APPLICATION NOTE – 011

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X-STRATA920 AN-SDD011

Analysis of chrome coatings

INTRODUCTION

Hard chromium plating is produced by electro-deposition from a solution containing chromic acid and a catalytic anion in proper proportion. The metal produced is extremely hard and corrosion resistant. The process is used for rebuilding mismachined or worn parts, for automotive valve stems, piston rings, shock rods, struts, the bores of diesel and aircraft cylinders, and for hydraulic shafts.

Hard chromium plating is also known as industrial, functional, or engineering chromium plating. Hard chromium normally is deposited to thickness ranging from 2.5 to 500 µm and for certain applications to considerably thicker. The major uses of hard chromium plating are wear-resistance applications, improvement of tool performance, service life, and parts salvage.

Decorative chromium plating differs from hard chromium plating in thickness and the type of undercoating used. Decorative chromium coatings are very thin, usually not exceeding an average thickness of 1.25 µm. Decorative chromium is applied over undercoatings, such as nickel or copper and nickel, which impart a bright, semibright, or satin cosmetic appearance to the chromium. The choice of undercoatings, as well as the type of chromium applied, can also provide corrosion protection. Currently, most decorative chromium coatings are applied from hexavalent and trivalent chromium processes.

To guarantee the good functionality of the plated components, platers need to ensure a consistent chromium thickness. The X-Strata920 offers rapid and accurate, non-destructive analysis of chrome 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's family of bench-top EDXRF analysers have been employed in the field for over forty years and have served as the choice solution for chrome coating thickness measurements.

X-STRATA920

Hitachi's X-Strata920 fitted with a high-resolution silicon drift detector (SDD) is a high performance, compact, rugged and reliable quality control analyser for simple, rapid coating thickness and composition analysis. Measurements can be made according to international test methods ISO 3497 and ASTM B568.

The X-Strata920 uses the non-destructive analytical technique of energy dispersive X-ray fluorescence (EDXRF) to generate an X-ray spectrum of the sample. This elemental X-ray spectrum is processed using the supplied Fundamental Parameters (FP) or empirical software to produce coating thickness or composition values. The X-Strata920 comes in a range of chamber and base configurations to accommodate samples of different shapes and sizes.

All chamber configurations are slotted for quick loading of flat or thin samples such as circuit boards and wire. A laser focus ensures reproducible sample placement to get consistent results from any operator. The optional motorised 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. Collimators are user-selectable to ensure the best fit and performance on parts of all sizes.

INTUITIVE SMARTLINK SOFTWARE MAXIMIZES USER PRODUCTIVITY TO ENSURE CONSISTENT PROCESS AND PRODUCT QUALITY

All instrument functions are driven by Hitachi's SmartLink 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 to display high/low indicators for rapid evaluation.
- Export results to a spreadsheet program.
- Create automatic programs to measure multiple features or samples.
- Add versatility to the instrument by selecting materials and solution analysis software options.

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, collimator size, elements present and thickness range. In some cases the error can be reduced by optimizing the calibration range for specific applications.

Typical applications

Top Layer	Second Layer	Third Layer	Substrate
Cr			Fe
Cr	Ni		Fe, Stainless Steel, Cu
Cr	Ni	Cu	Plastics, Zn

Typical performance for a single-layer application, Cr/Fe using a circular collimator with a diameter of 0.3 mm (12 mil)

Analyte	Tested range	Standard error	Precision (2σ)
Cr	0.11-4.42 µm (4.5-177 µin)	0.025 µm (1 µin) or 5% relative whichever is greater	0.01 µm @ 1.9 µm (0.54 uin @ 75 µin)

Typical performance for a dual-layer application, Cr/Ni/Fe using a circular collimator with a diameter of 0.3 mm (12 mil)

Analyte	Tested range	Standard error	Precision (2σ)
Cr	0.11-2.03 µm (4-81 µin)	0.025 µm (1 µin) or 5% relative whichever is greater	0.01 µm @ 0.5 µm (0.47 µin @ 18 µin)
Ni	0.58-10 µm (23-404 µin)	10% relative	0.004 µm @ 0.6 µm (0.17 µin @ 23 µin)

Typical performance for a triple-layer application, Cr/Ni/Cu/Zn using a circular collimator with a diameter of 0.3 mm (12 mil)

Analyte	Tested range	Standard error	Precision (2σ)
Cr	0.25-1.9 µm (9.9-75 µin)	0.025 µm (1 µin) or 5% relative whichever is greater	0.01 µm @ 1.9 µm (0.41 µin @ 75 µin)
Ni	2.4-10 µm (98-404 µin)	10% relative	0.02 µm @ 2.5 µm (0.79 µin @ 98 µin)
Cu	2.0-14 µm (80-575 µin)	~15% relative	0.34 µm @ 14.4 µm (13.5 µin @ 575 µin)

SUMMARY

The X-Strata920 reliably offers precise analysis of chrome coatings. Using Hitachi'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 optimisation of the production process.

Over 1,000 applications have been optimized for Hitachi's coatings analysers. For information about additional applications please contact our experts at contact@hitachi-hightech-as.com.

When a single micron can make the difference, depend on Hitachi's coatings analysers

Visit **www.hitachi-hightech.com/hha** for more information.

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