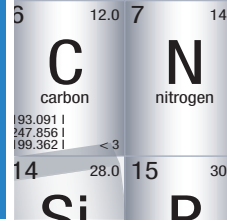


Follow up of carbonitriding process by RF GDOES



Application Note
Metallurgy
GD25

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Abstract

RF GDOES is suitable for fast and accurate measurements of carbonitrided samples allowing to follow C and N depth profiles.

Key words

Carbonitriding, thick layers, C & N

Introduction

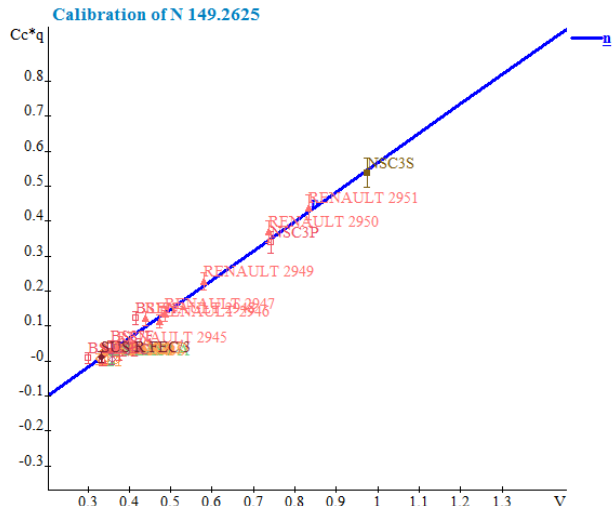
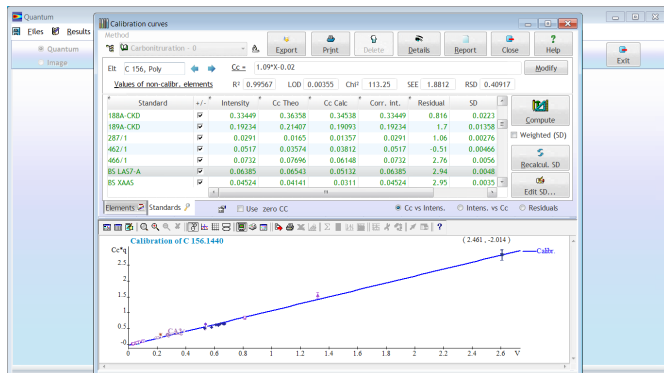
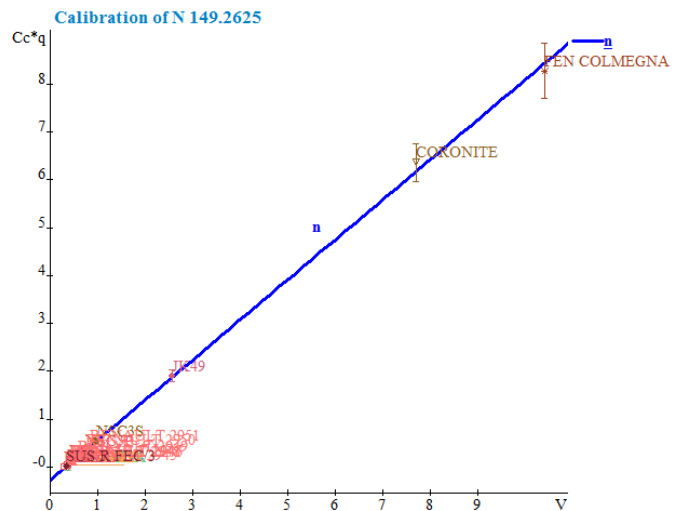
Carbonitriding is a metallurgical surface modification technique that is used to increase the surface hardness of a metal, thereby reducing wear. During the process, atoms of carbon and nitrogen diffuse interstitially into the metal increasing the hardness and modulus near the surface.

Calibration

GD is a comparative technique. Calibration curves are established for all elements of interest by running reference samples. Plasma cleaning can be applied during calibrations and analysis to minimize surface contaminations

Below is shown the calibration of Carbon. The Sputtering Rate mode is used allowing mixing within a single program, materials of different matrices.

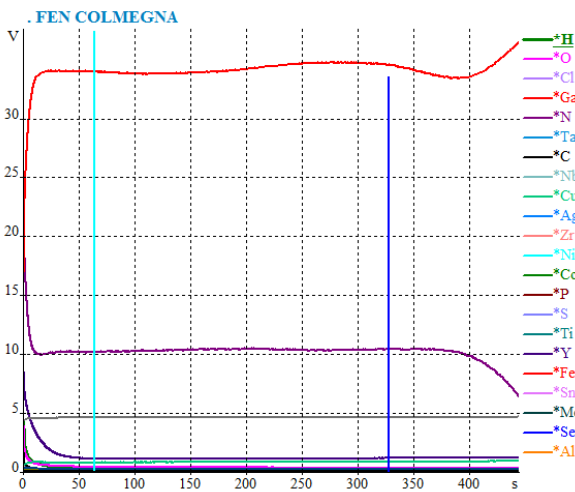
A similar calibration is done for N. The following graphs show the full calibration curve (we will further comment the high point value) and a zoom on the low concentrations indicating the sensitivity of the instrument in the UV/VUV range.



Comment on N calibration

Standard bulk CRMs, usually, have low contents in N (max is 1.49% for the most used JK49). However the samples to measure will contain layers with up to 10% or more in N. Though the calibrations in GD are quite linear, using some higher points in calibration is better for accuracy. This is possible as the HJY software allows to use coated samples as well as bulk ones within a single calibration curve. Here a FeN coating on steel is used and the principle is shown below.

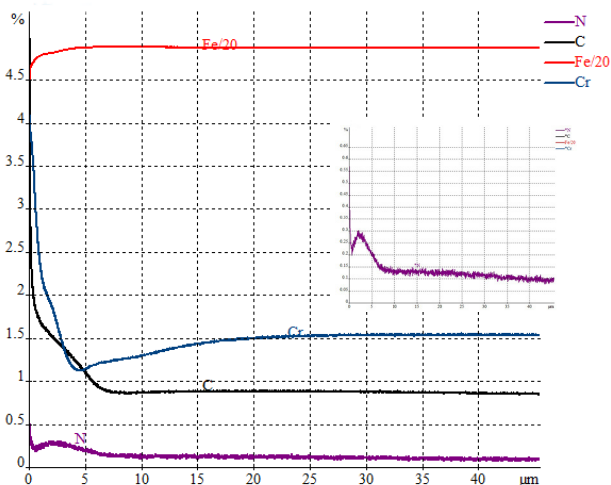
The entire depth profile is recorded and the zone of interest (plateau region of the FeN) is selected for N calibration.



Principle of use of a coated sample in a calibration

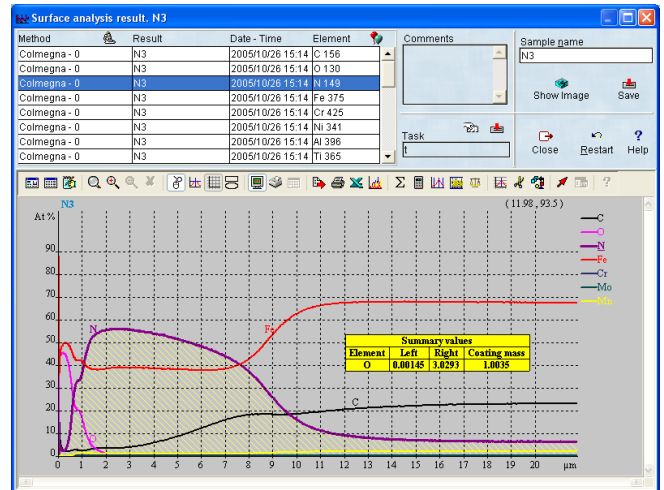
Example of measurement

A first example is shown here.



Depth profile of a carbonitrided sample with zoom on N

The second example below features a nitrided sample with post oxidation on the surface.



Several other results can also be found in the references below. One should finally note the recent presentation of Luc Pichon at the 7th GD day (Reims June 2014) on "Nitrogen incorporation in metallic alloys by plasma immersion surface treatments at moderate temperature". All the presentations of the GD days are available on request.

References :

- 1) "Microstructure and properties of the compound layer obtained by pulsed plasma nitriding in steel gears" by E.A. Ochoa, D. Wisnivesky, T. Minea, M. Ganciu, C. Olivero, P. Chapon, F. Alvarez. Surf. Coat. Technol. (2008), doi:10.1016/j.surfcoat.2008.11.025
- 2) M Lovonyak "GDOES for Knowledge Based Surface Design of Tool Steels", presentation at the 5th GD day
- 3) G. Mancuso "Heat Treatment Process Control with GD-OES", presentation at the 5th GD day.
- 4) "Study of the effects of E x B fields as mechanism to carbon-nitrogen plasma immersion ion implantation on stainless steel samples" E.J.D.M. Pillaca M. Ueda R.M. Oliveira L. Pichon, Applied Surface Science, doi:10.1016/j.apsusc.2014.04.003