

# FT160

## Analysis of Gold Coatings

### INTRODUCTION

Gold plating is used in applications where high conductivity is required and corrosion resistance is critical. Gold offers good electrical conductivity, but its relative softness and low melting temperature may be the limiting factors. Gold is one of the precious metals that have excellent solder-ability, weld-ability and infrared reflectivity. Most commonly, gold is plated in the range from 0.05 to 8.0 microns. Gold is primarily used in the electrical industry for connectors and printed circuits, and in the electronics industry for transistor integrated circuits. The use of gold in these industries is attributed to the fact that it is the only metal that will meet the stringent performance and property requirements. The excellent physical and chemical resistant properties offset the high price of gold. Gold is also commonly flashed over brass jewelry or other metal to achieve the desired appeal, color, and to prevent tarnishing.

To guarantee the good functionality of the plated components, platers need to ensure a consistent gold thickness. The FT160 offers rapid and accurate, nondestructive analysis of gold coatings with high degree of confidence, with minimal or no sample preparation needed. The system is extremely easy to operate by non-technical staff. Its robust and rugged design is well suited for the most challenging industrial conditions.

Hitachi High-Tech Analytical Science's family of bench-top EDXRF analyzers have been employed in the field for more than 45 years and have served as the cost-effective solution for gold coating thickness measurements.

### INSTRUMENTAL

#### FT160

The Hitachi High-Tech Analytical Science **FT160** is a high performance, compact, rugged and reliable quality-control analyzer for simple, rapid, coating thickness measurement and composition analysis. Measurements can be made according to international test methods, ISO 3497 and ASTM B568. The **FT160** uses the latest generation silicon drift detector (SDD) combined with polycapillary technology to provide the ultimate resolution and sensitivity for small measurement areas.

The **FT160** uses the non-destructive analytical technique of energy dispersive X-ray fluorescence (EDXRF) to generate an X-ray spectrum of the sample. This

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elemental X-ray spectrum is processed using the supplied Fundamental Parameters (FP) or empirical software to produce coating thickness or composition values.

The **FT160** includes as standard features that make it an ideal fit for coatings analysis. The large, sample chamber options can fit a wide range of parts. The motorized sample stage makes it easy to automatically measure multiple samples or multiple features on a single sample or perform scans to get a representative analysis on uneven surfaces. The 30 µm beam diameter ensures the best analysis performance of ultra-thin films, lead frame micro-connectors and printed circuit boards.

### Intuitive XRF Controller software maximizes user productivity to ensure consistent process and product quality

All instrument functions are driven by Hitachi High-Tech Analytical Science's **XRF Controller** software program which is a highly intuitive, Microsoft Windows 10 compatible analytical and user interface package. Minimum staff training is required, and the simple user-interface enables users at all levels to generate reliable data.

- | View the sample and measurement location with clarity
- | Configure results for rapid evaluation
- | Automatically export results to a spreadsheet program
- | Create automatic programs to measure multiple features or samples
- | Options include software for materials and solution analysis.

## PERFORMANCE AND RESULTS

Typical performance for common, representative applications is shown in the tables below. The precision was calculated from 30 repeat measurements. Precision is influenced by measurement time, beam size, elements present and thickness range. In some cases, the error can be reduced by optimizing the calibration range for specific applications.

**Table 1:** Typical Applications

Top Layer	Second Layer	Third Layer	Substrate
Au			Cu, Co
Au	Ni, NiP		Cu, Brass, Bronze, CuNi, Si wafer
Au	Pd		Cu, Brass, Bronze, CuNi, Si wafer
Au	Pd	Ni	Cu, Brass, Bronze, CuNi, Si wafer

**Table 2:** Typical performance for a dual-layer application, Au/Ni/Si using a Mo-target X-ray tube and polycapillary optic with a beam diameter of 30 µm

Analyte	Tested Range	Standard Error	Precision (2σ)
Au	0.02 - 0.1 µm (0.79 - 3.9 µin)	0.025 µm (1 µin) or 5 % relative, whichever is greater	0.002 µm @ 0.05 µm (0.06 µin @ 2.0 µin)
Ni	0.43 - 4.3 µm (16.9 - 172 µin)	10% relative	0.006 µm @ 2.0 µm (0.24 µin @ 79 µin)

**Table 3:** Typical performance for a triple-layer application, Au/Pd/Ni/Si using a Mo-target X-ray tube and polycapillary optic with a beam diameter of 30 µm

Analyte	Tested Range	Standard Error	Precision (2σ)
Au	0.01 - 0.53 µm (0.40 - 21 µin)	0.025 µm (1 µin) or 5 % relative, whichever is greater	0.001 µm @ 0.05 µm (0.04 µin @ 2.0 µin)
Pd	0.02 - 0.50 µm (0.82 - 20 µin)	10% relative	0.002 µm @ 0.05 µm (0.09 µin @ 2.0 µin)
Ni	0.9 - 10 µm (35 - 404 µin)	~15% relative	0.005 µm @ 1.1 µm (0.21 µin @ 42 µin)

**Table 4:** Typical performance for a triple-layer application, Au/PdNi/Ni/CuNi using a Mo-target X-ray tube and polycapillary optic with a beam diameter of 30  $\mu\text{m}$

Analyte	Tested Range	Standard Error	Precision ( $2\sigma$ )
Au	0.05 - 0.2 $\mu\text{m}$ (1.97 - 7.9 $\mu\text{in}$ )	0.025 $\mu\text{m}$ (1 $\mu\text{in}$ ) or 5 % relative, whichever is greater	0.001 $\mu\text{m}$ @ 0.11 $\mu\text{m}$ (0.05 $\mu\text{in}$ @ 4.4 $\mu\text{in}$ )
PdNi	0.8 - 2 $\mu\text{m}$ (31 - 79 $\mu\text{in}$ )	10% relative	0.024 $\mu\text{m}$ @ 1.0 $\mu\text{m}$ (0.95 $\mu\text{in}$ @ 41 $\mu\text{in}$ )
Ni	0.8 - 2 $\mu\text{m}$ (31 - 79 $\mu\text{in}$ )	~15% relative	0.007 $\mu\text{m}$ @ 1.0 $\mu\text{m}$ (0.27 $\mu\text{in}$ @ 38 $\mu\text{in}$ )

## SUMMARY

The **FT160** reliably offers precise analysis of gold coatings. Using Hitachi High-Tech Analytical Science's traceable calibration standards, routine production samples can be simply and quickly measured by any level of operator. Results appear in seconds, allowing near-instantaneous optimization of the production process.

Over 1,000 applications have been optimized for Hitachi High-Tech Analytical Science's coatings analyzers. For information about additional applications please contact our experts at

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