Application Brief

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# SFT3000S Measurement of Sn-Cu Coating

## 1. Overview

Recently, Sn-Cu solder has been used in replacement of lead type solders. This application brief introduces several points you should be aware of when measuring Sn-Cu solder with the Film Analysis Calibration menu selection of the SFT3000S. Methods of creating calibration curves differ for measuring Sn-Cu solder, depending on the type of base. Refer to the following table for creating the best calibration curve.

| | Type of Calibration Curve |
|---|---|
| Cu | Alloy (Fixed Compound) |
| 42 Alloy | Special Alloy Coating |

## 2. Copper Base

When the base contains Cu, X-rays from the Cu in both the coating and base are indistinguishable and thickness measurements can only be performed under condition of a fixed Cu%.

a. Measurement conditions

Typical measurement conditions and conditions for creating the calibration curve are shown below. First, drag and drop the trace component Cu into the input box in the Analysis Conditions [2/2] window.

| | Settings |
|---|---|
| Calibration curve | Alloy (Fixed Compound) |
| Collimator size | 0.1 mm in diameter |
| Tube voltage | 45 kV |
| Tube current | 1 mA |
| Primary filter | ON |
| Secondary filter | OFF |
| N. Filter | OFF |
| Calibration create time | 200 sec |
| Sample measurement time | 60 sec |

| | Su-Cu | Sn% | Cu% | Base |
|---|---|---|---|---|
| 1 | infinite | 100 | 0 | --- |
| 2 | --- | --- | 100 | infinite |
| 3 | 5.00 | 100 | 0 | infinite |
| 4 | 10.00 | 100 | 0 | --- |
| 5 | infinite | 97 | 3 | --- |

b. Measurement dispersion

The predicted standard deviation when measuring each thickness at a condition of 3% fixed Cu is listed below. These estimated values are targets and should not be considered guaranteed values.

| Sn-Cu (um) | Estimated SD (um) | Estimated SD (%) |
|---|---|---|
| 1.00 | 0.02 | 2.23 |
| 3.00 | 0.04 | 1.34 |
| 5.00 | 0.05 | 1.08 |
| 7.00 | 0.07 | 0.96 |
| 9.00 | 0.08 | 0.88 |

## 3. 42Alloy Base

Able to perform simultaneous measurement of thickness and Cu% in Sn-Cu coating.

a. Measurement conditions

Typical measurement conditions and conditions for creating the calibration curve are shown below. See "4. Supplemental Section" for a detailed procedure for creating a calibration curve. Cu cannot be correctly separated when creating a calibration curve with a typical alloy coating calibration and 42 alloy as the base, thus becoming a main cause of measurement error.

| | Settings |
|---|---|
| Calibration curve | Special Alloy Coating |
| Collimator size | 0.1 mm in diameter |
| Tube voltage | 45 kV |
| Tube current | 1 mA |
| Primary filter | OFF |
| Secondary filter | OFF |
| N. Filter | ON |
| Calibration create time | 200 sec |
| Sample measurement time | 60 sec |

| | Sn-Cu | Sn% | Cu% | Base 1 (Fe) | Base 2 (Ni) |
|---|---|---|---|---|---|
| 1 | Infinite | 100 | 0 | --- | --- |
| 2 | Infinite | --- | 100 | --- | --- |
| 3 | --- | --- | --- | Infinite | --- |
| 4 | --- | --- | --- | --- | Infinite |
| 5 | Infinite | 97 | 3 | --- | --- |
| 6 | 5.00 | --- | --- | 42 Alloy | |
| 7 | 10.00 | 100 | 0 | 42 Alloy | |
| 8 | 0.25 | 0 | 100 | 42 Alloy | |
| 9 | 0.50 | 0 | 100 | 42 Alloy | |

Measurement results

Results of Sn-Cu thickness and Cu % measurements are shown in the tables below. Comparative measurements were performed with the high resolution SEA5000 in order to verify measurement accuracy. 10 measurement repetitions were performed using identical samples and evaluated together with dispersion.

| Sn-Cu | Data no. | SEA5000 | Mean | Range | SD | Max | Min | CV (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 5.05 | 5.52 | 0.35 | 0.11 | 5.72 | 5.37 | 2.02 |
| 2 | 10 | 4.59 | 4.87 | 0.25 | 0.08 | 5.01 | 4.76 | 1.56 |
| 3 | 10 | 4.73 | 5.03 | 0.23 | 0.08 | 5.18 | 4.95 | 1.65 |

| Cu % | Data no. | SEA5000 | Mean | Range | SD | Max | Min | CV (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 1.82 | 1.96 | 0.46 | 0.16 | 2.18 | 1.72 | 7.98 |
| 2 | 10 | 5.26 | 5.38 | 0.61 | 0.20 | 5.69 | 5.08 | 3.72 |
| 3 | 10 | 9.00 | 8.78 | 0.43 | 0.13 | 8.98 | 8.55 | 1.43 |

We can see by creating a calibration curve with "Special Alloy Coating" and by being able to properly separate Cu from the 42 Alloy base that the results correspond well to the results of the SEA5000 measurements.

b. Advice

One especially difficult measurement is that of Cu contained in Sn-Cu in trace amounts. Compared to a typical calibration curve, error due to calibration curve drift that accompanies changes in elapsed time will occur and appear in the measurement readings. Calibration curves must be frequently verified by standard sample measurement. Daily verification is recommended.

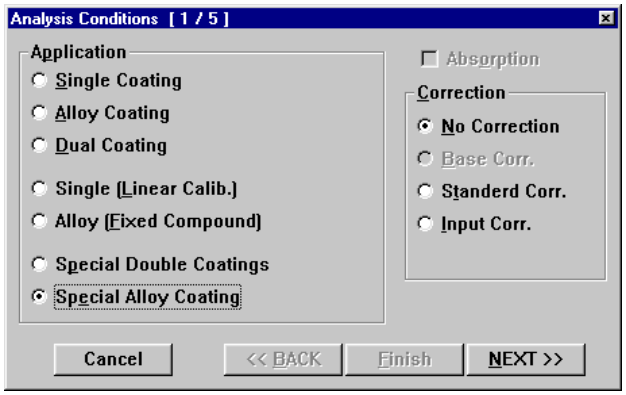
Re-measurement of a standard sample is fundamental when verifying calibration curve drift. However, there are cases in which you may be able to correct for this by re-measuring four infinite thickness samples of Sn, Cu, Fe, Ni.

If you can verify that there is still drift even after measuring infinite thickness samples then you need to re-measure all remaining standard samples.

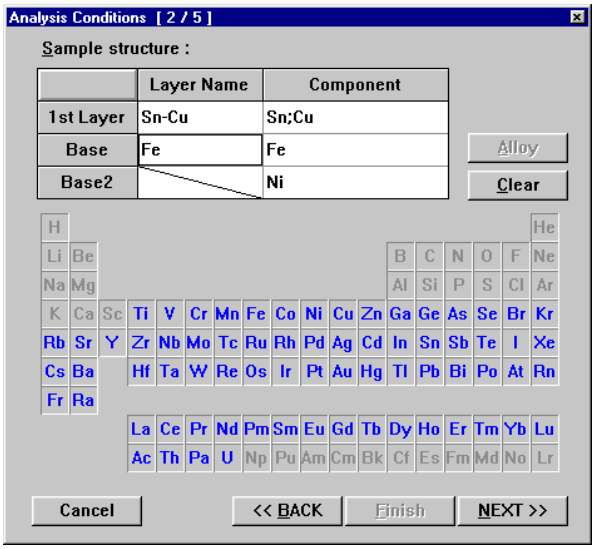
## 4. Supplemental Section

Below is the procedure for creating a calibration curve with the SFT3000S when the base is alloy 42.

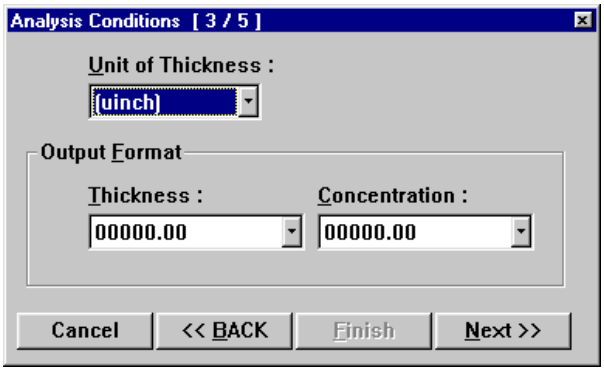
(a) Go to Main menu→Thin Film Calibration→ Analysis Conditions. Select "Special Alloy Coating" in the Analysis Conditions [1/5] window.



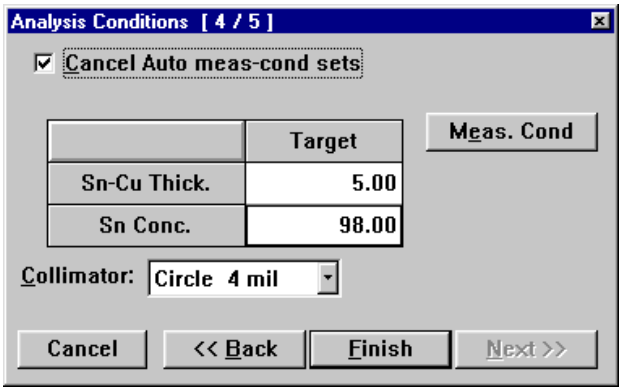
(b) Input the following information is the Analysis Conditions [2/5] window.



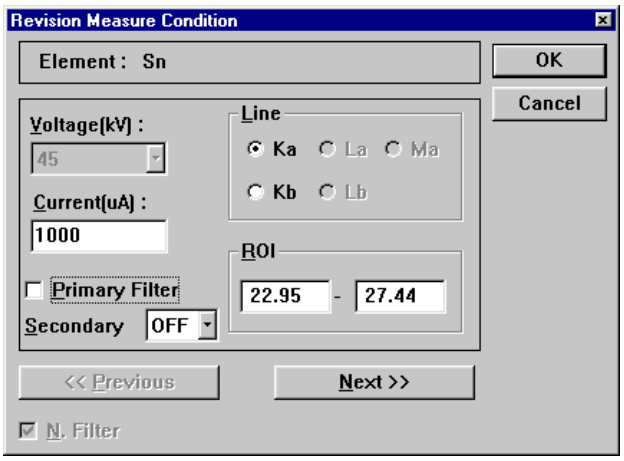

(c) Select units and the output format in the next window.



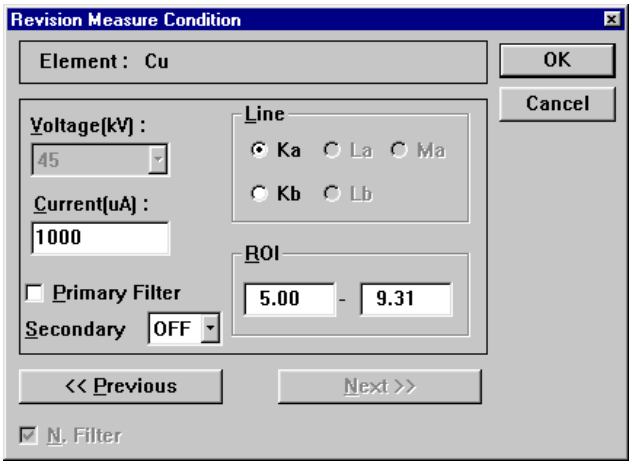

(d) Select the target value and collimator size in the window below and select the "Cancel Auto meas-cond sets" box.



(e) The next window is displayed by clicking on the "Meas. Cond" button. Make sure all points match the description.




(f) Click on the "Next" button and change the ROI setting as shown below.




(g) Click on the OK button to close the Analysis Conditions window. Enter the values of the standard samples as listed in the lower table on page 2 in the appropriate column.

(h) Input standard samples will be displayed as shown below. Measure the standards in this order. A red check mark is displayed at the start of each row after that measurement is finished. This ends the procedure. Enter and name and save the conditions.

| No. | 状態 | Sn-Cu | Sn % | Fe | 素材2 | Sn レシオ | Cu レシオ |
|---|---|---|---|---|---|---|---|
| 1 | ✓ | 無限厚 | 100.00 | --- | --- | 1.000000 | 0.000000 |
| 2 | ✓ | 無限厚 | 0.00 | --- | --- | 0.000000 | 1.000000 |
| 3 | ✓ | --- | 0.00 | 無限厚 | --- | 0.000000 | -0.000000 |
| 4 | ✓ | --- | 0.00 | --- | 無限厚 | 0.000000 | 0.000000 |
| 5 | ✓ | 無限厚 | 96.90 | --- | --- | 0.972372 | 0.015014 |
| 6 | ✓ | 4.54 | 100.00 | 無限厚 | --- | 0.138427 | 0.002269 |
| 7 | ✓ | 9.26 | 100.00 | 無限厚 | --- | 0.256763 | 0.001646 |
| 8 | ✓ | 0.26 | 0.00 | 無限厚 | --- | 0.000624 | 0.054225 |
| 9 | ✓ | 0.47 | 0.00 | 無限厚 | --- | 0.000716 | 0.095413 |