Application Brief

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Bromine Correction in Au Measurements on Printed Circuit Boards

1. Overview

In a previous application brief, we reported on a correction method for Br (bromine) added as a retardant to circuit boards, as a precaution in measuring a Au coating on PCB using the SFT3000S.

Although today this method is used at many sites, we know that the Br correction is inadequate and in some cases measurement error occurs from conventional Au coating thickness specifications of 0.5 um to 1.0 um, within an increased tendency to replace Au coating (flash Au coating) with a substrate layer electroless Ni coating, especially in measurements where the Au coating thickness is 0.1 um or less.

This application brief reports on our examination of effective methods of Br correction, even in flash Au, by improving conventional methods.

2. Calibration Curve Creation

Below is an example of standard sample combinations for creating a special dual layer calibration curve.

No	Au	Ni	Cu	Br base	Au intensity	Ni intensity
1	infinite	- - - -	- - - -	- - - -	1120.510	74.894
2	- - - -	infinite	- - - -	- - - -	28.354	2044.535
3	- - - -	- - - -	infinite	- - - -	30.210	2089.996
4	- - - -	- - - -	- - - -	- - - -	92.182	1321.542
5	0.260	- - - -	infinite	infinite	130.170	1739.066
6	0.800	- - - -	infinite	- - - -	370.473	1039.286
7	0.260	infinite	- - - -	- - - -	129.072	1577.707
8	0.980	infinite	- - - -	- - - -	369.960	933.064
9	- - - -	2.550	infinite	- - - -	29.749	2168.060
10	- - - -	10.200	infinite	- - - -	27.286	2115.411
11	0.400	5.220	infinite	- - - -	184.809	1530.235

When measuring an Au coating of 0.1 um or less, we recommend the calibration curve be created using a combination of standard samples of the same thickness' as those listed above for the purpose of controlling calibration dispersion.

3. Br Base Registration

When performing Br correction using the "Special Double (dual) Layer Calibration Curve application, registration of the #4 standard sample in the calibration curve listed above has a large effect on the measurement results. Up to now, we recommended only glass epoxy in registering the Br base; however, a large error occurs between the Au intensity and Br intensity, which accompanies Au flash coating in particular. This causes a worsening in the sharpness of separation. Here, calibration curves were created, their respective bases registered, and measurement accuracy examined as displayed below in figures 1 to 4.

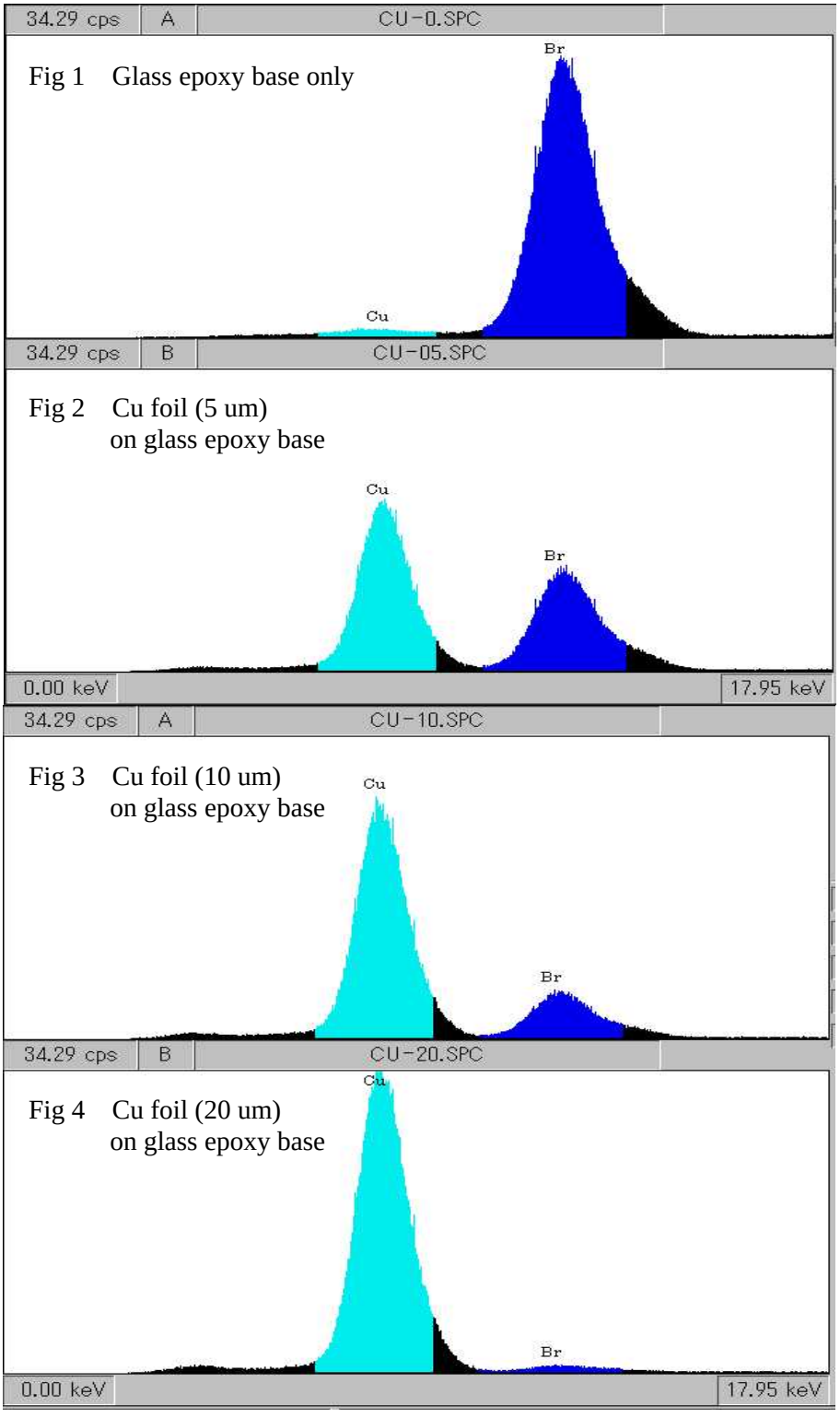

Fig 1 Glass epoxy base only

Fig 2 Cu foil (5 um) on glass epoxy base

Fig 3 Cu foil (10 um) on glass epoxy base

Fig 4 Cu foil (20 um) on glass epoxy base

4. Measurement Results

For each Au thickness surface layer, changing the thickness of the substrate Cu foil changed the Br amount and confirmed the effect of Br correction. Here we measured using four calibration curves, each calibration curve saved with one of four types of Br data (1 to 4). The SFT3200S was used in the evaluation. Collimator size is 0.1mm. Measurement time is 30 seconds. Each sample was measured 20 times. Statistics are shown below.

Calibration Curve A Br Data: 1

Au th (um)	Base	AVE	SD	MAX	MIN	CV (%)
0.040	Ni(5.22um)/Cu(05um)/PCB	0.008	0.009	0.025	0.000	122.6
	Ni(5.22um)/Cu(10um)/PCB	0.029	0.009	0.046	0.011	30.3
	Ni(5.22um)/Cu(20um)/PCB	0.039	0.006	0.050	0.024	16.5
0.110	Ni(5.22um)/Cu(05um)/PCB	0.107	0.008	0.121	0.095	7.30
	Ni(5.22um)/Cu(10um)/PCB	0.095	0.014	0.121	0.064	14.7
	Ni(5.22um)/Cu(20um)/PCB	0.087	0.012	0.108	0.059	13.9
0.250	Ni(5.22um)/Cu(05um)/PCB	0.230	0.013	0.253	0.205	5.78
	Ni(5.22um)/Cu(10um)/PCB	0.250	0.011	0.272	0.236	4.41
	Ni(5.22um)/Cu(20um)/PCB	0.262	0.010	0.279	0.246	3.68
0.400	Ni(5.22um)/Cu(05 um)/PCB	0.361	0.016	0.400	0.336	4.30
	Ni(5.22um)/Cu(10um)/PCB	0.380	0.013	0.403	0.353	3.44
	Ni(5.22um)/Cu(20um)/PCB	0.396	0.009	0.412	0.378	2.38

Calibration Curve B Br Data: 2

Au th (um)	Base	AVE	SD	MAX	MIN	CV (%)
0.040	Ni(5.22um)/Cu(05um)/PCB	0.032	0.013	0.068	0.007	40.6
	Ni(5.22um)/Cu(10um)/PCB	0.042	0.008	0.058	0.031	18.9
	Ni(5.22um)/Cu(20um)/PCB	0.042	0.004	0.050	0.034	10.1
0.110	Ni(5.22um)/Cu(05um)/PCB	0.124	0.017	0.152	0.092	14.0
	Ni(5.22um)/Cu(10um)/PCB	0.105	0.011	0.124	0.087	10.1
	Ni(5.22um)/Cu(20um)/PCB	0.108	0.005	0.120	0.098	4.77
0.250	Ni(5.22um)/Cu(05um)/PCB	0.243	0.010	0.266	0.229	4.20
	Ni(5.22um)/Cu(10um)/PCB	0.256	0.010	0.271	0.237	3.92
	Ni(5.22um)/Cu(20um)/PCB	0.263	0.009	0.283	0.242	3.46
0.400	Ni(5.22um)/Cu(05 um)/PCB	0.374	0.013	0.400	0.348	3.37
	Ni(5.22um)/Cu(10um)/PCB	0.396	0.016	0.427	0.365	4.00
	Ni(5.22um)/Cu(20um)/PCB	0.395	0.010	0.411	0.375	2.51

Calibration Curve C Br Data: 3						
Au th (um)	**Base**	**AVE**	**SD**	**MAX**	**MIN**	**CV (%)**
0.040	Ni(5.22um)/Cu(05um)/PCB	0.042	0.008	0.058	0.031	18.9
	Ni(5.22um)/Cu(10um)/PCB	0.042	0.004	0.050	0.034	10.1
	Ni(5.22um)/Cu(20um)/PCB	0.038	0.013	0.068	0.033	20.2
0.110	Ni(5.22um)/Cu(05um)/PCB	0.108	0.005	0.120	0.098	4.77
	Ni(5.22um)/Cu(10um)/PCB	0.105	0.011	0.124	0.087	10.1
	Ni(5.22um)/Cu(20um)/PCB	0.124	0.017	0.152	0.092	14.0
0.250	Ni(5.22um)/Cu(05um)/PCB	0.256	0.010	0.271	0.237	3.92
	Ni(5.22um)/Cu(10um)/PCB	0.263	0.009	0.283	0.242	3.46
	Ni(5.22um)/Cu(20um)/PCB	0.243	0.010	0.266	0.229	4.20
0.400	Ni(5.22um)/Cu(05 um)/PCB	0.396	0.016	0.427	0.365	4.00
	Ni(5.22um)/Cu(10um)/PCB	0.374	0.013	0.400	0.348	3.38
	Ni(5.22um)/Cu(20um)/PCB	0.395	0.010	0.411	0.375	2.51

Calibration Curve D Br Data: 4						
Au th (um)	**Base**	**AVE**	**SD**	**MAX**	**MIN**	**CV (%)**
0.040	Ni(5.22um)/Cu(05um)/PCB	0.039	0.010	0.051	0.010	25.5
	Ni(5.22um)/Cu(10um)/PCB	0.041	0.005	0.050	0.033	12.2
	Ni(5.22um)/Cu(20um)/PCB	0.036	0.015	0.057	0.004	42.1
0.110	Ni(5.22um)/Cu(05um)/PCB	0.108	0.009	0.134	0.092	8.66
	Ni(5.22um)/Cu(10um)/PCB	0.106	0.010	0.122	0.087	9.42
	Ni(5.22um)/Cu(20um)/PCB	0.121	0.013	0.140	0.096	10.5
0.250	Ni(5.22um)/Cu(05um)/PCB	0.258	0.016	0.297	0.239	6.26
	Ni(5.22um)/Cu(10um)/PCB	0.262	0.014	0.289	0.236	5.25
	Ni(5.22um)/Cu(20um)/PCB	0.250	0.014	0.276	0.223	5.49
0.400	Ni(5.22um)/Cu(05 um)/PCB	0.401	0.013	0.419	0.377	3.21
	Ni(5.22um)/Cu(10um)/PCB	0.370	0.016	0.402	0.340	4.20
	Ni(5.22um)/Cu(20um)/PCB	0.389	0.013	0.406	0.364	3.31

5. Remarks

Br over corrects and the Au layer becomes thinner for calibration curve A at the same conditions as before. A thicker substrate Cu foil enables a decrease in correction error by adjusting the X-ray intensity of Br and bringing the amount of Br near the actual sample.

When considering measurement accuracy and dispersion, these results show that Calibration Curve C with a substrate Cu foil of 10 um produced the best results.

6. Conclusion

The following two points must be considered for creating a calibration curve with the "Special Double Coating" application when measuring a Au coating on the surface of a PCB.

1. Even with a measurement thickness of flash coatings, standard samples for creating the calibration curve should be the same thickness' as the combination listed on page 1.
2. When creating the calibration curve, measure a sample with a 10 um Cu foil on top of glass epoxy board for #4. Br information.