

X-RAY FLUORESCENCE

Analysis of Pt-containing Catalytic Converters

Lab Report 127

Introduction

Stricter environmental laws and an increasing usage of automobiles around the world trigger a growing usage of catalytic converters. High prices for platinum group elements (PGE) vital for catalytic converters make their recycling mandatory and profitable. The PGEs recovered annually from catalytic converters have a value of several billion US\$.

For a cost efficient recovery of PGEs accurate elemental analysis is critical as different types of catalytic converters contain highly differing amounts of these precious metals. This lab report demonstrates the ability of the S2 PUMA Series 2 to analyze the PGEs Pt, Pd, and Rh and other relevant elements to monitor their content for quality control in recycling and re-manufacturing processes of catalytic converters (see Figure 1).

Fast and reliable when it counts: S2 PUMA!

The S2 PUMA Series 2 is a high-performance benchtop energy-dispersive X-ray fluorescence (EDXRF) spectrometer, ideal for a wide range of applications. It is engineered for demanding industrial environments, offering reliability, robustness, and precise results even under harsh conditions. The S2 PUMA's XY Autochanger enables the unattended analysis of large batches of process samples. Its HighSense™ beam path geometry and detector ensure high precision and accuracy. The S2 PUMA is equipped with Bruker's unique SampleCare™ protection system. It includes multiple safeguards designed to prevent contamination of the X-ray tube and detector head from solid or liquid sample residues (Figure 2).

The instrument is perfectly equipped for industrial environments due to its ergonomic TouchControl™ interface for 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.



Figure 1
Typical monoliths from catalytic converters coated with PGE-containing films.

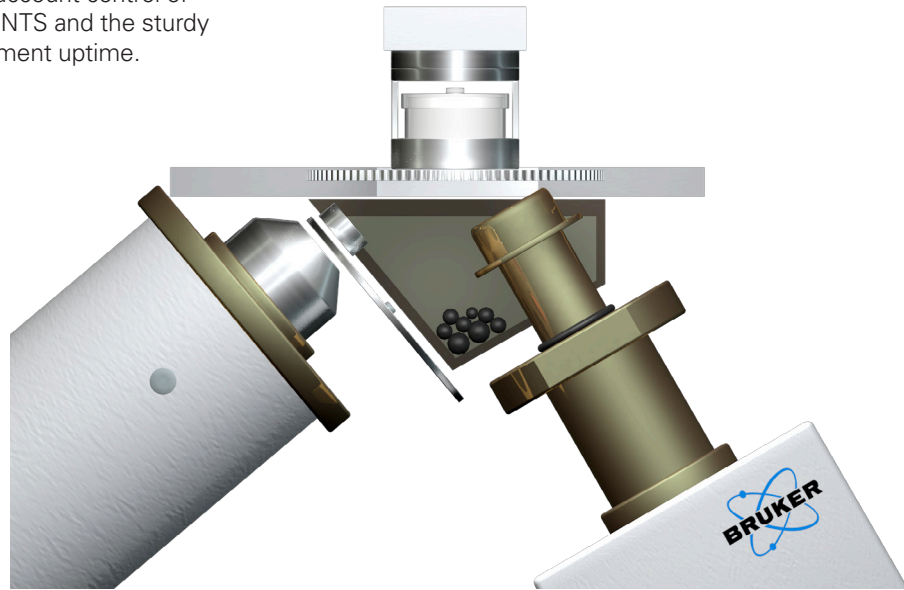


Figure 2
SampleCare™ protects all vital system components, providing high uptime and easy maintenance.

Calibration and Measurement Details

We used 15 reference materials prepared as pressed pellets with 8 g of sample material and 2 g of boric acid (see Figure 3). 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.

The automatic line selection of the instrument's software suite SPECTRA.ELEMENTS proposes the ideal measurement conditions for each element. The conditions used here are listed in Table 2.

Table 1
Calibration details for Pt

Line	Range [ppm]	Calibration Standard Deviation 3σ [ppm]	Squared Correlation Coefficient
Pt L α 1	630 - 1120	9	0.99734

Table 2
Measurement conditions

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

Figure 3
Prepared pressed pellets.

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 results 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 the Pt analysis is illustrated in Figure 4.

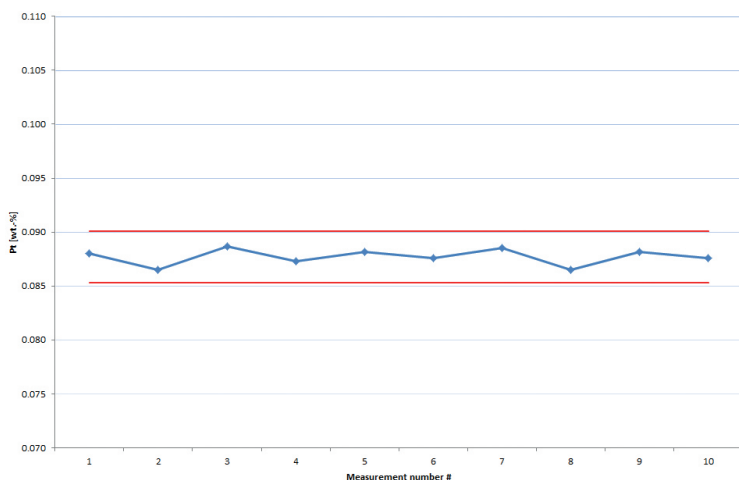


Figure 4

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

Table 3

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

	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%

Summary

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

The S2 PUMA comes with many features designed for the industrial user, such as our XY Autochanger, TouchControl, and our intuitive and powerful SPECTRA.ELEMENTS software suite.

This makes the S2 PUMA the analytical partner you can rely on!



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