Quality control in the aluminium packaging industry with RF-GDOES
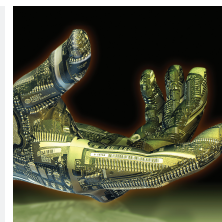
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Abstract: The quality control of materials used in the aluminium packaging industry can benefit from the fast erosion rate of pulsed RF Glow Discharge Optical Emission Spectrometry (RF-GDOES). This technique can be used to efficiently and rapidly compare batches of materials coming from different suppliers, allowing the fast detection of detrimental features for the manufacturing process.

Key words
Aluminium, Conversion layers, Depth Profile Analysis, GD OES, Pulsed RF source

Introduction

Aluminium can be considered the most versatile packaging material in the world. With its ability to form any shape, its protective qualities and its capacity to be fully recycled and reused an infinite number of times, aluminium's use in the packaging industry has become more and more interesting. Despite being more expensive to produce than a glass bottle, aluminium cans are lighter and don't break, making the use of this material in production significantly cheaper.

Even when reduced to thin foils, aluminium's unique strength and physical properties offer excellent protection against the effects of oxygen, light, moisture, micro-organisms and unwanted odors. However, for each application, specific surface finishing treatments have been developed, allowing improved corrosion resistance in various environments and the promotion of durable adhesive bonds with polymer films, lacquers and paints. For this reasons RF-GDOES, with its fast erosion rate, can be considered as an efficient technique for the assessment of plants problem solving.

Instrumentation and sample preparation

The GD Profiler 2 (Figure 1) couples an advanced Pulsed RF-GD source to a high resolution, wide spectral range Optical Emission Spectrometer. The precise and fast sputtering of a representative area of the investigated sample (usually a crater of 4 mm in diameter) is assured using an RF-pulsed source, which allows also the reduction of the thermal load on the sample, and a higher depth resolution, which is critical for the identification of the surface treatments. All elements of interest are simultaneously measured, as a function of the sputtering time, using a spectrometer.

Figure 1: GD Profiler 2

In the packaging industry, Al foils usually undergo a 3 steps process: i) rolled Al, ii) conversion coatings and iii) lacquering. In this application note four samples of rolled Al, with conversion coatings are studied. We show how RF-GD-OES can be used to discriminate between good and bad batches, namely concerning the last step of the process, when the lacquer is applied and adhesion problems are met. RF-GDOES is able to highlight the difference between the batches.

Such Al samples are relatively thin and therefore for a proper analysis with RF-GDOES it is necessary to cut them and glue them on a rigid substrate using a copper tape, as shown in Figure 2.
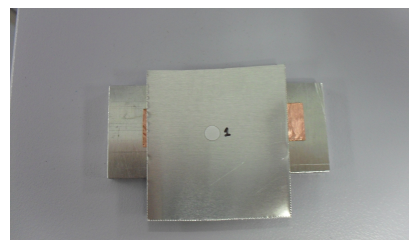

Figure 2: Al folder

Results

Thanks to the pulsed mode the phosphatation and chromatation layers on the surface of the aluminum sheets can be efficiently resolved (Figure 3). All useful information can be obtained in the first 30 seconds of the analysis, making this technique extremely interesting for such industries.
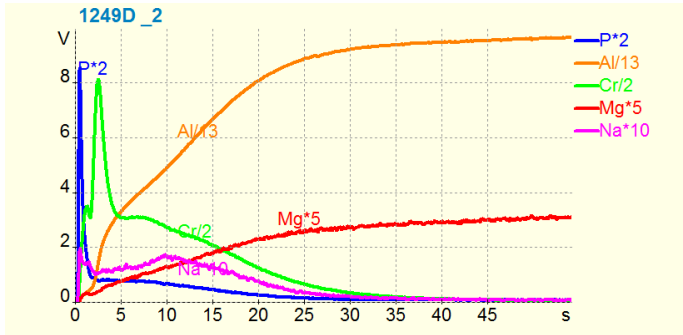

Figure 3: Aluminium sheet characterization

According to the packaging manufacturer, when performing adhesion tests for the lacquer application, a «good» batch (samples 1249 D and 1252F) and a «bad» batch (samples 837938 and 1346) can be identified. When studying the conversion coatings (Figure 4(a) and Figure 4(b)) no particular difference can be highlighted between the different samples. The P and Cr peaks show no specific trend that can be associated with the classification of «good» or «bad» batches, however the differences between suppliers can be identified.
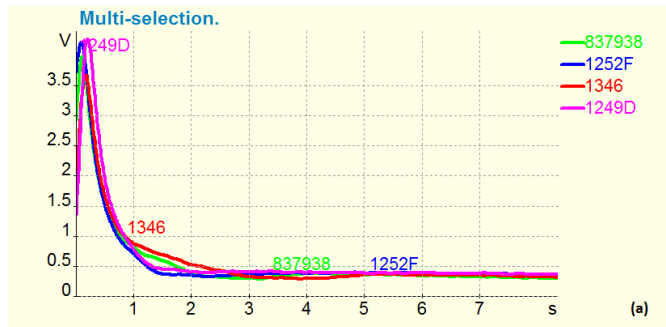

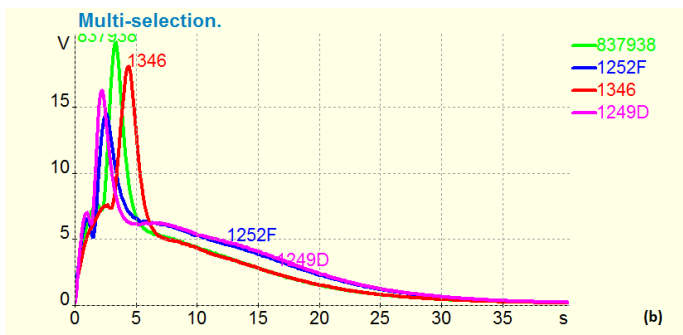*Figure 4a: P peaks for «good» and «bad» batches*

Figure 4b: Cr peaks for «good» and «bad» batches

On the other hand, when studying the Mg profile (Figure 5), a clear distinction between «good» and «bad» batches is highlighted.
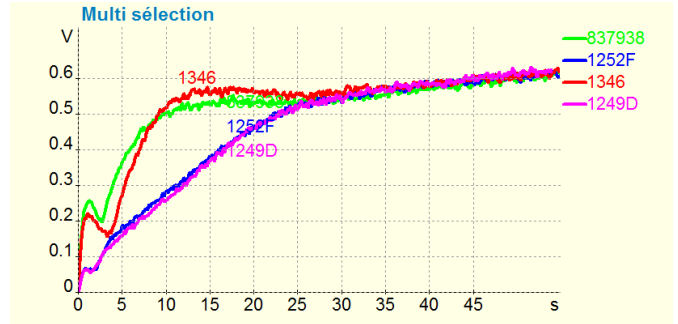

Figure 5: Mg peaks showing difference between «good» and «bad» sheets

Conclusion

The GD Profiler 2 can be a key instrument for the quality control in the packaging industry.

Thanks to its fast erosion rate, GDOES allows the efficient comparison of different samples and the easy detection of the problems during the manufacturing process, making this technique extremely useful as a quality control tool.

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