



Introduction of “Semi-quantitative kit”

Naoki Higa, Akira Fujimoto

HORIBA Techno Service Co., Ltd, 2 Miyahogashi, Kisshoin, Minami-ku, Kyoto-shi, Kyoto, Japan

Motivation

Rf-GD-OES for quantitative analysis require calibration curves to be built. For that certified reference materials (CRM) ideally must have a composition similar to the measured samples. But to cover the larger dynamic range of calibration curves used for depth profiles, the number of CRMs should be high. And moreover, it's difficult to find or prepare adequate CRMs when samples have an unknown composition. Furthermore, it's also not

always simple to obtain accurate quantitative data from another surface analysis such as SIMS or XPS. In general, layers also feature unevenness and roughness from results of SEM or TEM, so quantification in surface analysis also has uncertainty. And it isn't easy to simply compare samples qualitatively so this “Semi” quantification answers many users needs..

What's “Semi-quantitative kit”?

“The normal “Semi-quantitative kit” is constructed from 18 pure metals and 10 alloys.

Around 40 elements (include metals such as Fe, Cu, Al, semi-conductive elements such as Si, and light elements such as C and O) are covered by this “Semi-quantitative kit” which will help for a wide span of GD applications.

The kit comes as a box with samples well identified and elements measured defined.



In pink main elements covered

Over view of the kit box

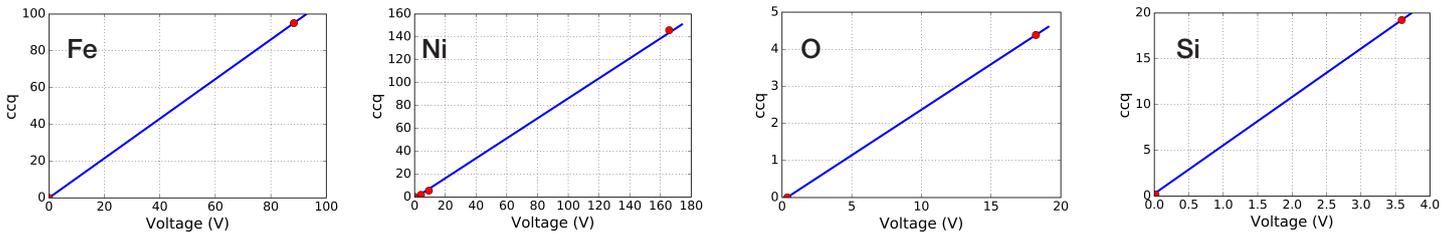
Materials of the kit

Calibration method

“Semi-quantitative kit” mainly consists of some pure material. Therefore, the calibration curves cover a large dynamic range by 2 points; Zero (or low concentration) point and High concentration (approximately 100wt%) point. Pure Si or Cu are often used as Zero point. This kind of large dynamic range is allowed by the use of HDD(High Dynamic Detection) system.. HDD prevents any saturation or lack of sensitivity thanks to automatic high voltage control.

In addition, some (few) elements have some middle points which are from alloys. Sputtering rates(SR) of all materials in the kit are already known. Therefore, it is not necessary to calculate these SRs. All materials in the kit have to be measured just one time to obtain calibration data.

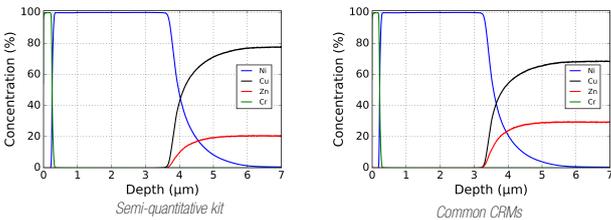
Calibration curves of Semi-quantitative kit



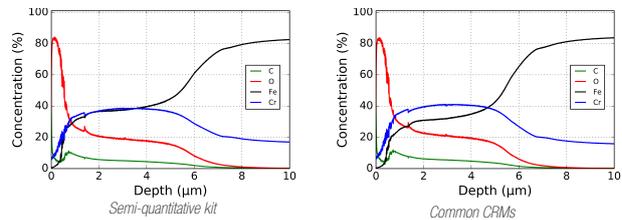
Comparison of results

Some test samples were measured and calculated with two different CDP methods. One calibrated with the “Semi-quantitative kit”, other one calibrated with common CRMs.

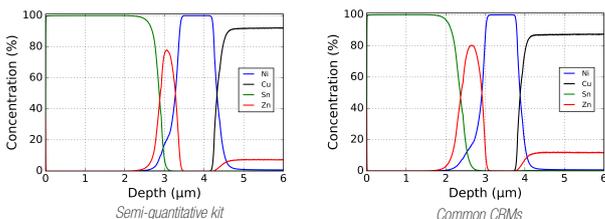
1. Depth profiles of chromium and nickel layers on brass



2. Depth profiles of oxidized chromium layer on steel



3. Depth profiles of tin, zinc and nickel layers on bronze



4. Bulk quantitative of low alloy steel

	Al	C	Cr	Cu	Fe	Mn	Mo	N	Ni	P	S	Si	Ti	V	Total
Certified [wt/%]	0.06	1.03	0.22	0.3	95.1	0.68	0.1	0	1.99	0.04	0.04	0.18	0.05	0.01	99.8
Measured [wt/%]	0	1.04	0.9	1.6	93	0.57	0	0	1.7	0.04	0.04	0.45	0.4	0	99.7
Error (%)	0.06	-0	-0.7	-1.3	2.08	0.11	0.1	0	0.29	0	-0	-0.3	-0.3	0.01	

Consideration

In general, results on thickness of layers are similar with the Semi-quantitative kit and the common CRMs. Of course here in both cases DIP is not used. The Composition ratio of substrate show small differences between the 2 methods.

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Conclusion

The “Semi-quantitative kit” makes easier to obtain quantitative depth profiles for a variety of applications. Of course accuracy has limitations depending on the type of samples to measure but this kit has already been proved to be useful in Japan as it was already sold to more than 10 customers.