DeLooperAnalytical B.V.
industrial analysis instruments & services

Application note #1: Analysing (anodized) layers on aluminium substrates

Background

Anodizing layers on aluminium, is a surface treatment to give the aluminium substrate an oxidised layer. The electrolytic process gives the aluminium a layer which is improves its hardness, wear and corrosion resistance.

To ensure that the thickness of the layer applied is sufficient to give parts and components the desired properties, companies need to control their process and the final products.

Instrumentation

The requirement for a rapid, simple analysis (carried out by non-laboratory staff) on site makes field-portable energy-dispersive X-ray fluorescence (EDXRF) spectrometry the ideal analytical technique for process control. XRF is a widely used analytical technique for the determination of layer thickness. It provides reliable and rapid analysis (results are available in seconds).

Sample preparation and measurements

There is no sample preparation required. The user simply places the nose of the analyser on the part to be measured, and presses the trigger to start the analysis. Initial results are displayed on the analyser's large (4.3") integrated touchscreen within seconds. A typical analysis time for a layer thickness measurement is 30-60 seconds.

Sorting aluminium with the X-MET

The most common aluminium alloys and their specifications used in the industry are listed in the table below.

Grade	Mg, %	Si, %	Cr, %	Mn, %	Fe, %	Cu, %	Zn, %
2014	0.2 – 0.8	0.5 – 1.2	< 0.1	0.4 – 1.2	< 0.7	3.9 – 5.0	< 0.25
2024	1.2 – 1.8	< 0.5	< 0.1	0.3 – 0.9	< 0.5	3.8 – 4.9	< 0.25
3003	-	< 0.6	-	1.0 – 1.5	< 0.7	0.05 – 0.2	< 0.1
3004	0.8 – 1.3	< 0.3	-	1.0 – 1.5	< 0.8	< 0.25	< 0.25
5052	2.2 – 2.8	< 0.25	0.15 – 0.35	< 0.1	< 0.4	< 0.1	< 0.1
5083	4.0 – 4.9	< 0.4	0.05 – 0.25	0.4 – 1.0	< 0.4	< 0.1	< 0.25
5086	3.5 – 4.5	< 0.4	0.05 – 0.25	0.2 – 0.7	< 0.5	< 0.1	< 0.25
6061	0.8 – 1.2	0.4 – 0.8	0.04 – 0.25	< 0.15	< 0.15	0.15 – 0.4	< 0.25
6063	0.45 – 0.9	0.2 – 0.6	< 0.1	< 0.1	< 0.35	< 0.1	< 0.1
7075	2.1 – 2.9	< 0.4	0.18 – 0.28	< 0.3	< 0.5	1.2 – 2.0	5.1 – 6.1

The separation of 2014 and 2024, which differ only in Mg and Si content, can be done by using a longer sample time of 60 seconds.

The same for separating 3003 and 3004. For identification of 5000 series alloys, based on Mg content, 30 seconds is needed. Conclusion: by the variation of sample time, all aluminium alloys can be sorted. Imported is that the surface of the samples are flat and clean.

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Empirical Calibration (EP)

For analysing layers on metal alloys or analysing a metal alloy substrate under the layer, an empirical calibration is needed. This type of calibration gives the best accuracy and can be developed by using standards provided by a customer. Each standard has to be measured for sixty seconds three times, rotating the samples between measurements. A ratio-to-scatter correction is applied to compensate for background variation (the aluminium substrate).

Instrument precision

In order to calculate the precision for the determination of layer on an aluminium alloy, one standard has to be measured ten times in the exact same location. This test has to carried out using 10 seconds measurement time, then again using 20 seconds.

EP calibration for layers on aluminium substrates

A similar EP calibration have already been done for Cr on an aluminium substrate. The procedure for the EP calibration for anodizing layers on aluminium is equal to the Cr layers on an aluminium substrate.

Summary

Once calibrated, Hitachi High-Tech Analytical Science Instruments' X-MET8000 provides accurate and repeatable layer thickness analysis for a wide variety of applications.

The X-MET's ease of use and ruggedness make it an ideal tool on the shop floor for the incoming inspection of parts or components, as well as for process and quality control.

The versatility of the calibration software also enables the analysis of plating solutions (single and multi-elements), ensuring the rapid monitoring of the plating baths composition. With results being available on the X-MET's large integrated screen in seconds, decisions to accept/reject a part or modify the plating process can be made on the spot, maximising productivity and savings costs.

Contact

For more information, please contact

E: support@delooperanalytical.com

T: +31 (0) 13 505 42 16

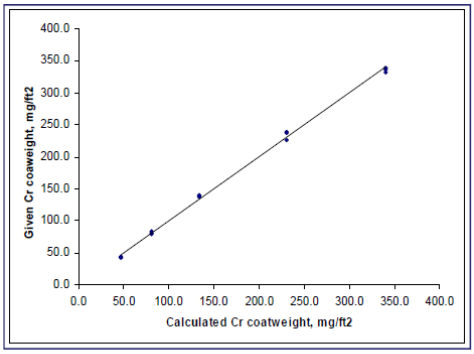

Figure 1: Calibration graph for Cr coatweight on aluminium

Calibration performance for Cr on aluminium substrates

Calibration name	Coatweight range (mg/ft^2)	Standard error of calibration (mg/ft^2)
Cr on Al	46 - 340	5

Hitachi High-Tech