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Reliable Solder Identification by X-ray Fluorescence Spectroscopy

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Biography:
Ron has worked with XRF technology and Fischer Technology for over 20 years. He has worked with many companies & government agencies to help solve their RoHS/High Reliability/ counterfeit components issues.

Fischer Technology, Inc. manufactures a complete line of hand held and bench top instrumentation including magnetic induction, eddy current, phase sensitive eddy current, x-ray fluorescence, beta backscatter, coulometric, hardness measurement, holiday detection, conductivity measurement and quality of anodic seals.

Executive Summary
High reliability applications in the military and aerospace industry require reliable solder finish identification on components within the supply system of DoD, NASA, and many other organizations.

Consumer products and military/aerospace industry commonly share the same suppliers of electronic components. The RoHS regulation has forced those suppliers to provide lead free solder solutions. As a result, components with many different solder finishes are now available. Compatibility issues, among those various solder finishes such as melting temperatures, tin whisker formation, stress fracturing etc. create a serious reliability problem the military/aerospace industry is trying to overcome.

A new technique has been developed to reliably identify unknown samples or materials utilizing XRF instrumentation. The technique will help in identifying quickly and reliably bulk and surface finish solders of individual components as well as populated boards.

This new identification tool can be used for any application and is particularly helpful if suitable standards are unavailable. Fischer Technology will present practical examples for solder analyses. The method will also assist the user to identify the correct measurement application which can then be used to make a full quantitative analysis if desired.

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Electronics IPC Midwest

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Scope

- High reliability applications in the military and aerospace industry require reliable solder finish identification on components within the supply system
- Consumer products and the military/aerospace industry commonly share the same suppliers of electronic components. RoHS regulations have forced those suppliers to provide lead free solder solutions. As a result, components with many different solder finishes are now available.
- Compatibility issues among those various solder finishes such as melting temperatures, tin whisker formation, stress fracturing etc. create a serious reliability problem the military/aerospace industry is trying to overcome.

Expectations

- Reliable Identification of Solder Alloy
- Simple User Interface (Novice users)
- No Sample Preparation
- Short Measurement Times
- Reporting

➢ Solution:

  ➢ X-Ray Fluorescence

    ➢ Class of Material Identification

Solder Classes

Family	Alloys	Family	Alloys
SnPb	SnPb37 (eutectic)	SnBi	SnBi30
	SnPb10		SnBi10
	SnPb3		SnBi3
	SnPb1		SnBi1
SnCuAg (SAC)	SnCu0.5Ag1(SAC105)	SnCuAgBi (SAC+Bi)	SnCu0.5Ag1Bi1
	SnCu0.5Ag1(SAC105)		SnCu0.5Ag4Bi1
	SnCu0.5Ag1(SAC105)		SnCu0.5Ag1Bi3
SnCuAgIn	SnCu0.5Ag1In1		SnCu0.5Ag4Bi3
	SnCu0.5Ag4In1	Sn (pure)	Sn
		SNIC	SnCu0.7Ni0.05
		SnAg	SnAg1
			SnAg4

Class of Material Identification

- Previous technique (Positive Material Identification)
  - is restricted to material samples which must have been measured before; variations of concentration or coating thickness are not included.
- New Class of Material Procedure
  - utilizes calculated spectra instead of experimental ones. The number of theoretical spectra is not limited. Therefore, it is possible to cover variations of parameters such as concentrations and/or coating thickness.

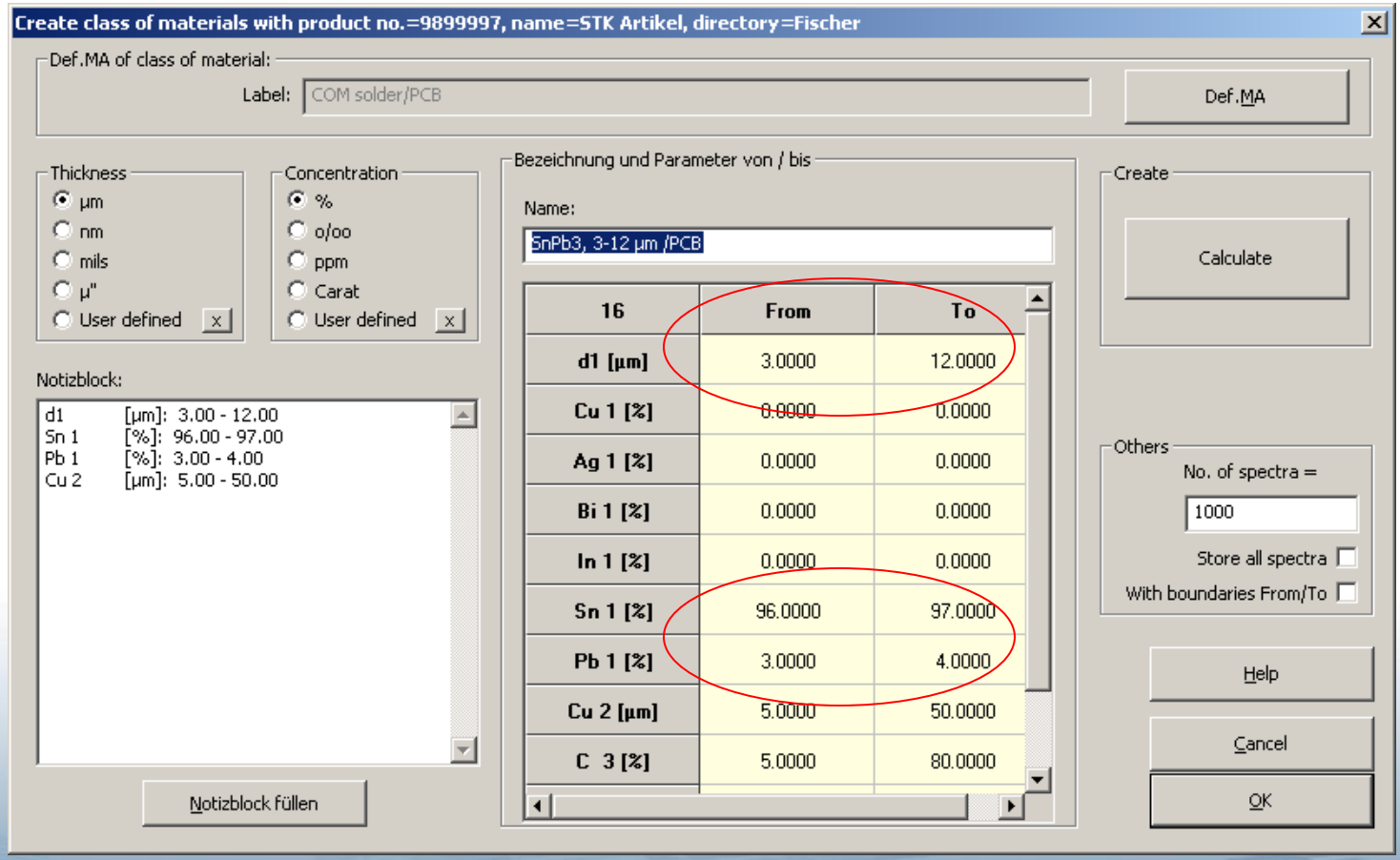
Advantage for the user

- Does not have to measure test samples of the respective material. User only has to define which type of material he wants to identify. Pre-defined classes of material can be imported to the instrument and are ready for application

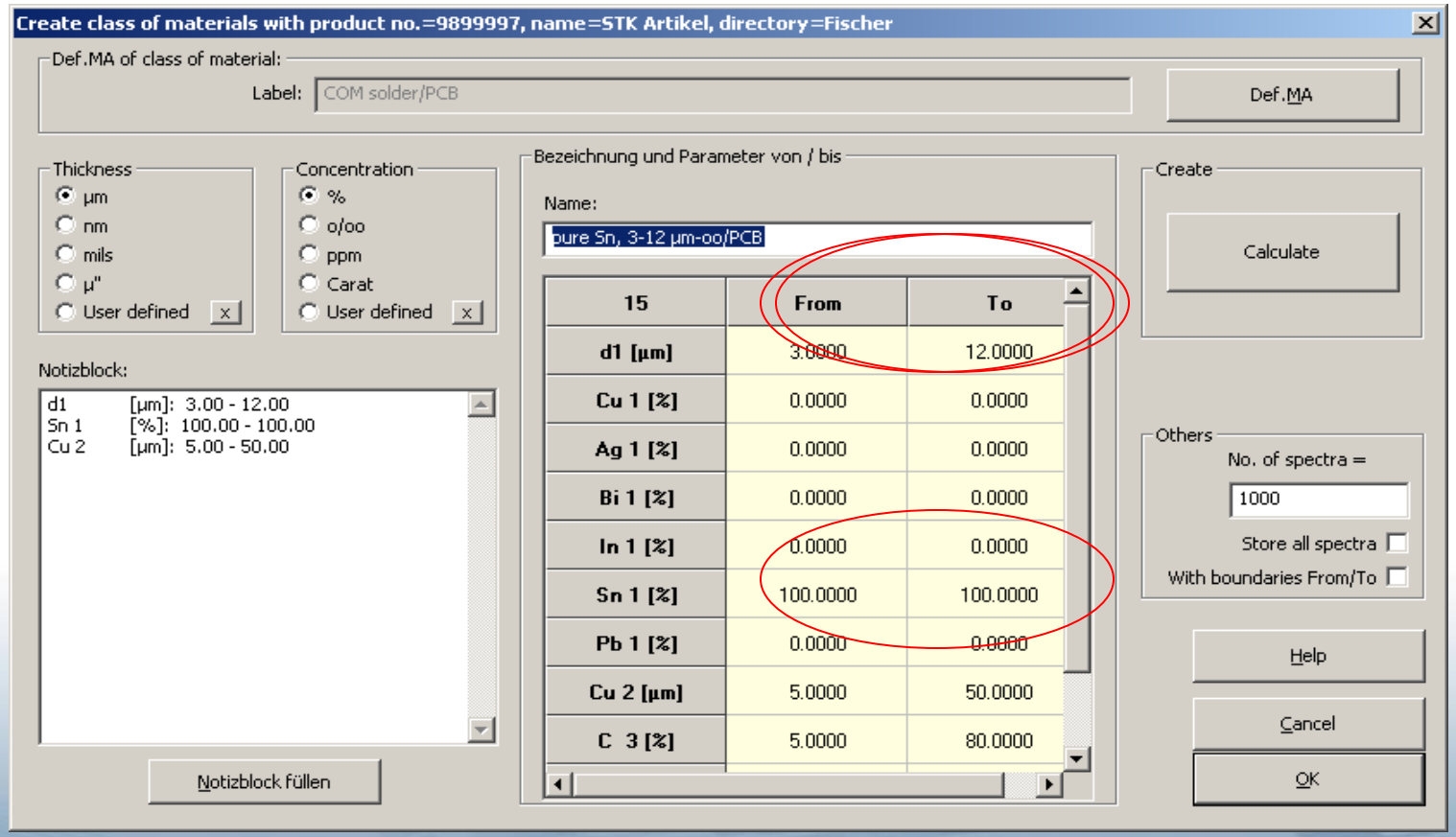
Prerequisites for Class of Material Identification

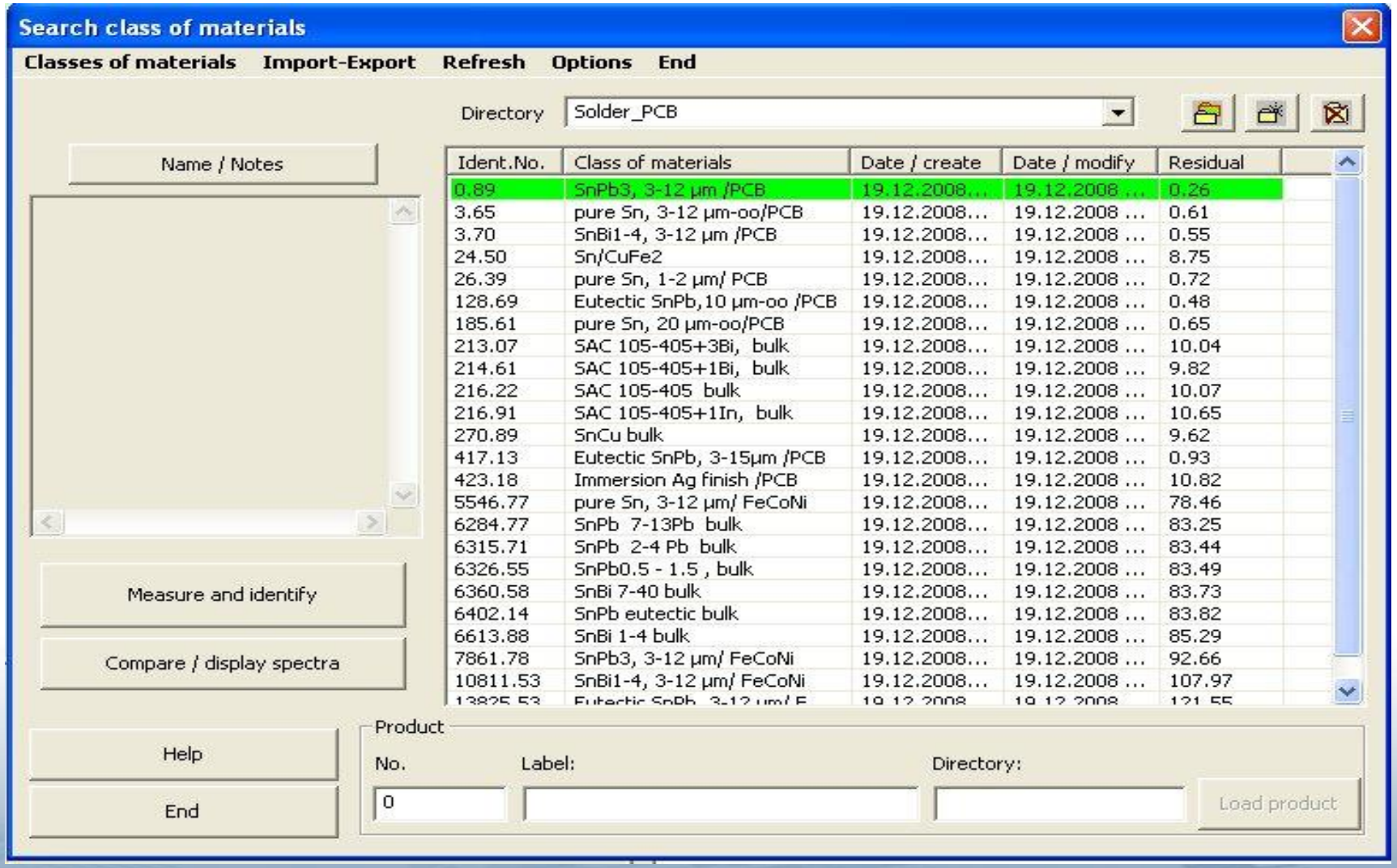
- The realistic calculation of spectra (instead of measuring known samples) is the basis of the new class of material identification technique.
  - Utilizing software of energy dispersive XRF instruments used for the analysis of layers and material analysis (coating thickness & composition)
- The determination of the unknown thickness and/or concentration values can be interpreted as an evaluation of free parameters. The basic algorithm searches for a best fit of a calculated spectrum with the measured one. The best fit parameters (concentration and/or thickness values) are the solution to the measuring task. The theoretical calculation of the spectrum takes into account:
- Known Instrument Parameters
  - photo-excitation and absorption, secondary enhancement excitation, and primary the geometry of the experimental setup
  - the primary excitation conditions
  - the properties of the detector (response function)
  - In addition ,both beam scattering are taken into account.

Definition of Solder Class SnPb3%



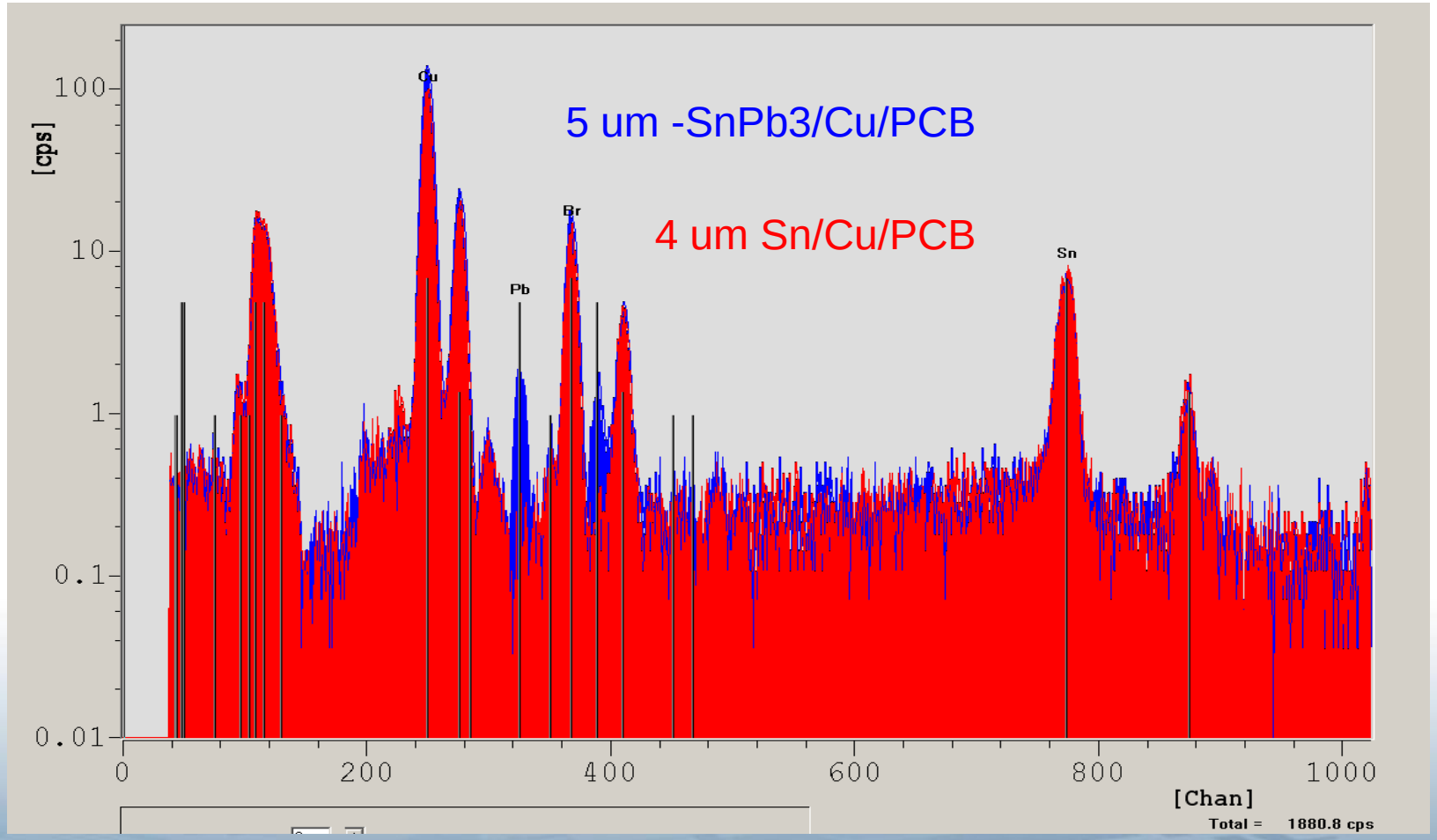
Definition of Solder Class Sn 100%



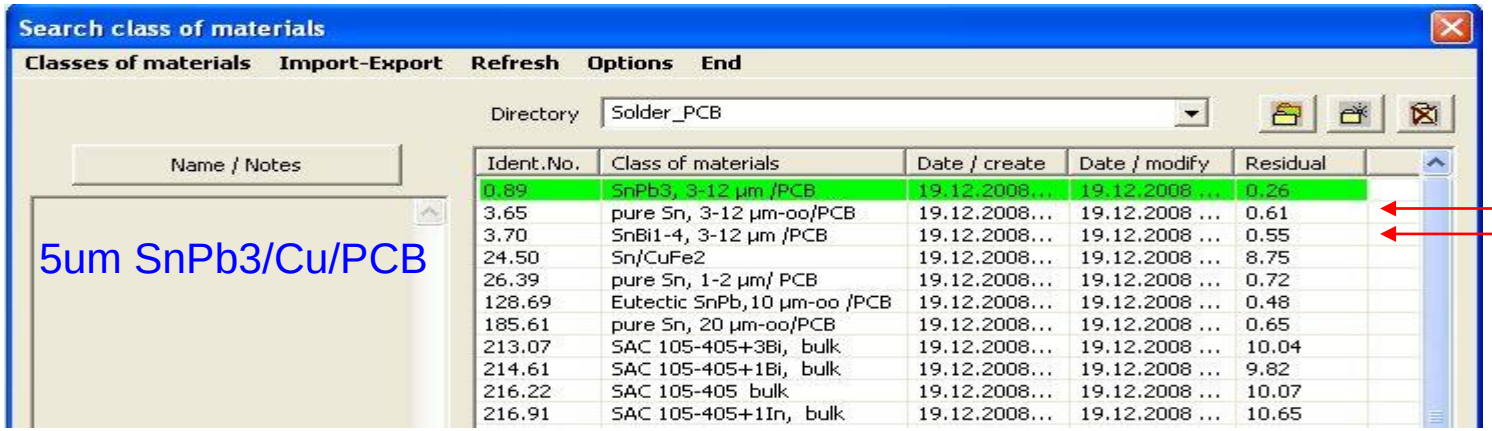


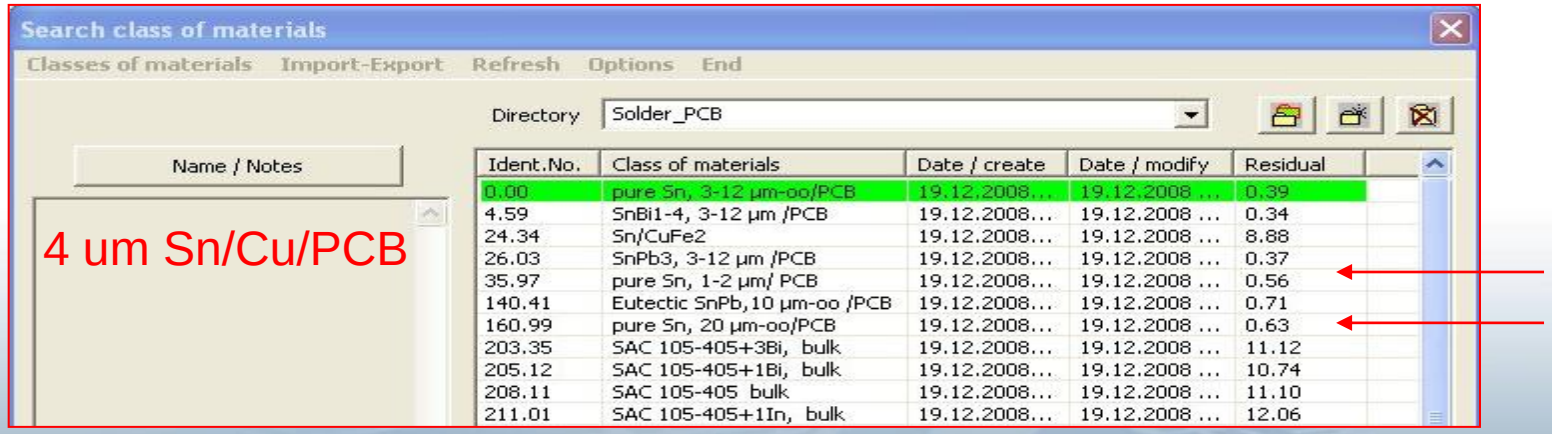
Ident.No.	Class of materials	Date / create	Date / modify	Residual
0.89	SnPb3, 3-12 µm /PCB	19.12.2008...	19.12.2008 ...	0.26
3.65	pure Sn, 3-12 µm-oo/PCB	19.12.2008...	19.12.2008 ...	0.61
3.70	SnBi1-4, 3-12 µm /PCB	19.12.2008...	19.12.2008 ...	0.55
24.50	Sn/CuFe2	19.12.2008...	19.12.2008 ...	8.75
26.39	pure Sn, 1-2 µm/ PCB	19.12.2008...	19.12.2008 ...	0.72
128.69	Eutectic SnPb,10 µm-oo /PCB	19.12.2008...	19.12.2008 ...	0.48
185.61	pure Sn, 20 µm-oo/PCB	19.12.2008...	19.12.2008 ...	0.65
213.07	SAC 105-405+3Bi, bulk	19.12.2008...	19.12.2008 ...	10.04
214.61	SAC 105-405+1Bi, bulk	19.12.2008...	19.12.2008 ...	9.82
216.22	SAC 105-405 bulk	19.12.2008...	19.12.2008 ...	10.07
216.91	SAC 105-405+1In, bulk	19.12.2008...	19.12.2008 ...	10.65
270.89	SnCu bulk	19.12.2008...	19.12.2008 ...	9.62
417.13	Eutectic SnPb, 3-15µm /PCB	19.12.2008...	19.12.2008 ...	0.93
423.18	Immersion Ag finish /PCB	19.12.2008...	19.12.2008 ...	10.82
5546.77	pure Sn, 3-12 µm/ FeCoNi	19.12.2008...	19.12.2008 ...	78.46
6284.77	SnPb 7-13Pb bulk	19.12.2008...	19.12.2008 ...	83.25
6315.71	SnPb 2-4 Pb bulk	19.12.2008...	19.12.2008 ...	83.44
6326.55	SnPb0.5 - 1.5 , bulk	19.12.2008...	19.12.2008 ...	83.49
6360.58	SnBi 7-40 bulk	19.12.2008...	19.12.2008 ...	83.73
6402.14	SnPb eutectic bulk	19.12.2008...	19.12.2008 ...	83.82
6613.88	SnBi 1-4 bulk	19.12.2008...	19.12.2008 ...	85.29
7861.78	SnPb3, 3-12 µm/ FeCoNi	19.12.2008...	19.12.2008 ...	92.66
10811.53	SnBi1-4, 3-12 µm/ FeCoNi	19.12.2008...	19.12.2008 ...	107.97
13825.53	Eutectic SnPb, 3-12 µm/ F	19.12.2008	19.12.2008	121.55

XRF Sample Spectra



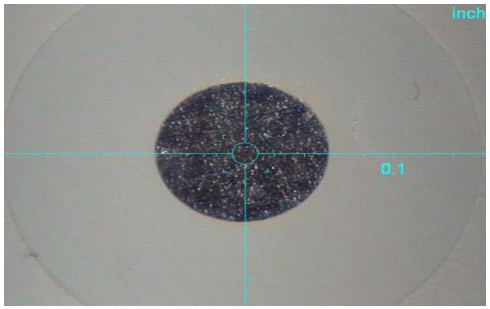
Solder Class Identification





Analysis Results

Fischerscope® XRAY XDAL
Product: 9 / SnPb/Cu/PCB Dir.: SnPb 3CAL Block: 1
Application: 94 / SnPb/Cu/PCB

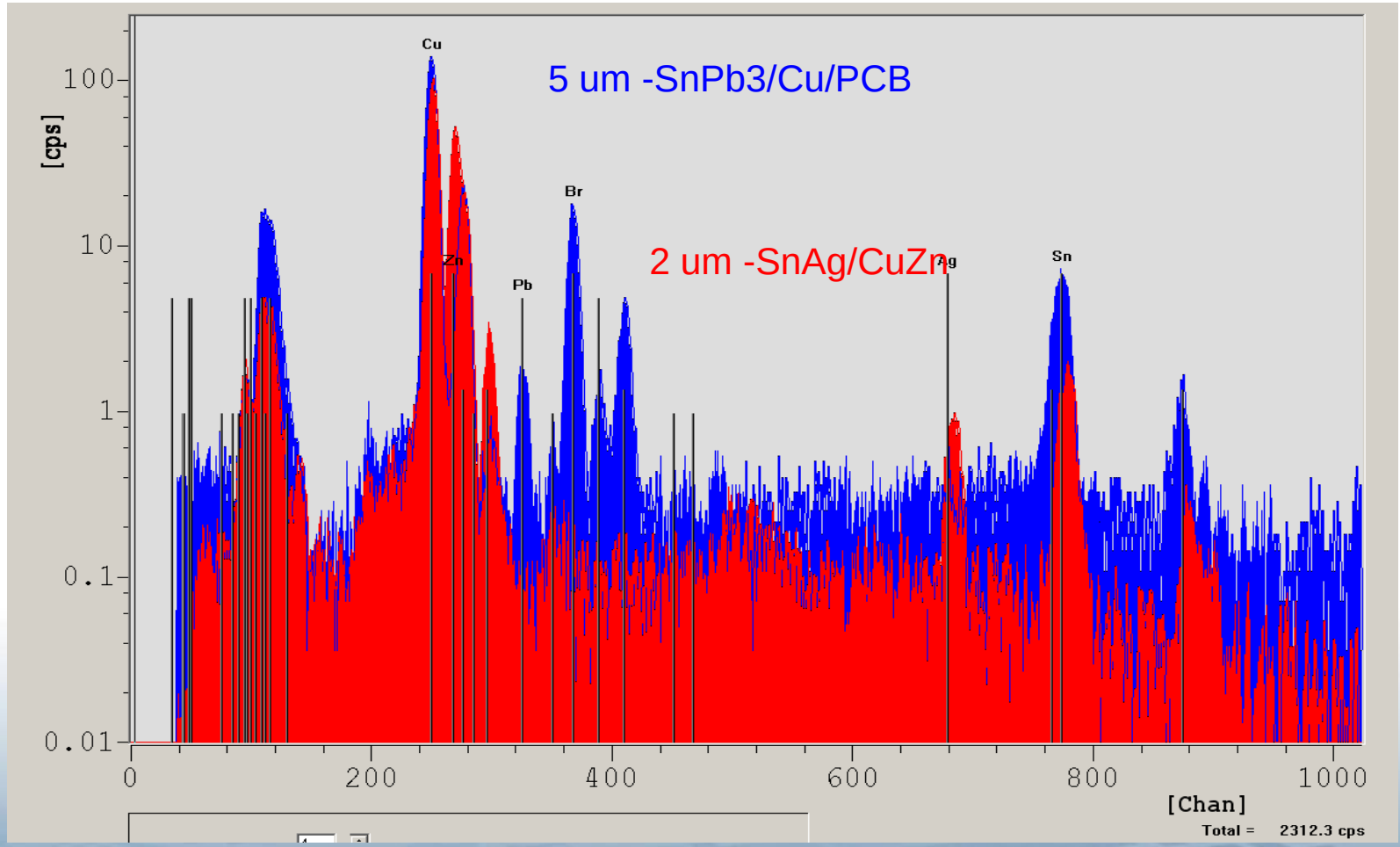


n	SnPb1[µm]	Sn 1[%]	Pb 1[%]	Cu 3[µm]
1	5.080	96.54	3.460	24.60

Mean	5.080 µm	96.54 %	3.460 %	24.60 µm
Number of readings	1	1	1	1
Min. reading	5.080 µm	96.54 %	3.460 %	24.60 µm
Max. reading	5.080 µm	96.54 %	3.460 %	24.60 µm
Measuring time	10 sec			

Operator:
Date: 1/6/2009 Time: 1:28:31 PM

XRF Sample Spectra



Conclusion

- Huge concern in high reliability industry - looking for a solution
- XRF Material Class Identification provides answers
  - No measured sample library required
  - Applicable for any material class identification
  - Solder Family Identification
  - Solder Alloy Analysis within Solder Family
  - Non-destructive
  - No sample preparation
  - Quick analysis (30-60 s)
  - Small spot size capability
- XRF software requires multi layered sample measurement capabilities