## Lab Report XRF 127

# S2 PUMA

- Analysis of Pt-containing Catalytic Converters with the S2 PUMA

### Introduction

Stricter environmental laws and an increasing usage of automobiles around the world trigger a growing usage of catalytic converters. Furthermore, climbing market prices for platinum group elements (PGE) vital for catalytic converters make their recycling mandatory. The price for platinum (see Figure 1), one of the most important elements in catalytic converters, is up despite increasing production! No wonder that the total value of PGEs extracted from used catalytic converters during recycling processes was $3 billion in 2010.

Figure 1: Metallic platinum on precision balance.

However, this highly profitable industry relies on reliable elemental analysis, as different types of catalytic converters contain highly differing amounts of these precious metals. This lab report demonstrates the ability of the S2 PUMA to analyze the PGEs Pt, Pd, and Rh and other present elements to monitor their content for quality control in recycling and re-manufacturing processes of catalytic converters (see Figure 2).

Figure 2: Typical monoliths from catalytic converters coated with PGE-containing films.

## Fast and reliable when it counts: S2 PUMA!

The S2 PUMA is the high-performing benchtop energy-dispersive X-ray fluorescence (EDXRF) spectrometer for a wide range of applications. It is designed for the demanding industrial user, who prioritizes a reliable and robust instrument which can provide him with accurate results under harsh conditions. The S2 PUMA's XY Autochanger enables the unattended analysis of large series of process samples; its HighSense™ beam path geometry with the XFlash® SDD detector ensures best precision, optimal accuracy, and high spectral resolution. The dedicated instrument protection system SampleCare™ makes the ideal set up for your industrial lab: It comprises of several protective measures to prevent contamination of X-ray tube and detector head (see Figure 3) by parts from solid or liquid samples.

The instrument is perfectly equipped for industrial environments due to its ergonomic TouchControl™ interface for the independent routine operation without any PC peripherals. The powerful user account control of the spectrometer's software SPECTRA.ELEMENTS and the sturdy design of the S2 PUMA guarantee a high instrument uptime.

## Calibration and Measurement Details

We used 15 standards prepared as pressed pellets with 8 g of sample material and 2 g of boric acid (see Figure 5). The samples have been pressed applying a pressure of 300 kN for 20 s. The stable pressed pellets have been measured under vacuum. An example for the excellent calibration is given with Pt in Table 1.

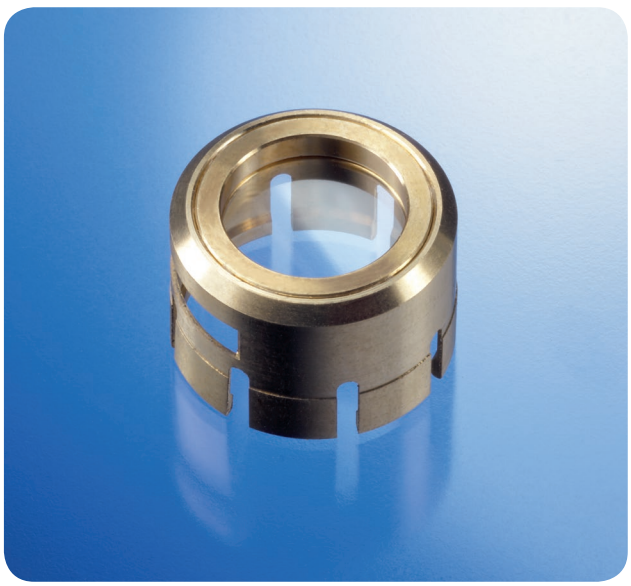

Figure 3: DustShield™ detector cap is part of SampleCare™ and prevents contamination of the detector head.

| Line | Range [ppm] | Calibration Standard Deviation 3σ [ppm] | Squared Correlation Coefficient |
|---|---|---|---|
| Pt Lα1 | 630 - 1120 | 9 | 0.99734 |

Table 1: Calibration details for Pt

The automatic line selection of the instrument's software suite SPECTRA.ELEMENTS proposes the ideal measurement conditions for each element. They can be agreed to, adjusted or discarded. The conditions used here have been listed in Table 2.

| Voltage [kV] | Analyzed Elements | Filter | Measurement Time [s] |
|---|---|---|---|
| 20 | Mg, Al, Si | none | 60 |
| 40 | Ti, Fe, Ni, Zn, Sr, Pt | Al (500 µm) | 60 |
| 50 | Rh, Pd | Cu (250 µm) | 60 |

Table 2: Measurement conditions

## Analysis Results

For demonstration of the analytical precision of the S2 PUMA, one sample was chosen and measured 10 times in row. After each analysis the sample was unloaded from the sample chamber. The details of the repetition tests are shown in Table 3. Excellent precision is achieved for all analyzed elements, but the PGEs in question show a particularly good repeatability. The precision of Pt is also shown in the graph of Figure 4 below.

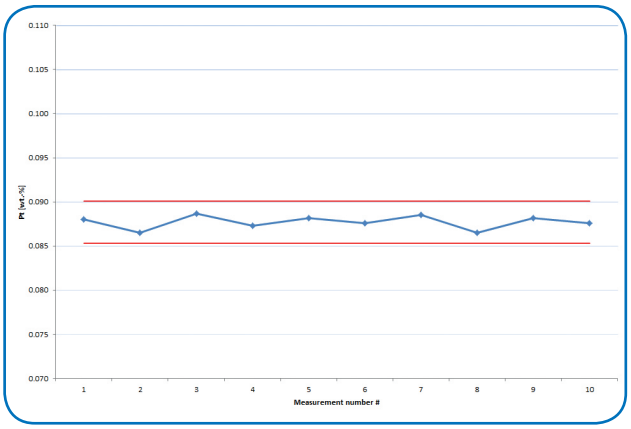


Figure 4: Excellent precision of Pt from the repetition test (see Table 3). Red lines denote 3σ confidence interval.

Figure 5: Raw sample material and prepared pressed pellets.

| | Al [wt.-%] | Si [wt.-%] | Mg [wt.-%] | Zn [wt.-%] | Ti [wt.-%] | Fe [wt.-%] | Ni [wt.-%] | Sr [wt.-%] | Pt [wt.-%] | Pd [wt.-%] | Rh [wt.-%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rep-1 | 69.61 | 19.86 | 3.74 | 0.1051 | 0.517 | 0.549 | 0.0157 | 0.1831 | 0.0880 | 0.1157 | 0.0340 |
| Rep-2 | 69.72 | 19.93 | 3.70 | 0.1040 | 0.508 | 0.553 | 0.0149 | 0.1802 | 0.0865 | 0.1151 | 0.0342 |
| Rep-3 | 69.62 | 19.93 | 3.72 | 0.1042 | 0.527 | 0.554 | 0.0161 | 0.1827 | 0.0887 | 0.1147 | 0.0337 |
| Rep-4 | 69.67 | 19.90 | 3.72 | 0.1046 | 0.510 | 0.547 | 0.0150 | 0.1830 | 0.0873 | 0.1140 | 0.0339 |
| Rep-5 | 69.96 | 20.06 | 3.75 | 0.1034 | 0.536 | 0.550 | 0.0145 | 0.1837 | 0.0882 | 0.1140 | 0.0347 |
| Rep-6 | 70.13 | 20.16 | 3.77 | 0.1042 | 0.492 | 0.557 | 0.0154 | 0.1838 | 0.0876 | 0.1142 | 0.0348 |
| Rep-7 | 69.88 | 20.04 | 3.65 | 0.1044 | 0.516 | 0.546 | 0.0151 | 0.1818 | 0.0885 | 0.1148 | 0.0338 |
| Rep-8 | 69.61 | 19.86 | 3.70 | 0.1040 | 0.508 | 0.553 | 0.0149 | 0.1802 | 0.0865 | 0.1151 | 0.0342 |
| Rep-9 | 69.62 | 19.93 | 3.72 | 0.1046 | 0.536 | 0.550 | 0.0161 | 0.1827 | 0.0882 | 0.1140 | 0.0339 |
| Rep-10 | 69.67 | 19.90 | 3.65 | 0.1044 | 0.492 | 0.557 | 0.0145 | 0.1837 | 0.0876 | 0.1142 | 0.0348 |
| **Avg.** | **69.75** | **19.96** | **3.71** | **0.1043** | **0.514** | **0.552** | **0.0152** | **0.1825** | **0.0877** | **0.1146** | **0.0342** |
| **Abs. Std. Dev.** | **0.18** | **0.10** | **0.04** | **0.0005** | **0.016** | **0.004** | **0.0006** | **0.0013** | **0.0008** | **0.0006** | **0.0004** |
| **Rel. Std. Dev.** | **0.26** | **0.49** | **1.01** | **0.43** | **3.04** | **0.68** | **3.87** | **0.73** | **0.87** | **0.52** | **1.23** |

Table 3: Repetition results of a sample from the PGE-coated monolith of a catalytic converter.

## Summary

The extraordinary instrument stability of the S2 PUMA reflects into analytical performance – best precision and accuracy! This translates directly into cost-savings on your side, especially when every gram of your material counts.

Furthermore, the S2 PUMA comes with many features designed for the industrial user, such as our XY Autochanger, TouchControl, and our highly ergonomic SPECTRA.ELEMENTS software suite. This makes the S2 PUMA the analytical partner you can rely on!




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## Links

**S2 PUMA XY Autochanger**

www.bruker.com/s2puma-xy-autochanger

**Metals**

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**TouchControl**

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