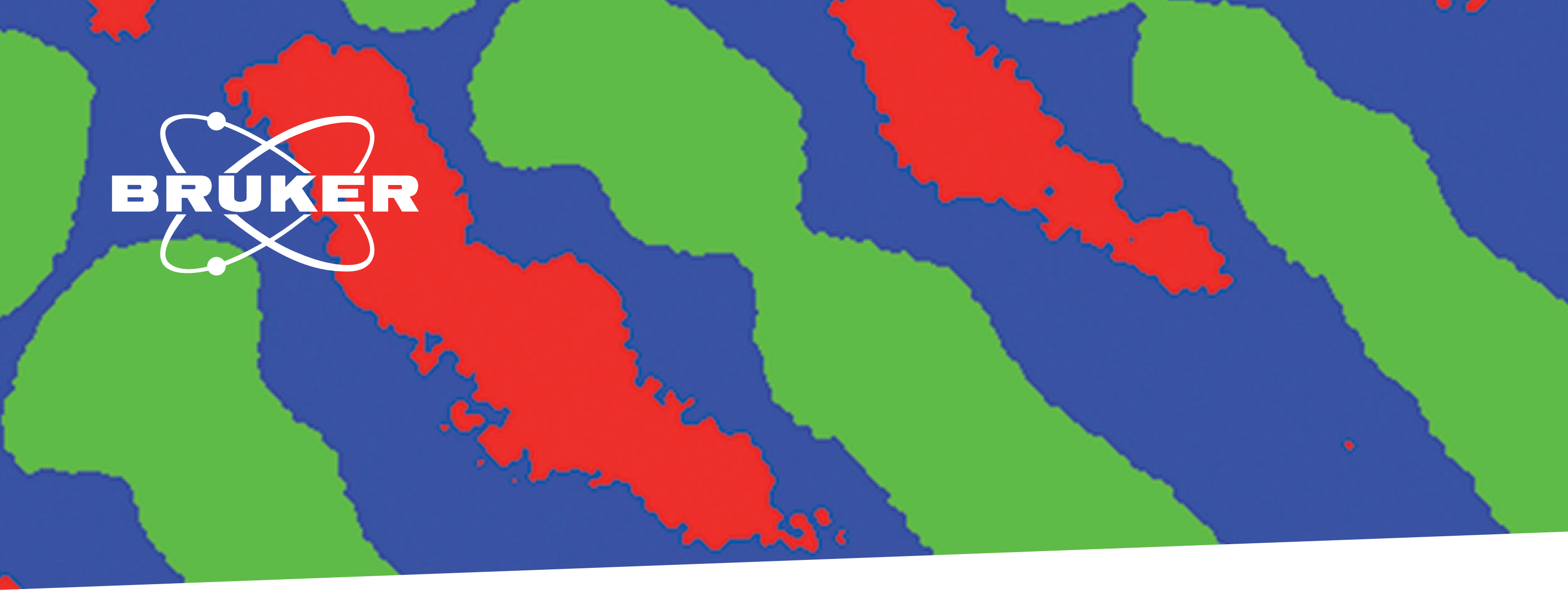

EDS

Spectroscopic phase analysis of a ternary alloy using QUANTAX HyperMap

Application Note # EDS-03

Introduction

The combination of SDD technology and modern data processing sets the stage for hyperspectral imaging techniques such as position tagged spectroscopy (PTS). QUANTAX HyperMap is Bruker´s version of PTS. It uses a database that contains, in addition to the image, an EDS spectrum for each pixel. With this tool, evaluation methods like quantitative analysis, intensity element mapping and spectroscopic analysis of differently composed phases can be performed offline.

This report shows the application of these options with an Al-Ru-Pt alloy.

Methods used

The sample was analyzed with a JEOL 6490LV SEM equipped with a Bruker QUANTAX EDS system including a liquid nitrogen free XFlash® 5010 Detector (energy resolution of 123 eV for MnKα at 100,000 cps).
A HyperMap was performed under the following measurement conditions:

- Accelerating voltage: 20 kV
- Acquisition time: 15 h 40 min
- Input count rate: ~23,000 cps
- Image resolution: 800 x 600 pixels

Acquired spectra were evaluated using the standardless peak-to-background model (P/B) and subsequent ZAFcorrection.

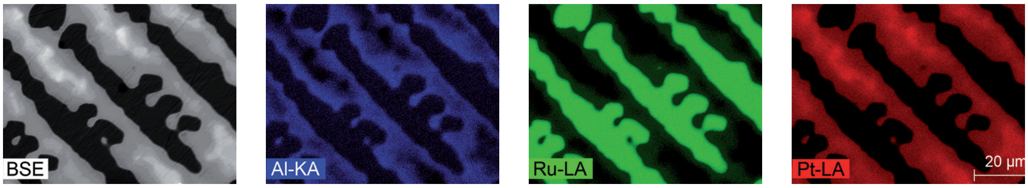

Figure 1
BSE micrograph of Al-Ru-Pt-alloy and intensity element maps of Al-Kα (blue), Ru-Lα (green) and Pt-Lα (red).

Results

A heterogeneous microstructure is displayed in the back scatter electron (BSE) micrograph and the intensity element maps (Figure 1). Three different phases can be distinguished in the individual element maps (Figure 1) and the composite element map (Figure 2). In the composite element map, phase 1 (green) is rich in ruthenium. The matrix can be separated into phase 2 (blue), which contains all three elements (aluminum, ruthenium and platinum), and phase 3 (red), which is significantly rich in platinum and poor in ruthenium.

The compositions of three areas (Figure 2) were used by the Autophase function to obtain the distribution of similarly composed phases (Figure 3). Table 1 displays the composition of the three areas, their correspoding phases as well as the area fraction of each phase.

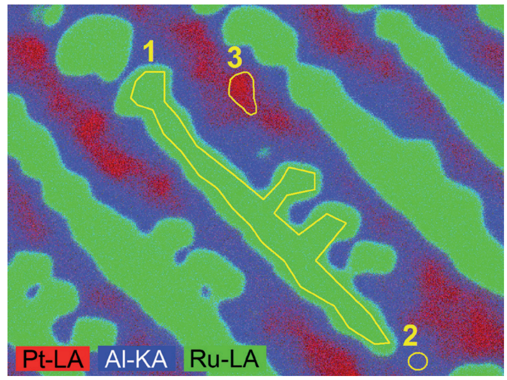

Figure 2
Composite element map of Al-Kα (blue), Ru-Lα (green) and Pt-Lα (red). Numbers correspond to three differently composed areas (1: ruthenium-enriched crystals, 2: matrix with less platinum, 3: platinum-enriched matrix).

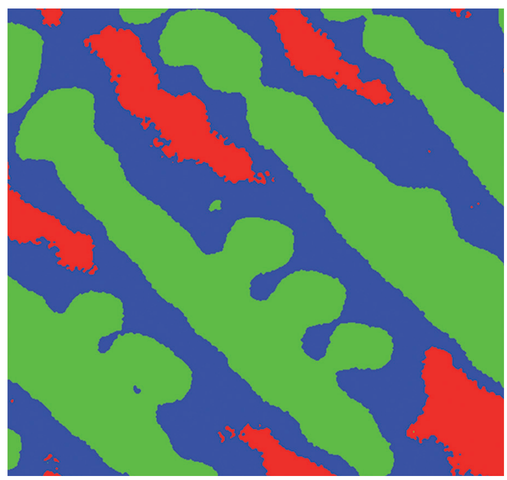

Figure 3
Result of phase analysis. Each phase is represented by one color.

Conclusions

Areas of similar composition can be easily made visible by the automatic or user-controlled phase detection system Autophase. The distinction of phases by their composition has a significant advantage when compared to intensity element maps.

Using Autophase, the phases are displayed by one distinct color. Through this, a defined phase distribution including the area fraction of each phase can be obtained. Phase spectra have a significantly higher number of impulses than the area spectra. This results in much better statistics for determination of phase composition.

	Pulses	Area fraction	Al	Ru	Pt	Sum
Region						
1	60801556	–	64.13	35.27	0.61	100.0
2	1462410	–	72.46	18.17	9.38	100.0
3	4784462	–	72.96	10.98	16.05	100.0
Phase						
P1	491976648	46.2	64.90	33.60	1.51	100.0
P2	451620382	41.8	73.15	17.28	9.57	100.0
P3	131274862	12.0	73.09	13.23	13.68	100.0

Table 1
Quantification and phase analysis results

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Sample courtesy of Prof. Mike Lee, Nelson Mandela Metropolitan University, South Africa.

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