Application Brief

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Sn-Bi Measurement

1. Overview

Regarding Sn-Bi measurement, some technical instructions have already been shown in the application brief No.17 and 18. This application brief introduces the comparisons of the measurement accuracy by our existing instruments, the latest SFT9300, the standard SFT3000 and the highest resolution SEA5000.

2. Measuring conditions

The measuring conditions are shown in the table below.

	SFT9300	SFT3000S	SEA5000
Collimator Size	Φ0.1mm	Φ0.1mm	Φ0.1mm
Primary Filter	OFF	ON	OFF
Numerical Filter	ON	ON	OFF
X-ray Tube Voltage（kV）	50	45	50
X-ray Tube Current（μA）	1500	1000	1000
Preset Measuring Time（sec）	60	60	60
Calculation	Thin Film Fundamental Parameter Method		
Reference Material	Sn-Bi：7.8μm、Bi：2.8%		

3. Experiments

The following 16 kinds of samples were measured 20 times for each sample.

	Sn-Bi（μm）	Bi%	Base
#1	5	0.7	Cu
#2	5	1.4	Cu
#3	5	2.5	Cu
#4	5	4.0	Cu
#5	10	0.7	Cu
#6	10	1.4	Cu
#7	10	2.5	Cu
#8	10	4.0	Cu
#9	5	0.7	Alloy 42
#10	5	1.4	Alloy 42
#11	5	2.5	Alloy 42
#12	5	4.0	Alloy 42
#13	10	0.7	Alloy 42
#14	10	1.4	Alloy 42
#15	10	2.5	Alloy 42
#16	10	4.0	Alloy 42

4. Results and discussion

The measuring results are shown in the table below.

	SFT9300								SFT3000								SFT5000							
	Sn-Bi(μm)				Bi%				Sn-Bi(μm)				Bi%				Sn-Bi(μm)				Bi%			
	A	R	S	CV	A	R	S	CV	A	R	S	CV	A	R	S	CV	A	R	S	CV	A	R	S	CV
#1	6.50	0.40	0.09	1.40	0.74	0.37	0.08	**11.49**	6.40	0.57	0.11	1.66	0.83	1.52	0.28	34.12	6.81	0.36	0.09	**1.20**	0.57	0.27	0.08	13.70
#2	6.46	0.60	0.16	2.42	1.16	0.48	0.13	10.88	6.33	0.78	0.13	1.98	1.20	1.23	0.27	22.30	6.55	0.48	0.14	**1.81**	1.04	0.24	0.07	**6.28**
#3	6.42	0.40	0.11	1.68	2.15	0.44	0.10	**4.82**	6.26	0.46	0.10	**1.64**	2.21	2.13	0.35	15.99	6.48	0.60	0.16	2.18	1.84	0.53	0.13	6.99
#4	5.95	0.37	0.09	**1.43**	4.32	0.76	0.17	**4.03**	5.78	0.65	0.13	2.33	4.06	1.86	0.40	9.81	5.78	0.52	0.13	1.88	3.59	0.57	0.15	4.27
#5	11.74	0.50	0.13	**1.14**	0.65	0.24	0.05	**8.47**	11.90	0.79	0.15	1.25	0.65	0.73	0.16	24.13	11.86	0.67	0.20	1.53	0.58	0.24	0.07	11.39
#6	10.00	0.40	0.11	**1.06**	1.35	0.47	0.12	**8.64**	9.74	0.82	0.16	1.68	1.39	0.91	0.20	14.45	9.57	0.59	0.13	1.26	1.05	0.32	0.11	10.48
#7	10.00	0.36	0.10	**0.98**	2.30	0.51	0.12	5.20	10.05	0.88	0.15	1.51	2.32	1.50	0.29	12.32	9.68	0.63	0.18	1.65	1.97	0.39	0.09	**4.37**
#8	10.92	0.49	0.13	**1.19**	3.99	0.47	0.13	**3.20**	10.91	0.81	0.14	1.30	4.16	2.04	0.37	8.93	10.52	0.68	0.21	1.83	3.65	0.42	0.13	3.51
#9	5.60	0.14	0.03	**0.51**	0.93	0.76	0.13	**14.37**	5.27	0.24	0.04	0.77	0.95	1.59	0.29	31.08	5.47	0.14	0.04	0.60	0.75	0.49	0.13	17.39
#10	5.70	0.14	0.03	**0.52**	1.39	0.70	0.12	9.00	5.46	0.21	0.05	0.86	1.48	1.46	0.31	20.92	5.46	0.12	0.03	0.53	1.25	0.35	0.10	**8.14**
#11	6.83	0.14	0.02	**0.34**	2.44	0.46	0.10	**3.96**	6.52	0.28	0.05	0.73	2.68	1.24	0.29	11.00	6.54	0.15	0.04	0.58	2.08	0.48	0.13	6.22
#12	6.49	0.14	0.03	**0.44**	4.60	0.74	0.15	**3.17**	6.16	0.23	0.04	0.70	4.82	2.77	0.47	9.69	6.01	0.12	0.04	0.57	4.01	0.51	0.15	3.65
#13	10.94	0.13	0.03	**0.26**	0.85	0.46	0.08	**9.45**	10.40	0.29	0.05	0.52	0.97	0.98	0.16	16.97	10.11	0.23	0.06	0.53	0.75	0.32	0.10	12.91
#14	11.89	0.22	0.05	0.39	1.23	0.32	0.06	**4.49**	11.33	0.40	0.07	0.65	1.35	0.93	0.14	10.18	11.31	0.15	0.04	**0.34**	1.12	0.32	0.08	7.15
#15	11.68	0.16	0.04	**0.32**	2.16	0.51	0.09	**4.00**	11.13	0.33	0.06	0.53	2.29	1.07	0.19	8.40	11.21	0.27	0.08	0.63	1.90	0.41	0.10	5.42
#16	9.35	0.15	0.03	**0.30**	4.73	0.55	0.11	**2.39**	8.89	0.22	0.04	0.45	4.97	1.14	0.26	5.33	9.02	0.17	0.05	0.48	4.18	0.44	0.13	3.03

Where, A, R, S, CV is average of 20 times measurement, range, standard deviation, CV (= S ÷ A) % respectively

In this table, the bold type font shows the lowest CV for each horizontal line in thickness and Bi% respectively. Regarding the trueness, the results of SE5000 is most reliable because of its higher resolution. The results of SFT9300 and SFT3000 would also be reliable because these results match with that of SEA5120. Regarding the repeatability, SFT9300 gave its ability. In almost all measurements, SFT9300 showed the lowest CV. It's due to SFT9300's higher power X-ray generator and the higher count rate. On the other hand, SEA5000 also gave the notable CV that is almost equal with SFT9300. It shows that SEA5000 also be able to be used in the process control section.