Brief nos. 17 and 18 introduce a method used in Pb-free compliance for measuring Sn-Bi coatings. Measurement accuracy was introduced in Application Brief no. 21.

By using a new function added to the Film Analysis (FP) application in the X-ray Station software, measurement accuracy of Sn-Bi coating was improved in instruments using proportional counter detectors. This application brief reports on the method and its accuracy.

Version 7.08.0.0 or later of the X-ray Station program is required to use this new feature.

2. New Digital Filter

The digital filter is used conventionally in the background subtraction process. However, in proportional counter measurements, background from the effects of peak surrounding noise tends to be subtracted excessively when the digital filter is applied to small peaks. For this reason, it was used instead of the numerical filter when measuring Sn-Bi coatings. However, background fluctuation is larger than the digital filter, and this method links the size of that fluctuation to the size of the measurement dispersion.

The new digital filter averages the effects of noise around the peak by smoothing the spectrum, and then subtracts the background with the digital filter. When this is applied to Sn-Bi coatings, the background becomes stable and excessive subtraction can be controlled.

3. Test

Table 1 shows the measurement conditions. Please see the end for detailed settings in the software. The SIINT made 10.9um, Bi2.9wt% Sn-Bi standard is registered as a known standard.

Table 1 Measurement Conditions

Instrument	SFT9400
Voltage	50kV
Current	1500uA
Collimator	0.1mm
Primary Filter	ON
Target	W
Focal Point	Standard
Detector	PC
Measure Method	Film Analysis (FP)
Time	Standard: 100 sec Unknown: 60 sec

4. Results

4-1 Comparison by Standard Samples

Table 2 and Table 3 show results of 20 measurements using several standard samples together with measurement results from the conventional method. From these results, we can see that there is a big improvement in the measurement accuracy of Bi composition.

Table 2 Measured Results with 42 Alloy Base (n=20)

Standard Foils		New Method				Conventional Method			
		Ave	SD	Range	CV%	Ave	SD	Range	CV%
Thickness (um)	7.5	7.30	0.093	0.32	1.27	7.23	0.094	0.40	1.30
Bi (wt%)	2.7	2.70	0.112	0.43	4.13	2.74	0.291	1.19	10.63
Thickness (um)	10.9	10.87	0.064	0.32	0.59	10.85	0.092	0.36	0.85
Bi (wt%)	3.5	3.63	0.099	0.50	2.73	3.64	0.257	0.98	7.07
Thickness (um)	10.9	11.14	0.078	0.28	0.70	11.06	0.099	0.38	0.89
Bi (wt%)	0.9	0.99	0.091	0.36	9.17	0.66	0.188	0.85	28.54
Thickness (um)	18.5	18.96	0.142	0.55	0.75	18.84	0.143	0.58	0.76
Bi (wt%)	3.6	4.13	0.089	0.33	2.15	3.73	0.192	0.87	5.16
Thickness (um)	25.1	25.58	0.188	0.72	0.73	25.42	0.196	0.83	0.77
Bi (wt%)	0.9	0.90	0.089	0.38	9.91	0.67	0.112	0.46	16.68

Table 3 Measurement Results with Cu base (n=20)

Standard Foils		New Method				Conventional Method			
		Ave	SD	Range	CV%	Ave	SD	Range	CV%
Thickness (um)	7.5	7.21	0.079	0.31	1.10	6.60	0.048	0.16	0.72
Bi (wt%)	2.7	2.50	0.146	0.55	5.84	2.93	0.274	0.92	9.36
Thickness (um)	10.9	10.79	0.070	0.29	0.65	10.48	0.082	0.30	0.78
Bi (wt%)	3.5	3.51	0.137	0.55	3.92	3.55	0.239	0.86	6.72
Thickness (um)	10.9	10.99	0.078	0.32	0.71	10.50	0.035	0.13	0.34
Bi (wt%)	0.9	0.88	0.079	0.36	8.99	1.03	0.223	1.03	21.66
Thickness (um)	18.5	18.93	0.123	0.48	0.65	16.90	0.533	2.52	3.15
Bi (wt%)	3.6	4.04	0.094	0.34	2.34	3.77	0.250	0.93	6.63
Thickness (um)	25.1	25.45	0.243	0.95	0.96	18.73	0.434	1.71	2.32
Bi (wt%)	7.5	7.21	0.079	0.31	1.10	6.60	0.048	0.16	0.72

4-2 Comparison from actual samples

Table 4 shows a comparison of results using a proportional counter detector and the new digital filter with results using a SSD detector. The sample base material was 42 Alloy. In both cases the same results were obtained.

Table 4 Measured Results of Actual Sample (42 Alloy Base)

Measurement Spot		1	2	3	4	5
New method	Thickness (um)	11.77	11.83	13.6	12.38	10.07
	Bi (wt%)	1.61	1.73	1.35	1.56	1.81
SFT9400 SSD detector	Thickness (um)	11.76	11.75	13.37	12.9	9.99
	Bi (wt%)	1.56	1.88	1.34	1.45	1.79

5. Conclusion

From these results we see that dispersion of Bi composition was reduced 1/2 to 1/3 when using the new digital filter. This agrees well with results when an SSD detector was used. Consequently, this method introduced here is very effective for measuring Sn-Bi coating.