Technical Report

XRF No. 84 X-ray Fluorescence Analysis

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Thickness Measurement of Au/Pd/Ni Multilayer plating using FT150

2015. 2

Triple-layer Au/Pd/Ni plating are commonly used in lead frames and printed circuit boards. The Au and Pd plating have thicknesses of up to a few tens of nanometers, which must be accurately measured and controlled.

In order to detect X-ray fluorescence emitted from a thin film with a better-sensitivity, an x-ray collecting optical system and a semiconductor detector are necessary. We developed the FT9500/FT9500X series to meet this demand. However, the FT150 series equipped with a new x-ray collecting optical system and an improved Vortex detector makes even higher-accuracy measurements possible.

We evaluated the performance of the FT150 using a sample with a Au/Pd/Ni multilayer on a Cu sheet, and compared the results with those for the FT9500X.

FT150 Series

Measurement of Au/Pd/Ni Layer Thicknesses

Measurement conditions and standard materials

Table 1 Measurement conditions

	Measurement condition 1	Measurement condition 2
Instrument	FT150	
Tube voltage	45 kV	45kV
Beam diameter*	30 μm ϕ	
Primary filter	No	Al500
Measurement time	50 s	50 s
Measurement method	Thin Film FP	
Analysis line	Pd Lα Ni Kα Cu Kα	Au Lα

Note: Defined as the diameter that encloses 90% of primary X-rays with an energy equivalent to Mo Kα.

The reference sample consisted of Hitachi High-Tech Science Corporation Au (0.049 μm), Pd (0.038 μm) and Ni (1.07 μm) standard films stacked on a Cu substrate.

Samples

The following samples were evaluated:

1. Hitachi High-Tech Science Corporation standard Au (0.013 μm)/Pd (0.012 μm)/Ni (0.5 μm equivalent: 0.496 or 0.469 μm) stacked on a Cu substrate.

2. Au/Pd/Ni/Cu lead frame used in Technical Report XRF No. 43

Due to the new x-ray collecting optical system with the improved Vortex detector, more intense XRF peaks were obtained with the FT150 than with the FT9500X.

Compared with the FT9500X, the FT150 achieved better repeatability, enabling highly efficient measurement with high accuracy.

Spectra comparison

The same position on the same sample was measured using the FT150 and the FT9500X and the spectra were compared. More intense Au and Pd XRF peaks were obtained with the FT150, indicating that it is capable of measuring a sample with higher accuracy.

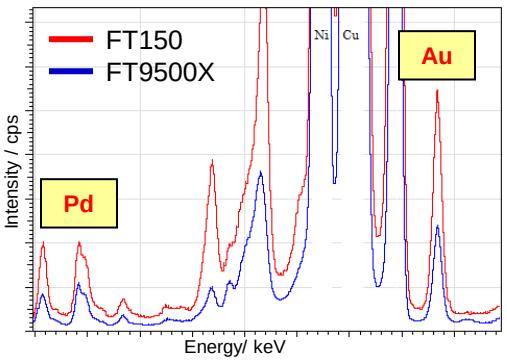

Figure 1 Comparison of spectra obtained from the same sample

Thickness measurement results *

Repeat measurements were performed and the results for Au, Pd, and Ni were compared for the FT150 and FT9500X.

Table 2 Results for standard films (repeated 30 times)

	FT9500X			FT150		
	Average	Standard deviation	RSD%	Average	Standard deviation	RSD%
Au (μm)	0.0129	0.00040	**3.1%**	0.0131	0.00016	**1.3%**
Pd (μm)	0.0118	0.00031	**2.6%**	0.0111	0.00019	**1.7%**
Ni (μm)	0.4940	0.00116	**0.2%**	0.4676	0.00047	**0.1%**

Table 3 Results for lead frame (repeated 10 times)

	FT9500X			FT150		
	Average	Standard deviation	RSD%	Average	Standard deviation	RSD%
Au (μm)	0.0061	0.00018	**2.9%**	0.0062	0.00010	**1.5%**
Pd (μm)	0.0176	0.00058	**3.3%**	0.0180	0.00034	**1.9%**
Ni (μm)	0.9042	0.00164	**0.2%**	0.9045	0.00078	**0.1%**

* These are example measurements and do not guarantee the performance of the instrument.