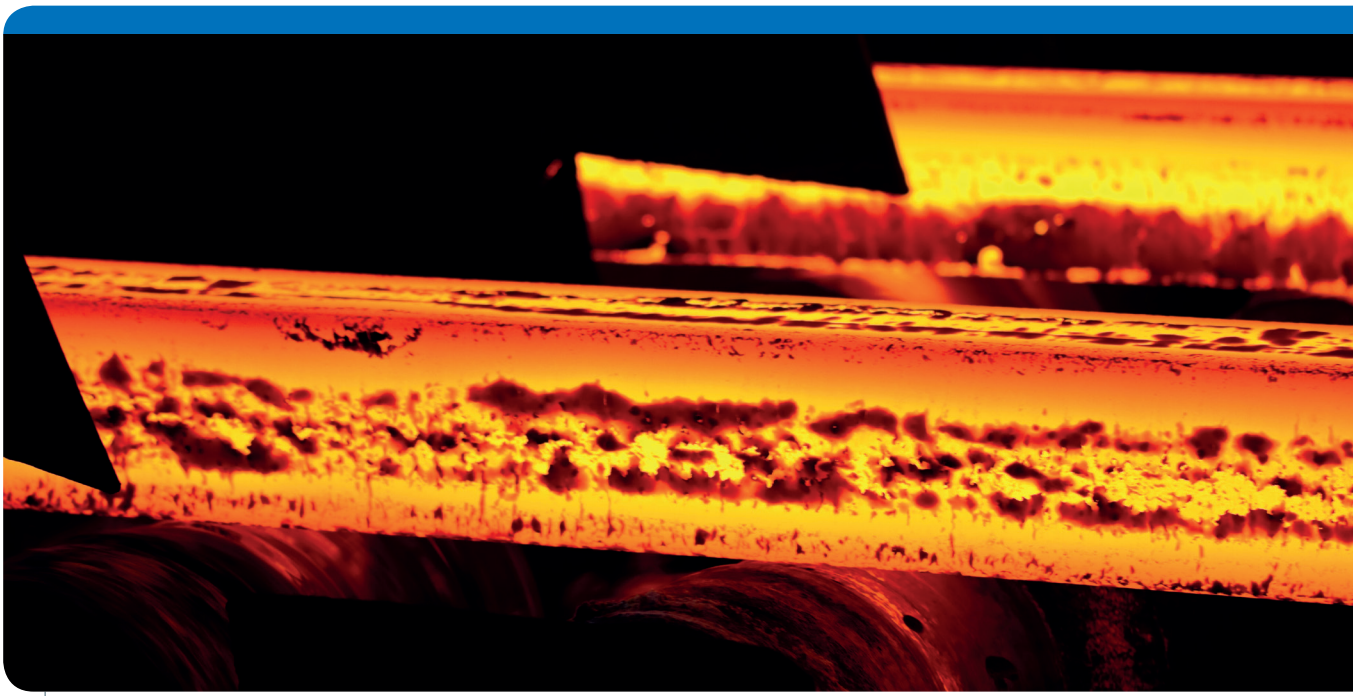


Lab Report XRF 131

S2 PUMA

- Analysis of Ferroalloy Granulate with the S2 PUMA

Introduction

Ferroalloys encompass a wide group of alloys of iron with other elements, such as titanium, nickel or tungsten. Alloys are used to develop certain desired characteristics in steel and benefit the production process: Ferrotitanium is alloyed in high-strength steels; ferrotungsten is used in high-speed and tool steels (see Figure 1); ferronickel is used for heat-resistant and stainless steel. Two of the most widely used ferroalloys are ferromanganese and ferrosilicon. These alloys are used as deoxidizers in the manufacturing process of steel where they remove the oxygen content.

Figure 1: Drill bits made from high-speed steel.

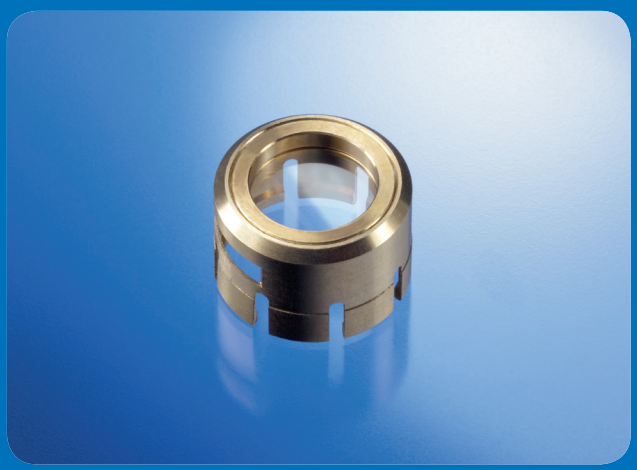


Figure 2: The DustShield™ detector cap is part of SampleCare™ and prevents contamination of the detector head.

Figure 3: The S2 PUMA XY Autochanger – ideal for applications with high-sample throughput requirements.

Ferrosilicon is also used to produce corrosion- und heat-resistant ferrous alloys.

These and many other applications make ferroalloys an important ingredient in almost any steel.

Reliable Results under Harsh Conditions: S2 PUMA!

The S2 PUMA is the high-performance benchtop energy-dispersive X-ray fluorescence (EDXRF) spectrometer for harsh conditions. It is designed for the industrial user who depends on a reliable instrument to make his processes work.

SampleCare™ (see Figure 2), the dedicated instruments protection system, protects vital parts of the spectrometer from sample particles, dust, and other contaminants. This ensures high instrument up-time and low maintenance times and cost. Equipped with the XY Autochanger (see Figure 3) – a unique feature among benchtop EDXRF instruments – and the option to seamlessly integrate the analyzer into fully automated lab environments make the S2 PUMA the go-to EDXRF solution for high sample through-put applications.

The 50 W X-ray tube and the XFlash® SDD detector, coupled through the HighSense™ beam path, stand for high analytical performance with best precision, optimal accuracy, and high spectral resolution. TouchControl™, the touch screen user interface on the instrument, allows for ergonomic spectrometer handling and independent routine operation without any PC peripherals. The powerful instrument software suite SPECTRA.ELEMENTS guarantees intuitive use and highest analytical flexibility.

Calibration and Measurement Details

Sample preparation applied for this lab report was simple: 12 g of ferroalloy granulate was poured into a liquid cup (see Figure 4) with a 4 µm polypropylene film. See Table 1 for calibration details.

Loose granulate and powder samples can either be analyzed under a helium atmosphere or under air. Here we demonstrate the high analytical performance of the S2 PUMA for measurements under air, which offer a quick and cost-effective solution as no expensive purging gas is required.

Line	Range [wt.-%]	Calibration Standard Deviation 3σ [wt.-%]	Squared Correlation Coefficient
Al Kα1	0 - 1.38	0.04	0.99664
Si Kα1	0.40 - 75.0	0.8214	0.99951
Mn Kα1	0 - 86.42	1.359	0.99895
Fe Kα1	13.0 - 17.1	0.4955	0.96770
Cu Kα1	0.05 - 0.1	0.0037	1.00000

Table 1: Calibration details of the measured lines.

Voltage [kV]	Analyzed Elements	Filter	Measurement Time [s]	Atmosphere Mode
40	Al, Si, Mn, Fe, Cu	Al (500 µm)	100	Air

Table 2: Measurement conditions for the set up ferroalloys solution.

Figure 4: Liquid cups provide a simple solution to analyze granulate and powder right away.

Analysis Results

To demonstrate the analytical precision of the S2 PUMA, a certified reference material (CRM) sample was used to perform a repetition test. The sample was measured ten times in row under the conditions given in Table 2.

The results of the repetition test are shown in Table 3. Analysis results of all elements show low standard deviations, even the measurements of the lighter element Al in lower concentration show good analytical stability. The excellent repeatability of Fe with an absolute standard deviation of 0.023 % is shown in Figure 5.

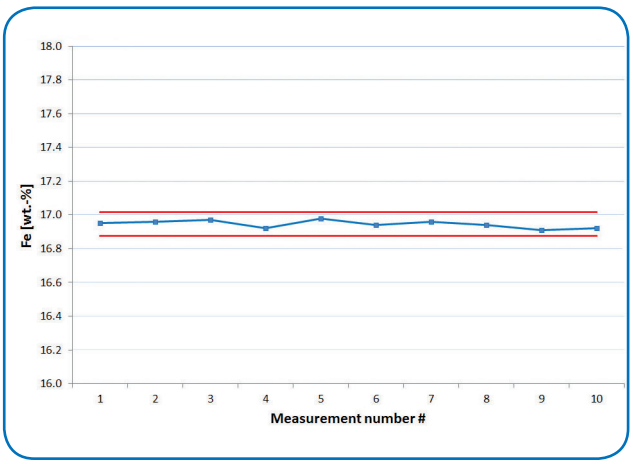


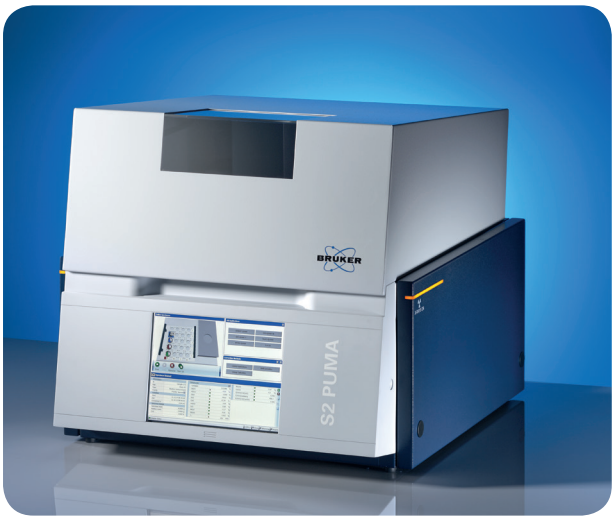
Figure 5: Excellent precision of Fe results from the repetition test conducted under air. Red lines denote 3σ confidence interval.

BCS305-1	Al [wt.-%]	Si [wt.-%]	Mn [wt.-%]	Fe [wt.-%]	Cu [wt.-%]
Rep-1	1.35	75.76	0.09	16.95	0.09
Rep-2	1.34	74.01	0.09	16.96	0.09
Rep-3	1.32	76.00	0.09	16.97	0.09
Rep-4	1.36	75.93	0.10	16,92	0.09
Rep-5	1.38	75.89	0.09	16.98	0.09
Rep-6	1.37	73.97	0.09	16.94	0.09
Rep-7	1.32	74.15	0.09	16.96	0.09
Rep-8	1.33	75.24	0.09	16.94	0.09
Rep-9	1.31	75.36	0.09	16.91	0.09
Rep-10	1.35	73.96	0.09	16.92	0.10
Mean	**1.34**	**75.03**	**0.09**	**16.95**	**0.09**
Abs. Std. Dev.	**0.023**	**0.898**	**0.003**	**0.023**	**0.003**
Rel. Std. Dev.	**1.72**	**1.20**	**3.48**	**0.14**	**3.48**

Table 3: Measurement results of the repetition test under air.

Summary

The S2 PUMA's optimized beam path geometry with the high-power X-ray tube and the XFlash detector assure analytical performance. The XY Autochanger sample handling, SampleCare, the rugged design, TouchControl, and the intuitive instrument software make the S2 PUMA the ideal choice for rough working environments as they occur in all steel plants around the world. When worst comes to worst, Bruker's worldwide network of service engineers are there to help. This makes the S2 PUMA the right choice when it comes to demanding elemental analysis under harsh conditions.



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Links

S2 PUMA XY Autochanger

www.bruker.com/s2puma-xy-autochanger

Metals

www.bruker.com/applications/metals

TouchControl

www.bruker.com/s2puma-technical-details

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