

Energy-optimized
Production of Secondary
Aluminum through Inline
Analytics (LIBS)

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Geschäftsführender Gesellschafter

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SECOPTA
Fast. Precise. Robust.



History

- **1998** Spin-off Clausthal University of Technology
- **2001** LIBS mine detection by Secopta
- **2010** Market introduction of FiberLIBS
- **2014** Market introduction of MopaLIBS (Recycling)
- **2017** Change of Shareholder structure, Business Angles,
New Facilities in Teltow (south of Berlin) focus on
industrial applications
- **2021** SlagLIBS, New PMI Applications, New Mineral Applications,
18 employees turnover 2.3Mio.€

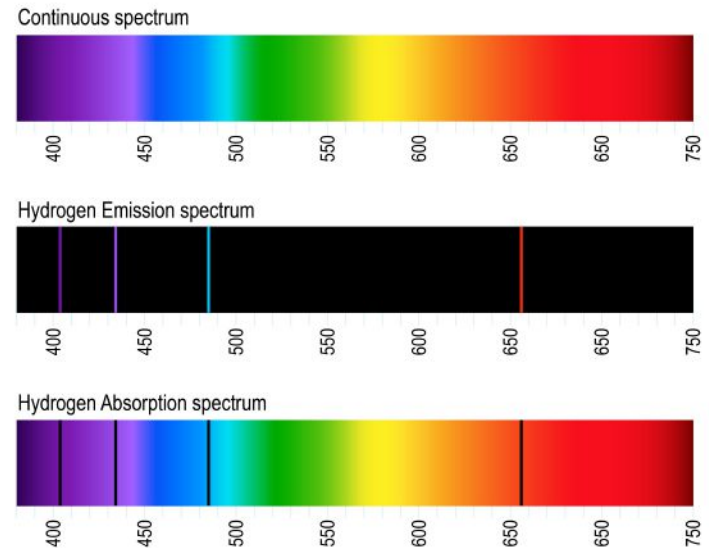
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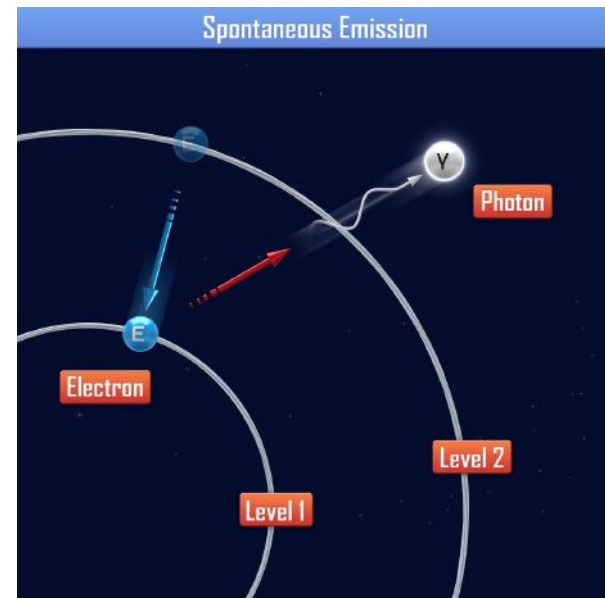
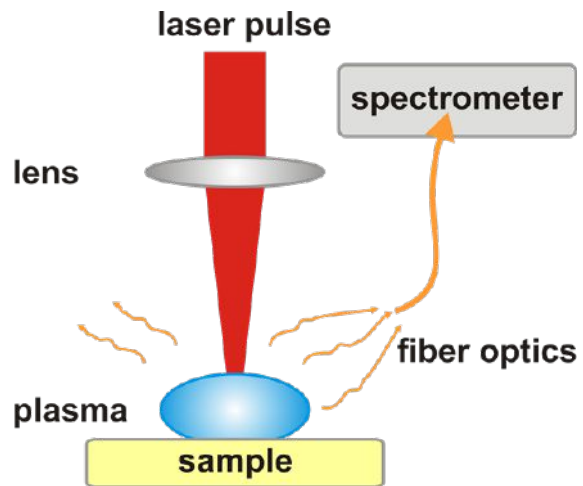
Content

1. **LIBS Basics**
2. Application: Recycling
3. Application: meltLIBS
4. Application: Positive Material identification (PMI)
5. Application: Lab-Analytics

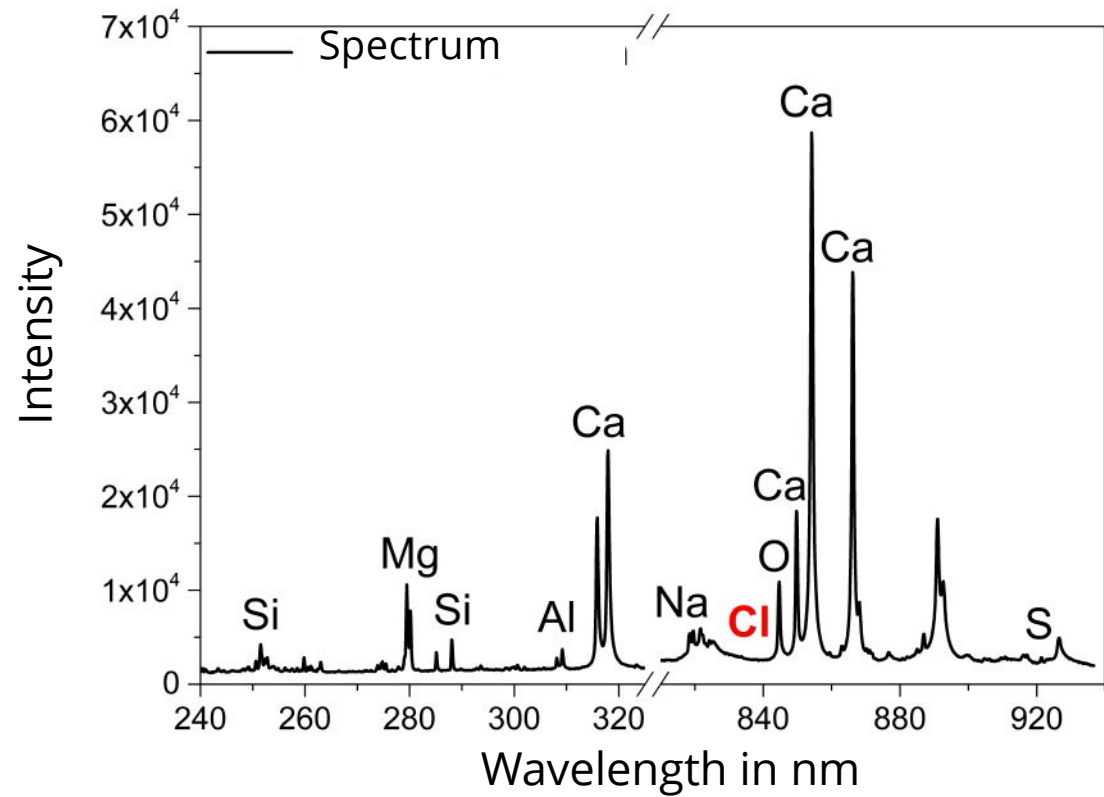
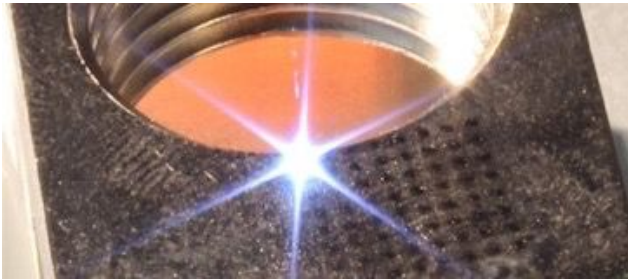
SPECTRUM



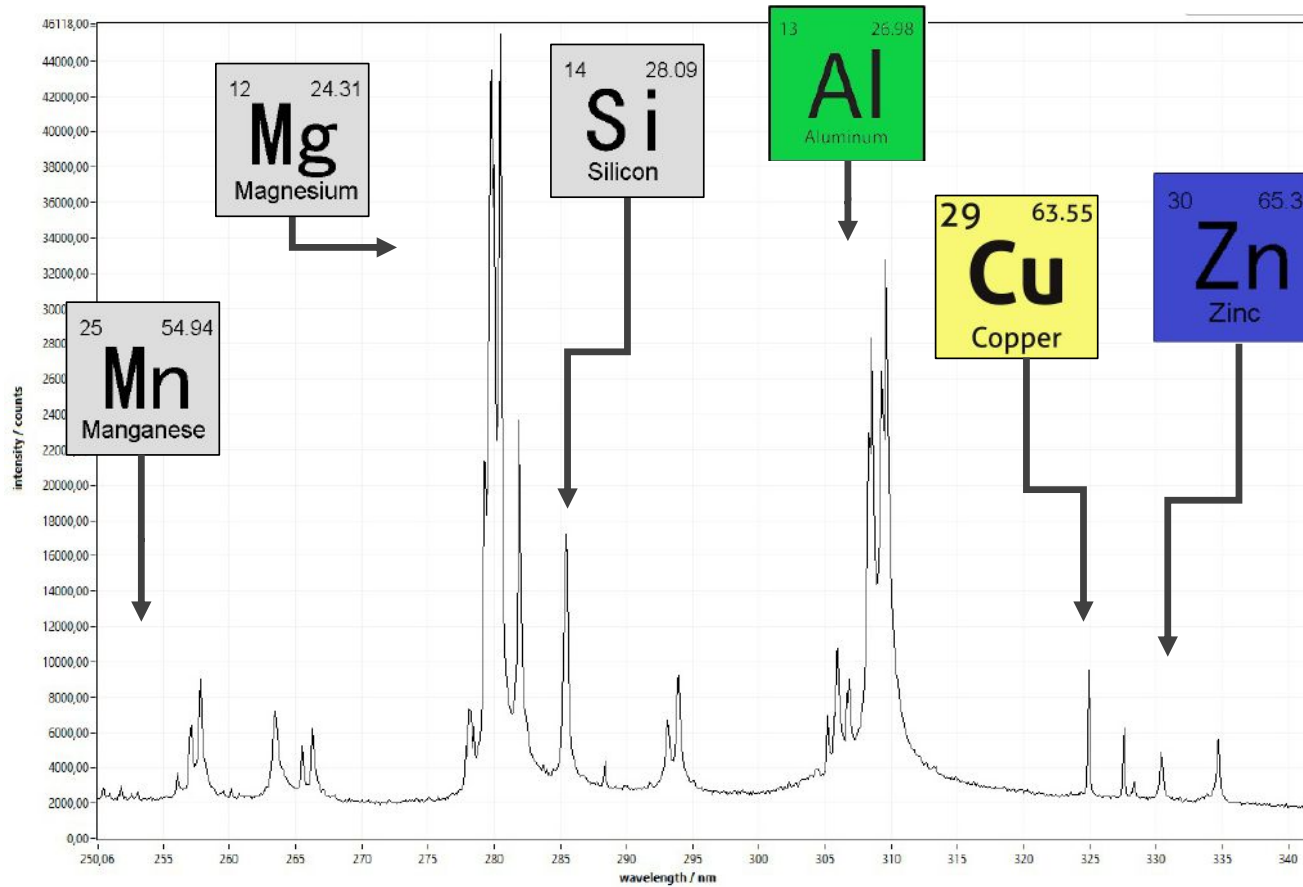
Laser Induced Breakdown Spectroscopy (LIBS)



Laser Induced Breakdown Spectroscopy (LIBS)



LIBS spectrum: Aluminum

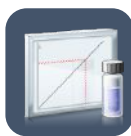


LIBS Basics – Advantages of the method

Universal and flexible

- each element is detected, even lightweight
- identification of complex objects by “fingerprint”
- adjustable by software

The image shows a standard periodic table of elements titled "Periodensystem der Elemente". It includes the main groups (1-18) and the lanthanide and actinide series at the bottom. Elements are color-coded by groups: Group 1 (orange), Group 2 (yellow), Groups 3-10 (blue), Groups 11-12 (green), Groups 13-18 (purple), and the lanthanide/actinide series (light green).



Quantitative



Qualitative



Process qualified

Fast and straight forward

- **Online** – full automated data analysis in ~1 ms
FiberLIBS with up to 100 measurements per second
applicable for monitoring und process control
- **Inline** – compact sensor head for integration directly into machinery
- **Insitu** – no sampling and no sample preparation

USPs SECOPTA LIBS Technology

fast.

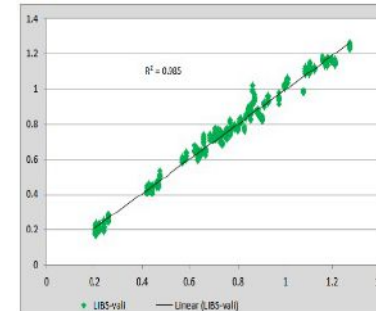
- Results within milliseconds
- 1000 measurements / s
- Up to 20.000 measurement points / s

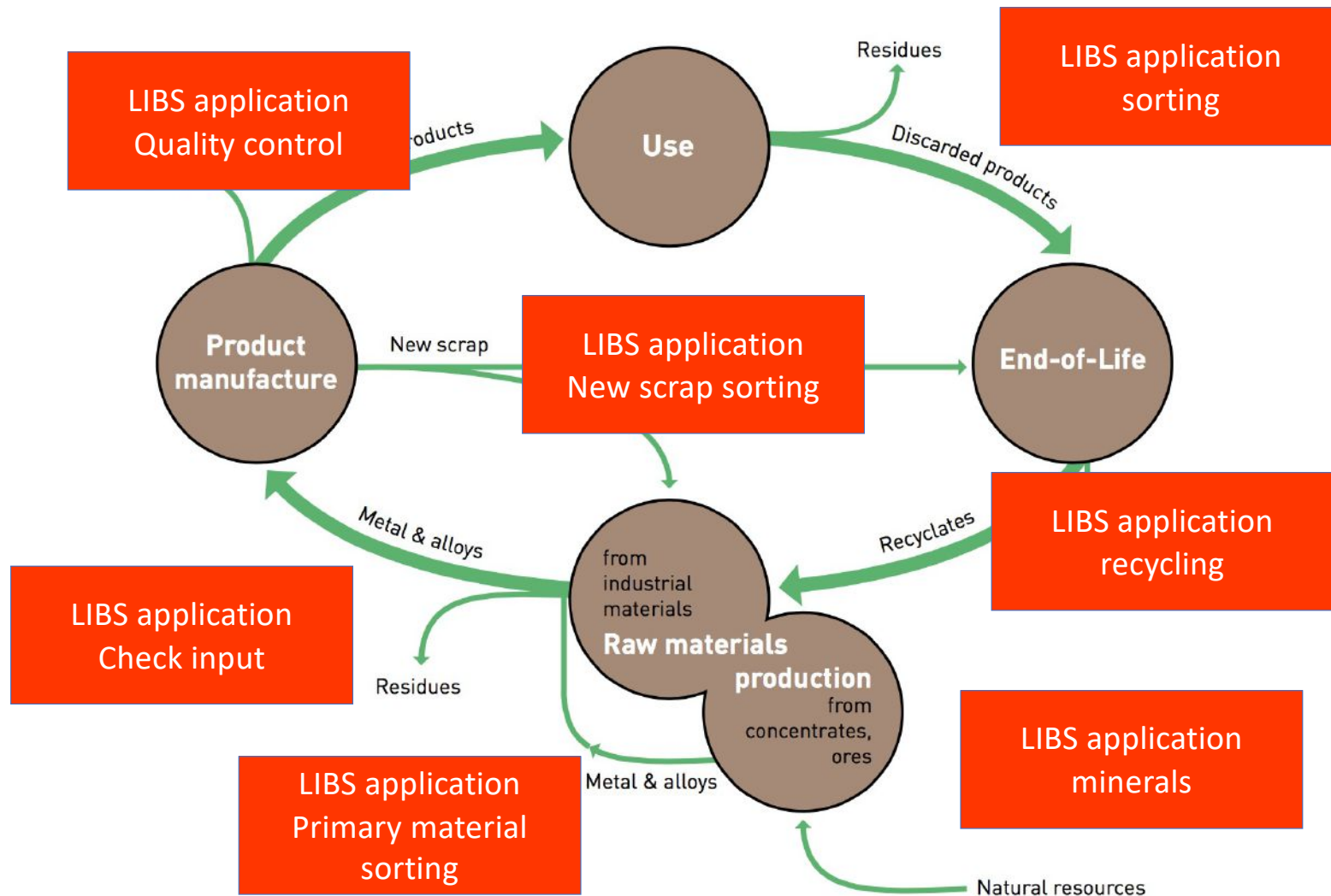
precise.

- Quantitative Measurements <0,1 wt%
- Typical error of approx. 5% rel. possible @ 3m/s
- Simultaneous measurement of all elements (even lightweight)

robust.

- SECOPTA sensors in industry quality
- IP67, sealed in clean room environment, air stream
- Connection to PLC via common industrial interfaces





SECOPTA Products and Applications



FiberLIBS inline

- Fast. without sample preparation
- PMI Steel
- PMI Aluminum
- PMI NDT finishing line
- black bar
- bright bar
- billets

FiberLIBS inline SP

- Non metal applications
- Volume flows on belt conveyors
- Metal industry
- Glass industry
- Ore. coal. slag
- Coating thickness

MopaLIBS

- Extreme fast
- Autofocus
- Applications:
 - Al-Recycling
 - Stainless steel
 - ZORBA
 - Non-Iron
 - Copper
 - Zn

meltLIBS

- Analytics on molten metals
- distance 700mm
- automated distance control
- applications: cast iron. pig iron. aluminium. copper. slag

Lab solutions

- 2D- and 3D mapping
- Segregations (Steel/Al)
- Inclusions
- concreteLIBS
- concrete analysis
- slagLIBS
- slag without sample preparation

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Materials recycled by LIBS



Aluminium
(Si, Mg, Mn, Cr, Zn,... alloys)



Titanium Classification
(Ti Al6 V4, Ti Al3 V2.5, Ti 99, ...)



Low-alloy steel
(Mn, Cr, Ti, Al, Si, Cu,... alloys)



High-alloy steel
(Mo, Cr, Ni, Si, Mn, Cu, P, ... alloys)



Minerals / material mixes
(furnace refractories, sinter,...)

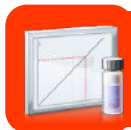


Building material
(concrete, Gypsum)

MopaLIBS



Features



Fast precise online
Measurements > 350 / s

IP65

Sealed, purged window
Higher inner pressure

auto
focus

Target distance 350 +/- 75 mm
Extreme fast: 7mm/ms

Options

PA

Preablation

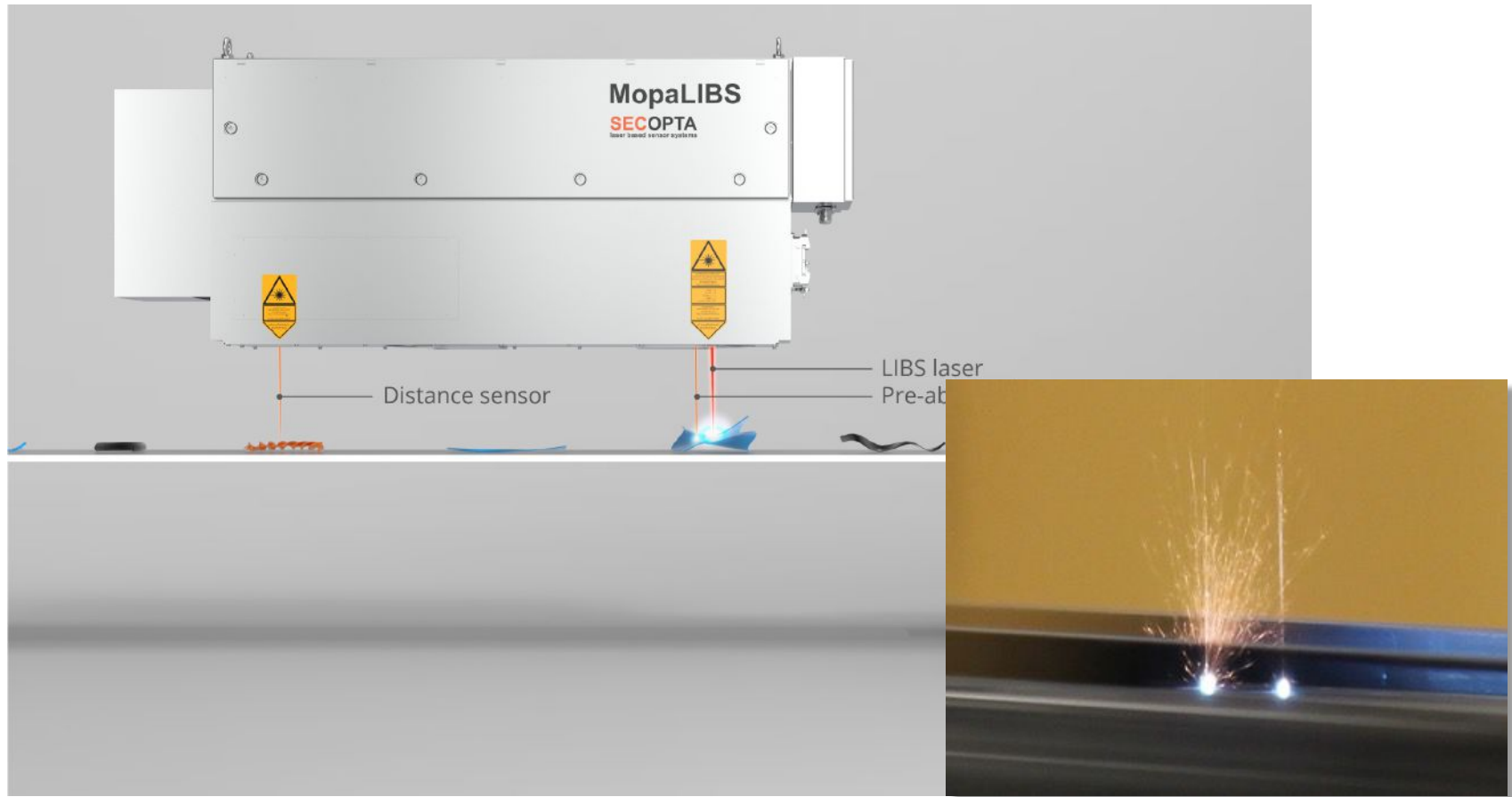
ALU

Standard appl. Al-Recycling

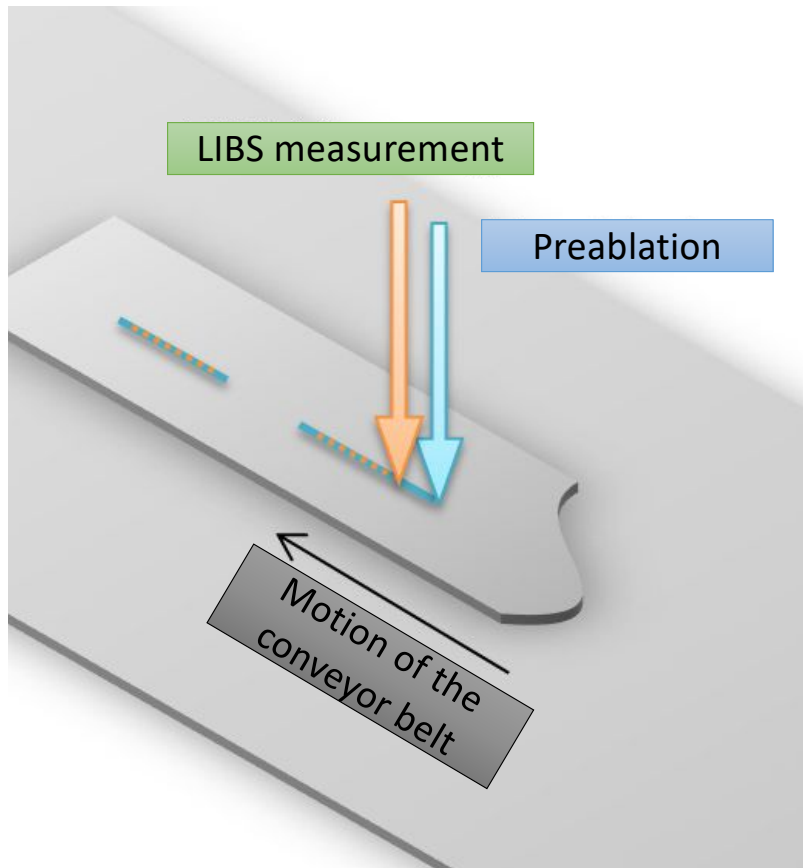
STEEL

Standard appl. Steel-Recycling

MopaLIBS, how it works



Principle of preablation

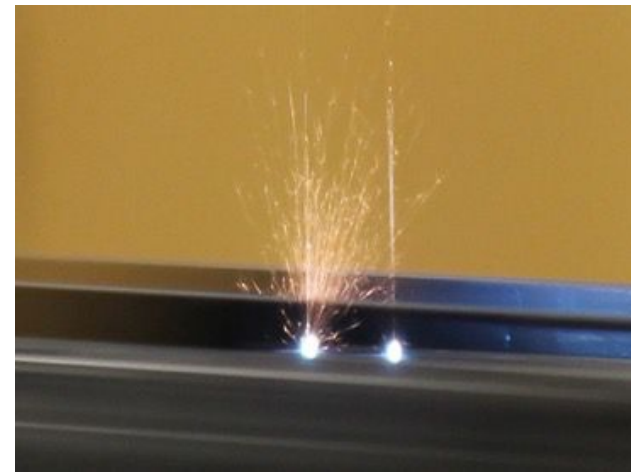


Laser Preablation: 100 kHz

Belt speed: 3m/s
spatial resolution between laser shots: 30 μm

Measurement laser: 20 kHz

Belt speed: 3m/s
spatial resolution between laser shots: 150 μm

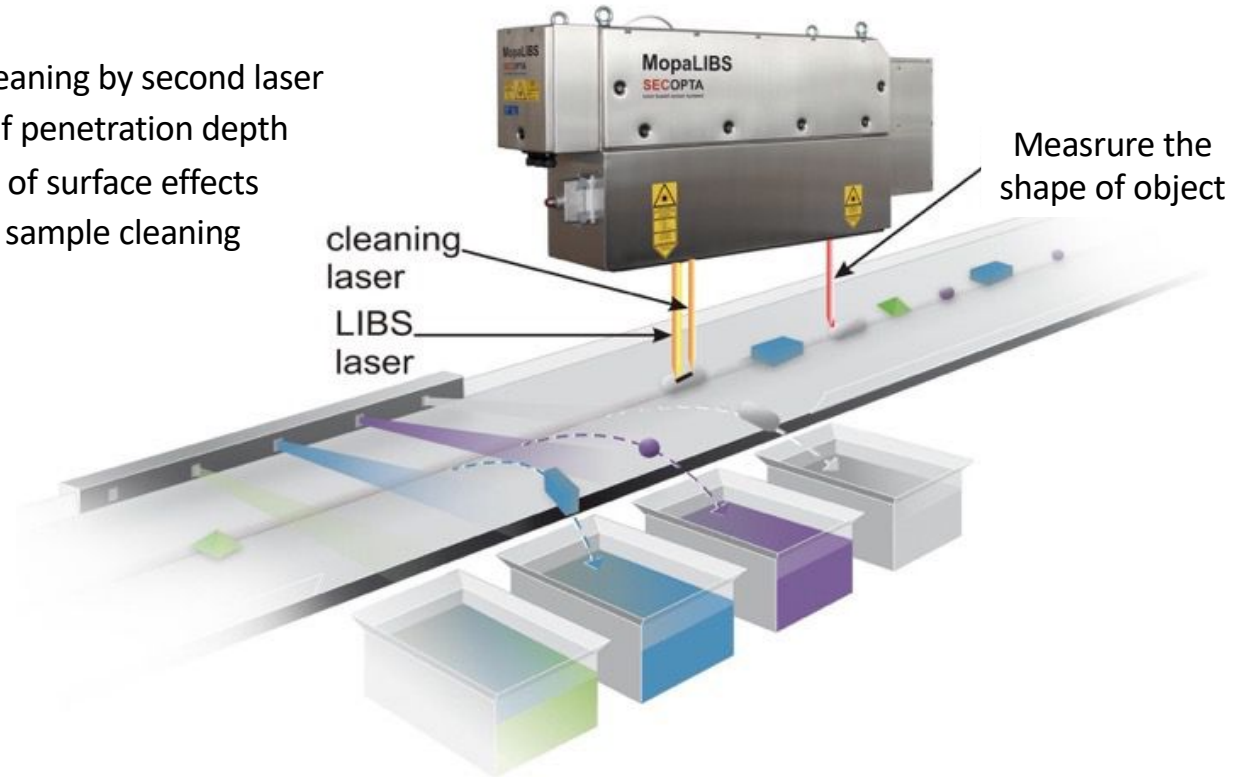


RMSEC calibration Al at 3m/s

	methode	Without PA	With PA	Better?
1	Cu	0.15	0.02	YES
2	Fe	0.08	0.05	YES
3	Mg	0.27	0.13	YES
4	Mg < 2%	0.070	0.039	YES
5	Mn	0.09	0.04	YES
6	Si-classification	0.74	0.58	YES
7	Si < 5%	0.11	0.17	No
8	Si > 5%	1.06	0.80	YES
9	Zn	0.07	0.03	YES

Setup Sorting Unit

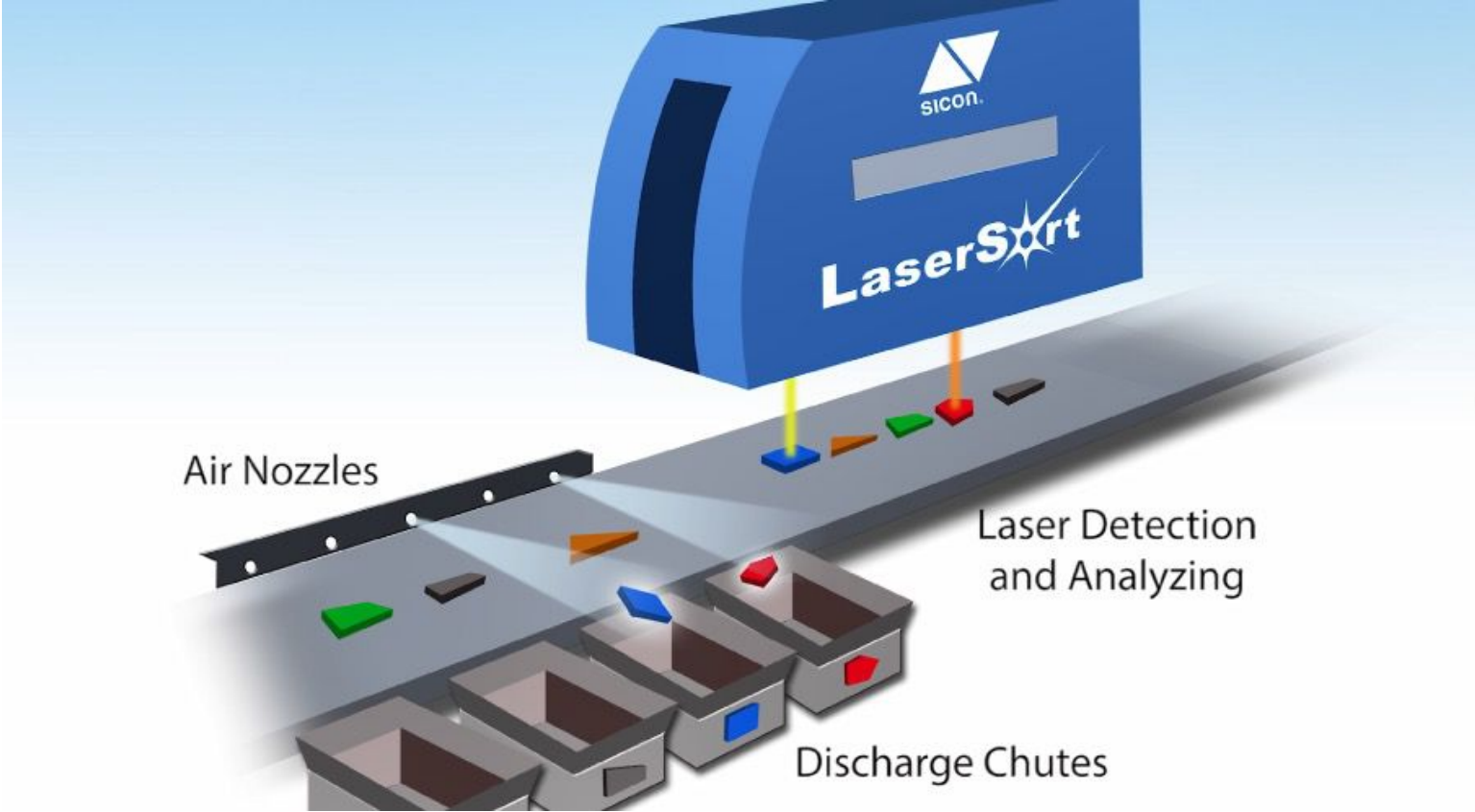
- Surface cleaning by second laser
- Increase of penetration depth
- Reduction of surface effects
- Waving of sample cleaning



Steinert LSS



Sicon Sorter



Presentation our technology at the G20



**The World's First LIBS Sorter Machine
Successfully Developed for Commercialization**

— Using a laser for individual item screening enables precise sorting of materials, for the ultimate in recycling technology —

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System

 **ARENNA**
国立研究開発法人 産総研
NATIONAL INSTITUTE OF
ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

SECOPTA
laser based sensor systems
MopaLIBS by SECOPTA



LIBS prototype sorter is made by Pellenc ST Japan



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20.01.2022

AMAP, LIBS for AI

22

Small Sorters in Japan





20.01.2022

AMAP, LIBS for AI

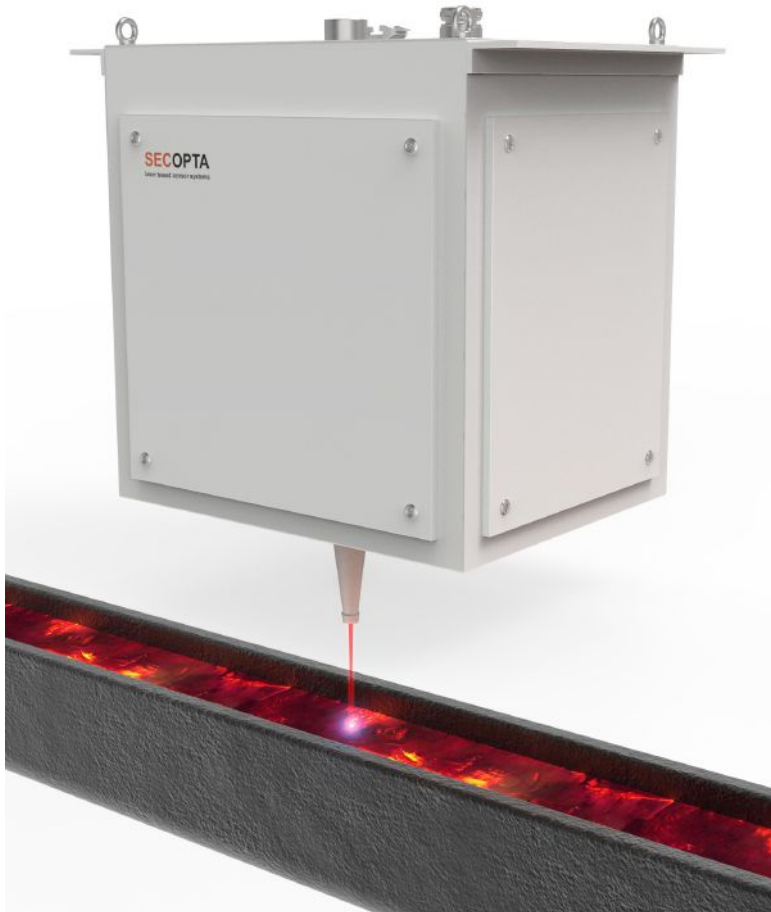


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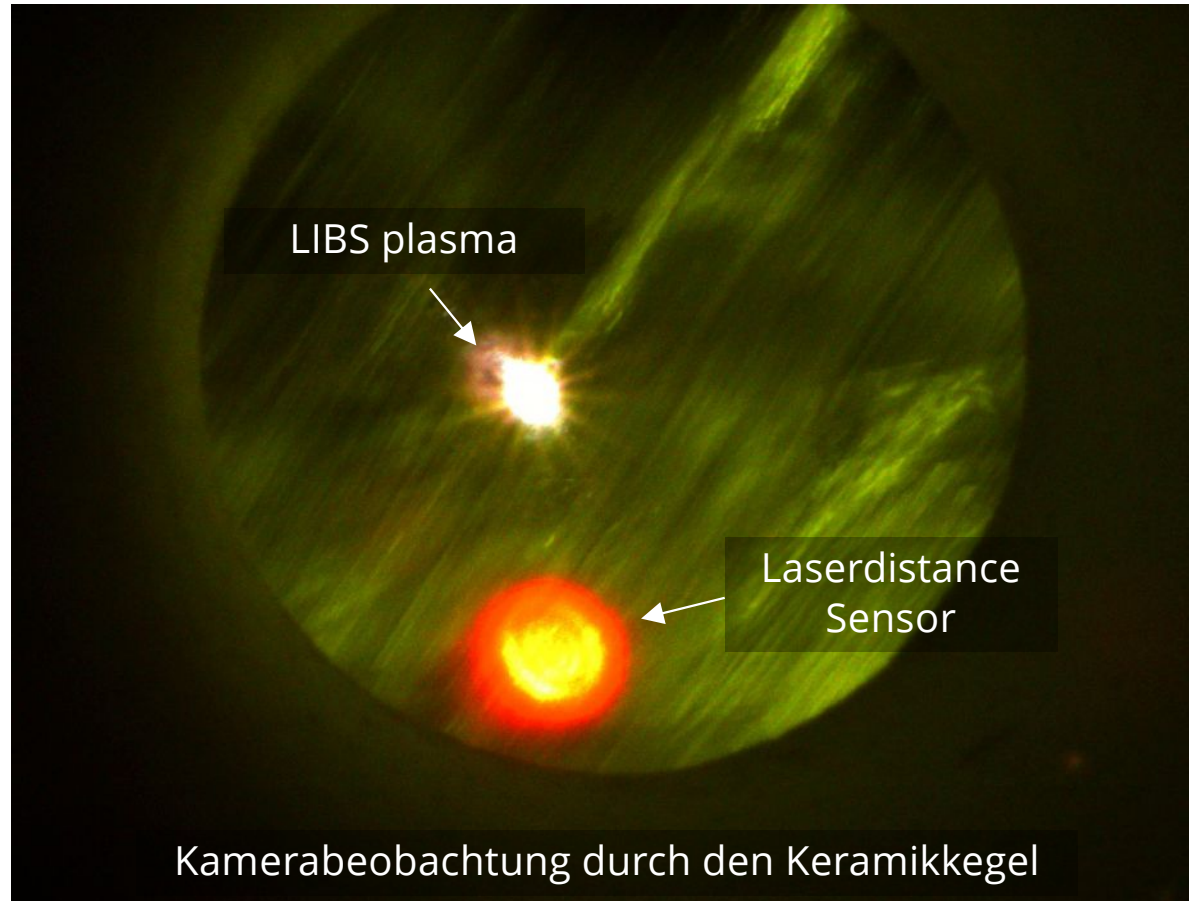
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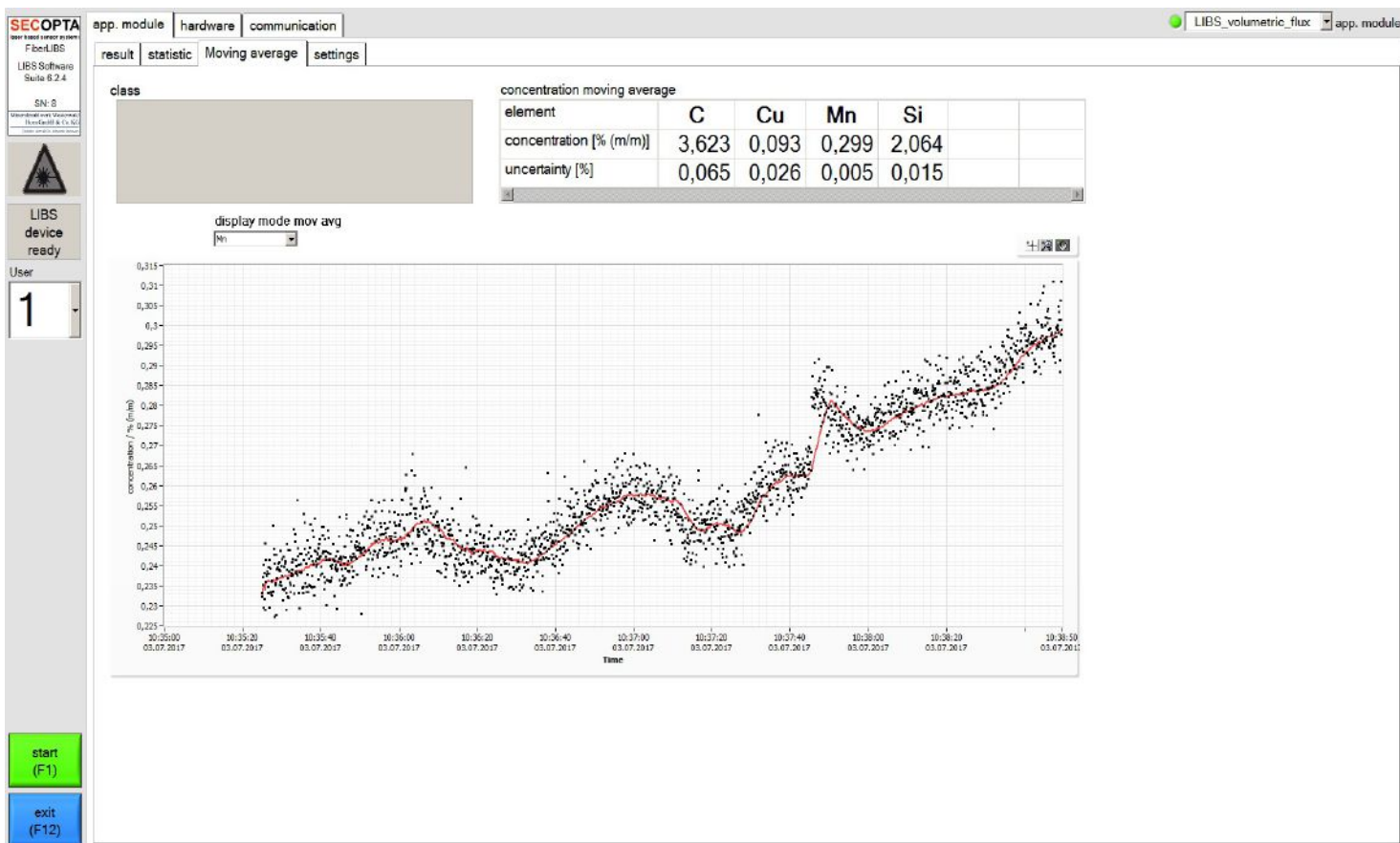
MeltLIBS – in process



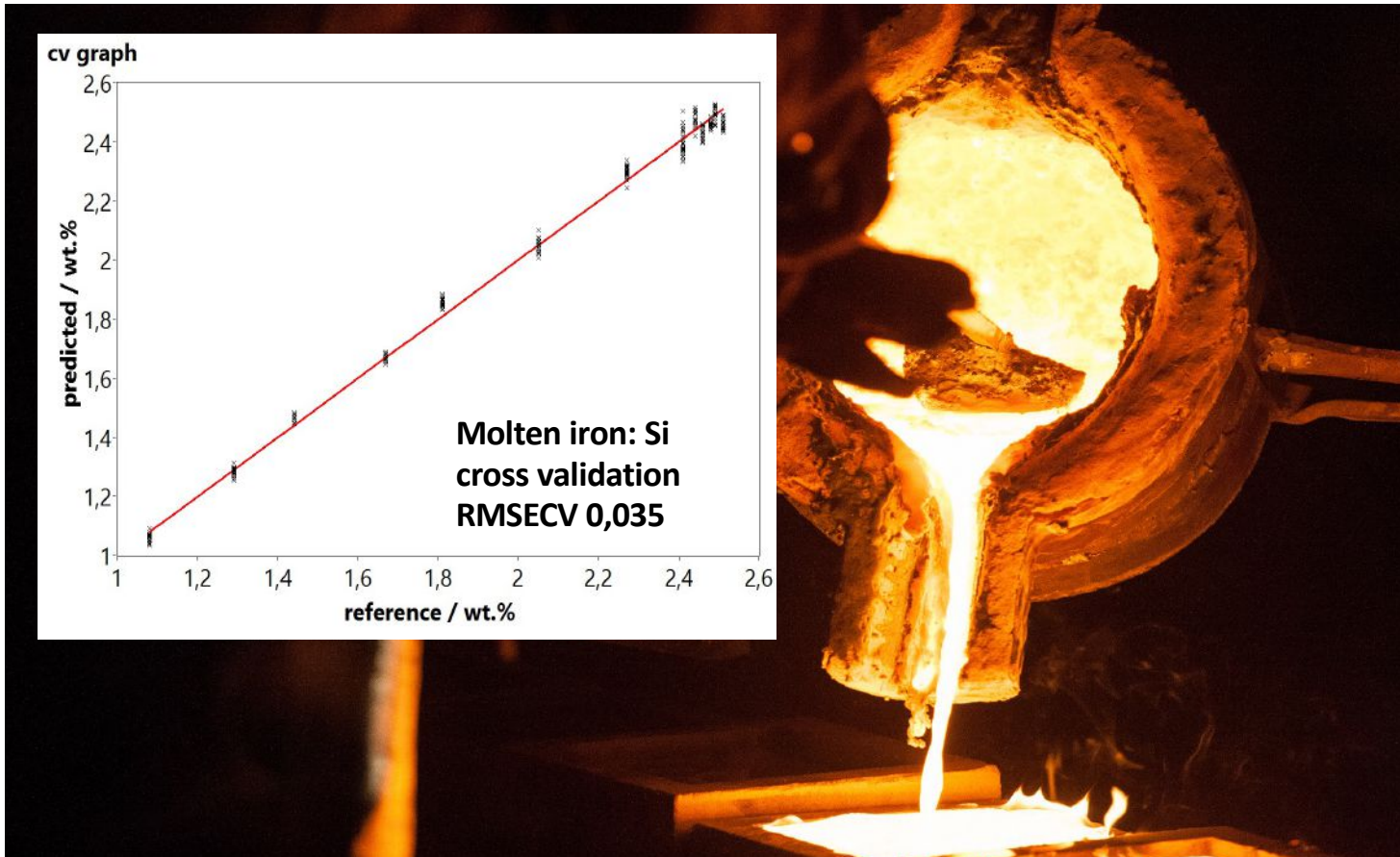
Camera view through the measurement hole



Software and GUI



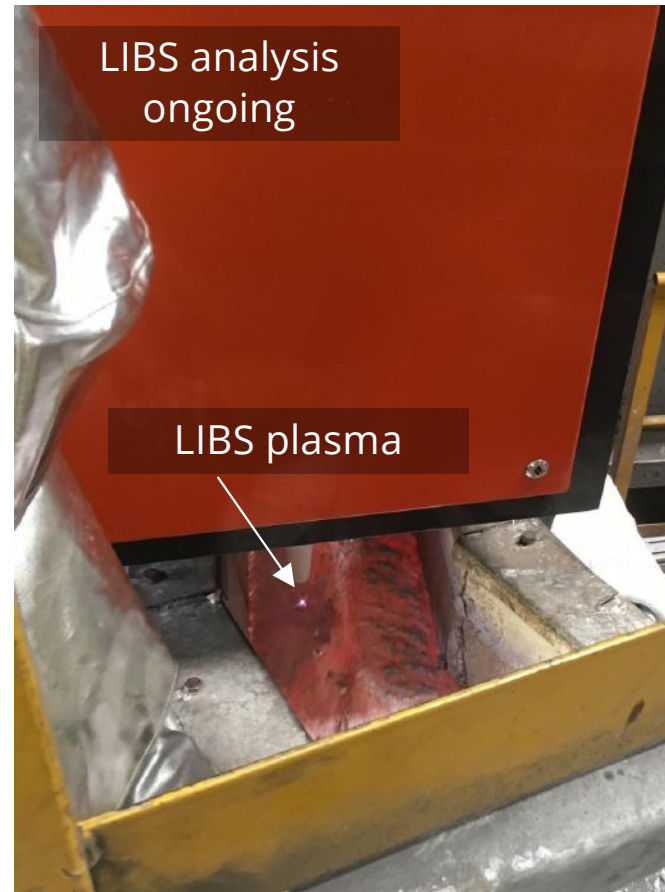
Liquid iron: calibration Si



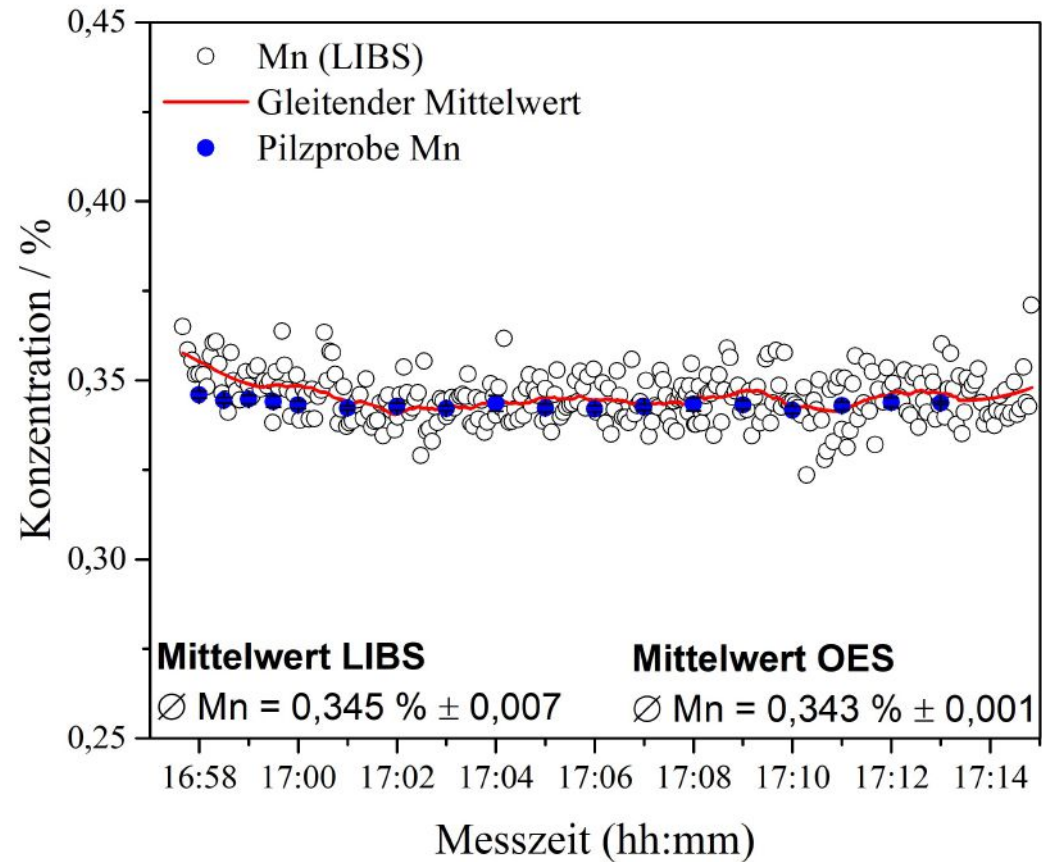
meltLIBS II, Aluminum Analysis



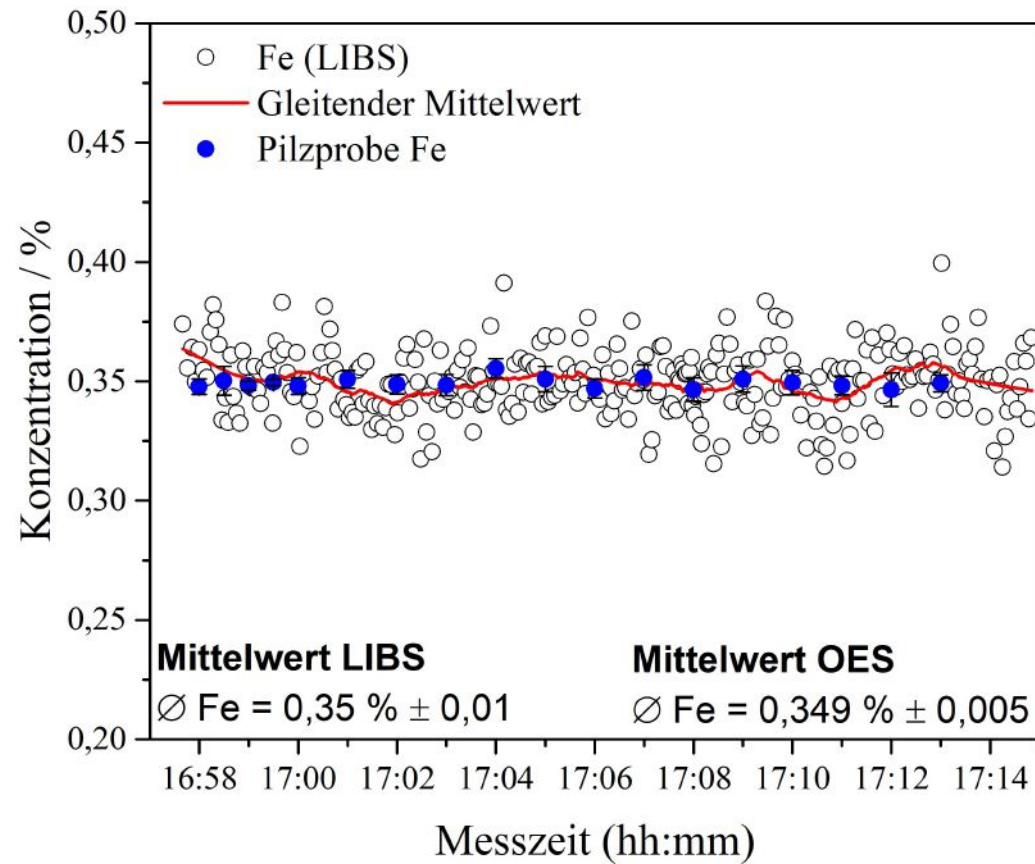
Liquid aluminium analysis



LIBS results of inline MeltLIBS measurements



LIBS results of inline MeltLIBS measurements



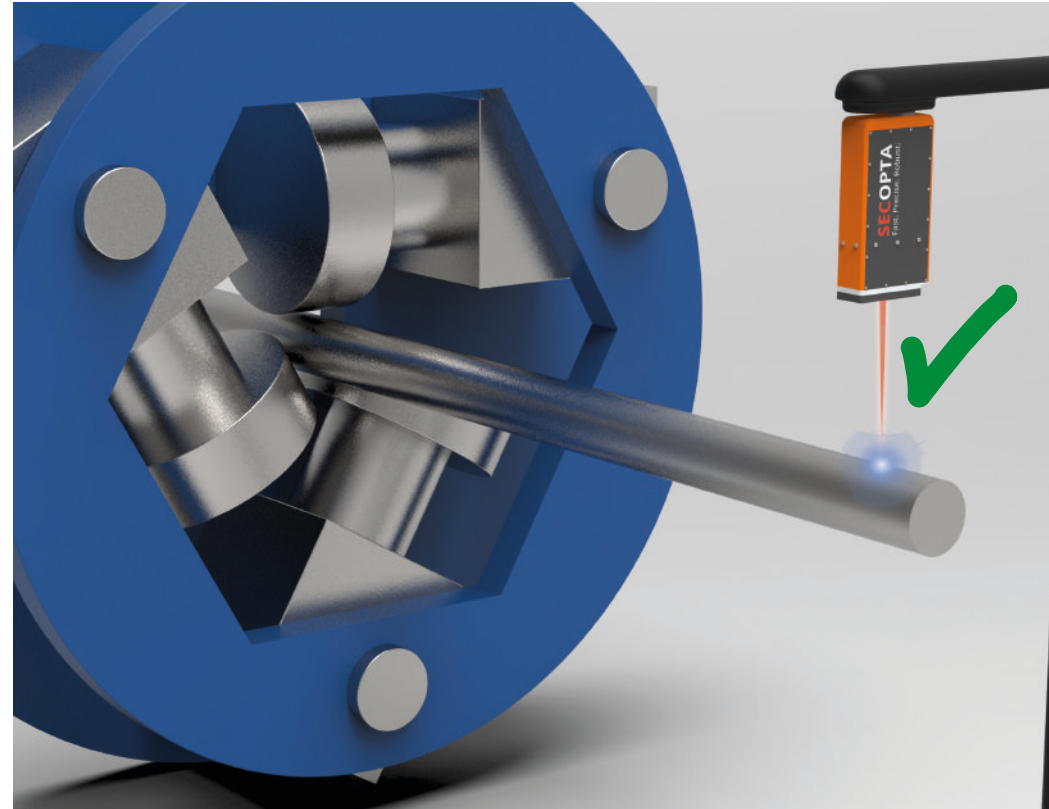
Analytical performance of MeltLIBS

SECOPTA analytics standard calibration

	Element	Min. wt.%	Max. wt.%	Precision
Based on standard calibration (quantitative calibration)	Si	0	1.50	4 %
	Cu	0	0.32	6 %
	Fe	0	1.20	6 %
	Mn	0	2.25	4 %
	Mg	0	5.60	5 %
	Cr	0	0.24	5 %
	Zn	0	0.30	5 %
	Ti	0	0.34	6 %
Alarm thresholds (semi-quantitative)	V	> 1000 ppm	-	1 σ
	Sn	> 1000 ppm	-	1 σ
	Pb	> 1000 ppm	-	1 σ
	Zr	> 1000 ppm	-	1 σ
	Na	> 1000 ppm	-	1 σ
	Ca	> 1000 ppm	-	1 σ

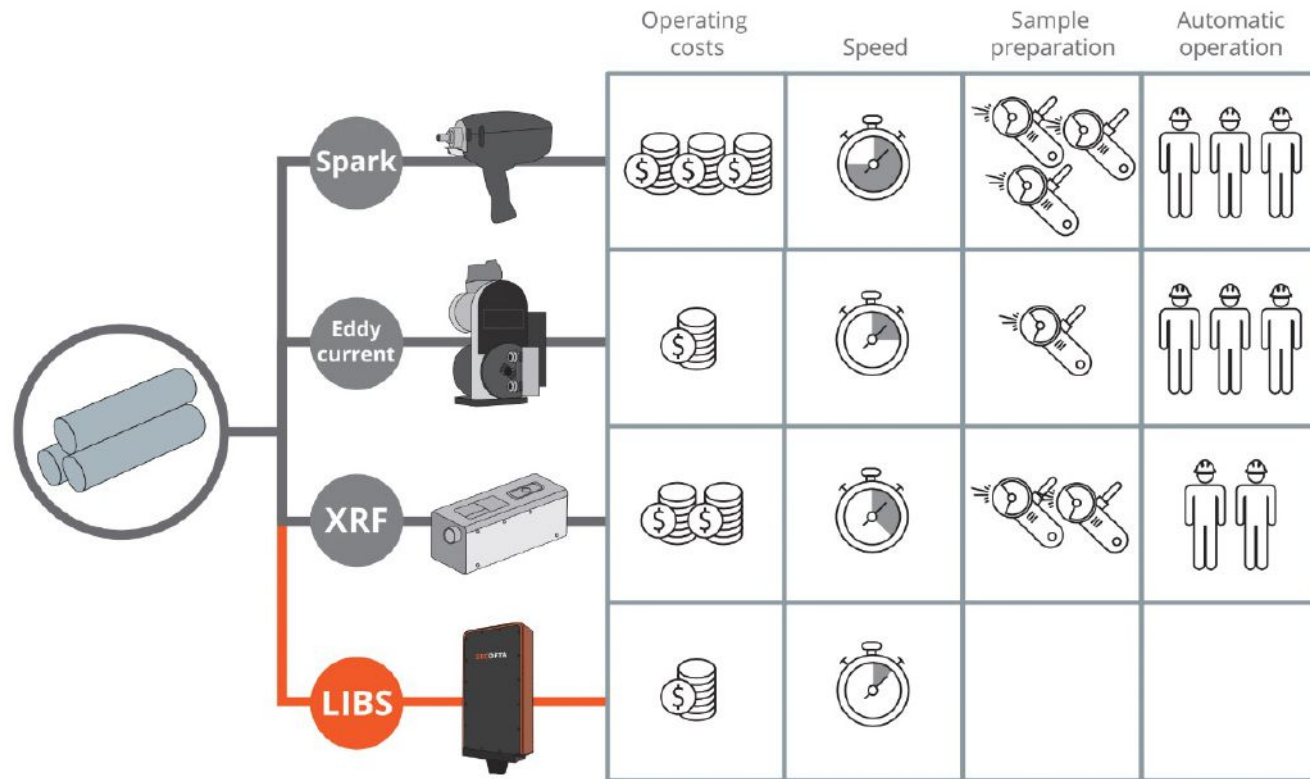
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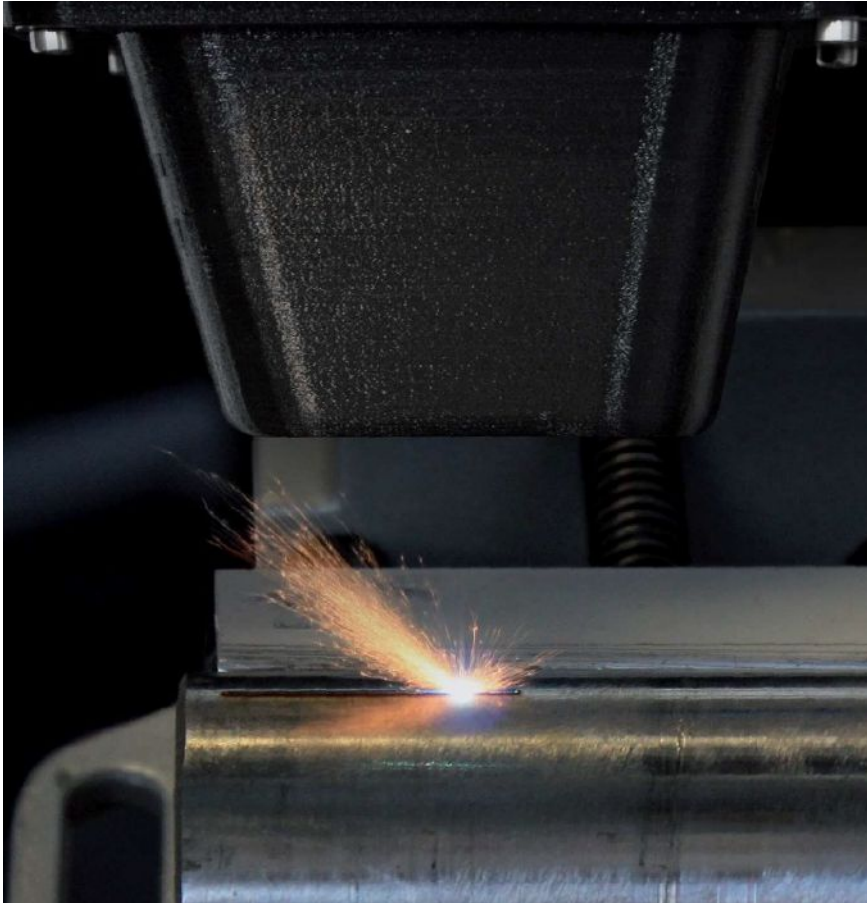


PMI Market Overview



Comparing today's standard PMI approaches and the LIBS

PMI Technology – LIBS



- + Inline applicable
- + Speed
- + Low operating costs
- + Fully automatic
- + Integrated sample preparation
- + Universal
- + Based on chemical composition

- Market implementation ongoing
- Initial Invest

Black bar analysis – Laser safe housing



SECOPTA PMI software

SECOPTA
FiberLIBS
LIBS Software
Suite 6.7.9
SN: 20180921
12.33.09.6

LIBS device ready

User: **1**

language: EN

start (F1)

exit (F12)

module | status | communication

quality_control | app. module

result | history | settings

order nr:

ok

97,67 %

element	target value m%	measured value m%	deviation m%	match %	measurement error
Al	0,03	0,03	0,00	94,54	0,01
Cr	0,09	0,08	0,01	97,32	0,02
Cu	0,05	0,05	0,00	99,80	0,03
Mn	0,67	0,65	0,02	98,97	0,12
Mo	0,00	0,00	0,00	99,98	0,03
Ni	0,01	0,00	0,01	96,68	0,03
Si	0,21	0,23	0,02	92,08	0,04
Ti	0,01	0,01	0,00	99,99	0,03
V	0,00	0,00	0,00	99,98	0,04

overall consistency

target %

SECOPTA PMI software

SECOPTA FiberLIBS LIBS Software Suite 6.7.9
 SN: 20180321 12.38:54.3

LIBS device ready

User: 1

language: EN

start (F1)

exit (F12)

module status communication quality_control app.module

result history settings

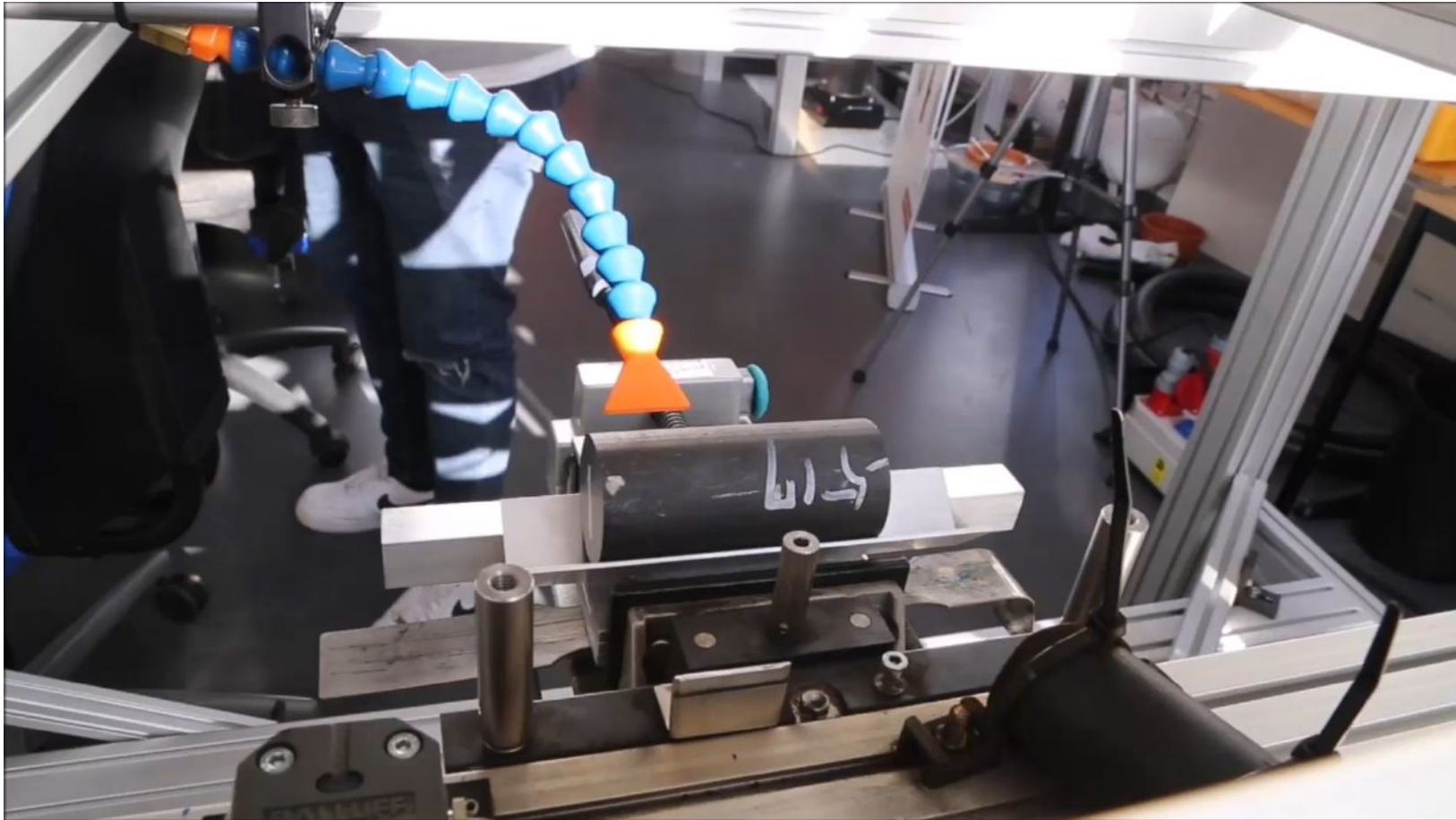
order nr: 56790

result: not ok 0,00 %

element	target value m%	measured value m%	deviation m%	match %	measurement error
Al	0,02	0,03	0,01	71,08	0,01
Cr	1,17	0,09	1,08	0,00	0,02
Cu	0,02	0,05	0,03	66,04	0,03
Mn	1,06	0,65	0,41	50,38	0,12
Mo	0,00	0,00	0,00	99,97	0,03
Ni	0,00	0,00	0,00	99,98	0,03
Si	0,27	0,21	0,06	96,30	0,04
Ti	0,01	0,01	0,00	99,98	0,03
V	0,00	0,00	0,00	99,98	0,04

overall consistency: 95,00 target %

The measurements



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Bright bar production reference 1



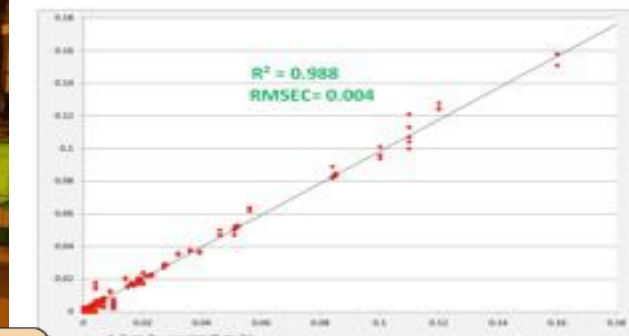
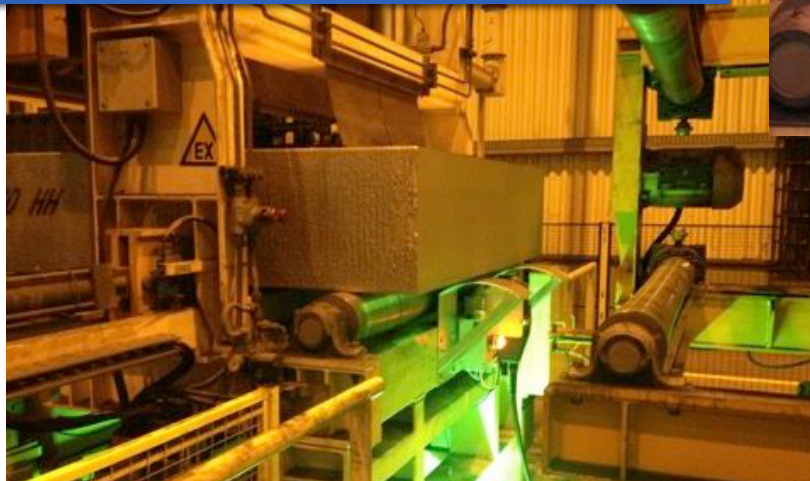
Bright bar production reference 2



Inline identification of rolling ingots

Application

- Identify the customer's material number of the Al alloy
- Find confusion in feeding material



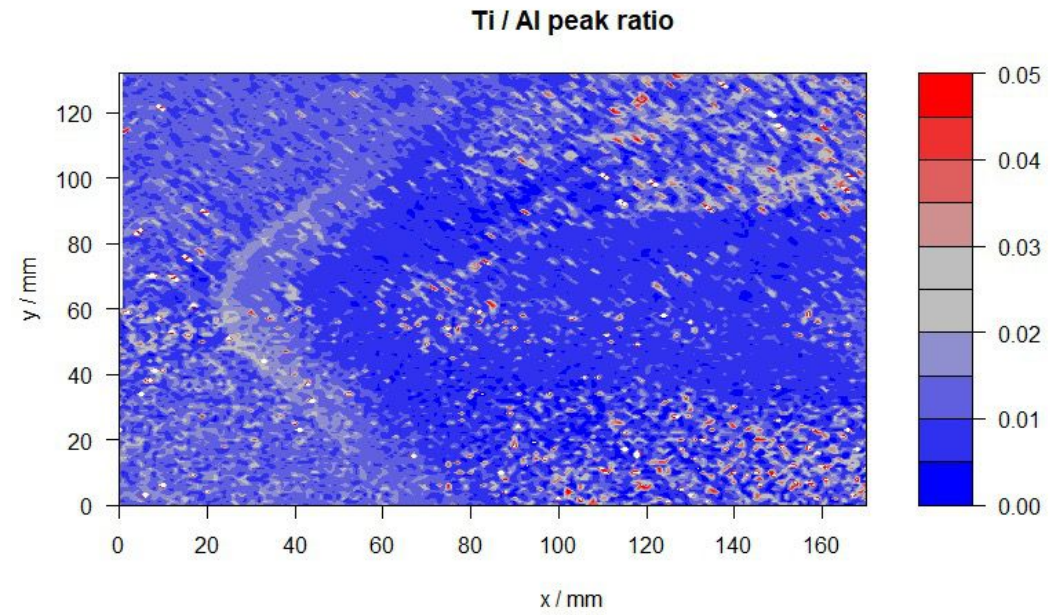
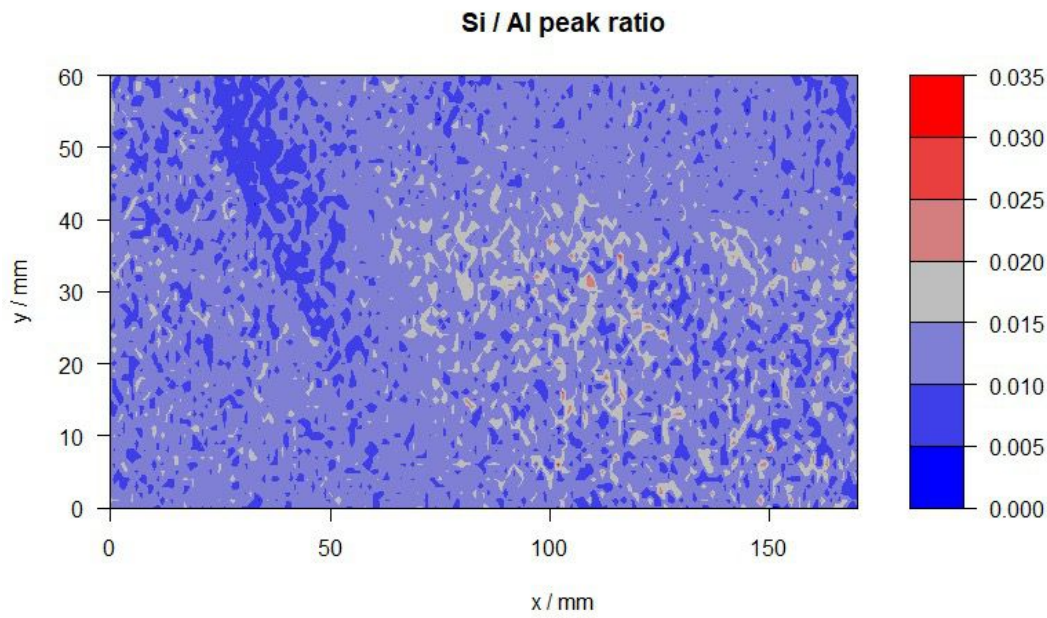
Determination of the concentrations of elements in alloy composition

Content

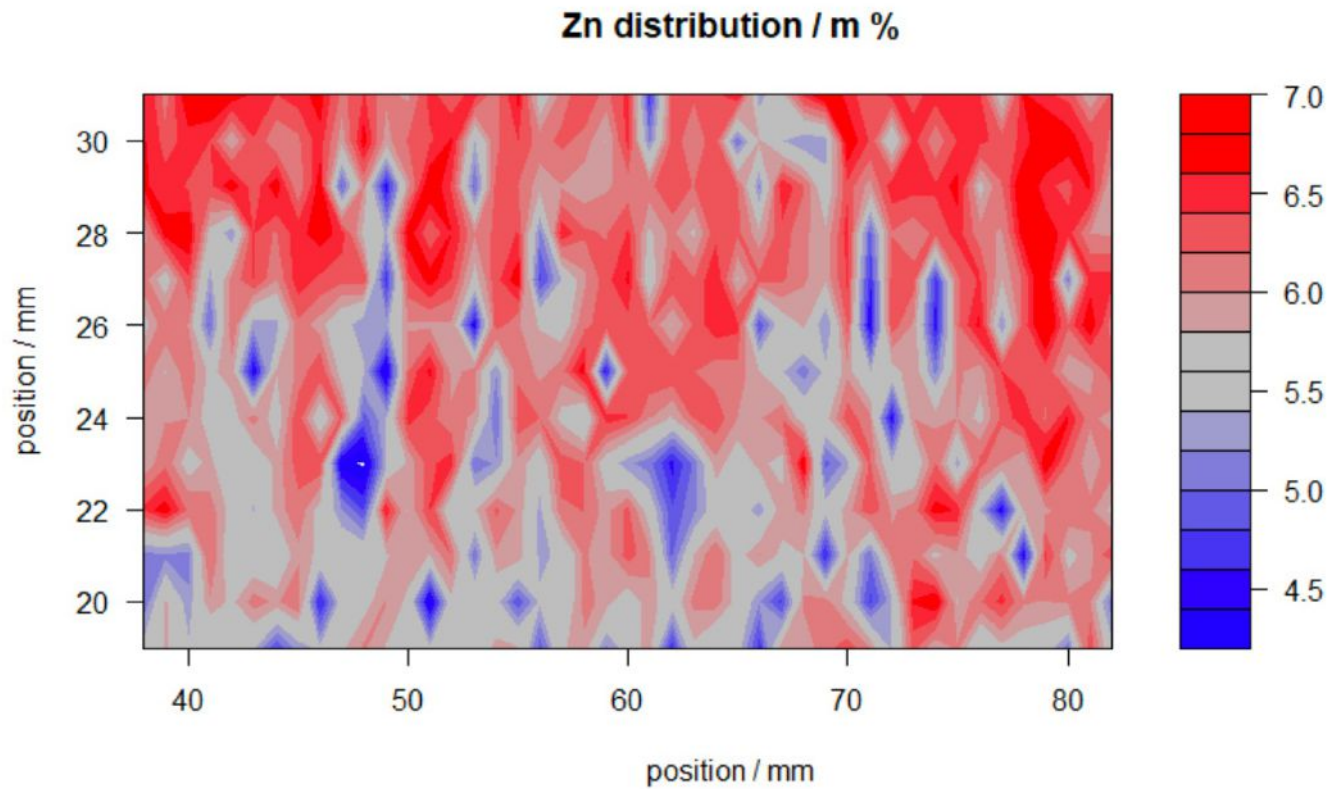
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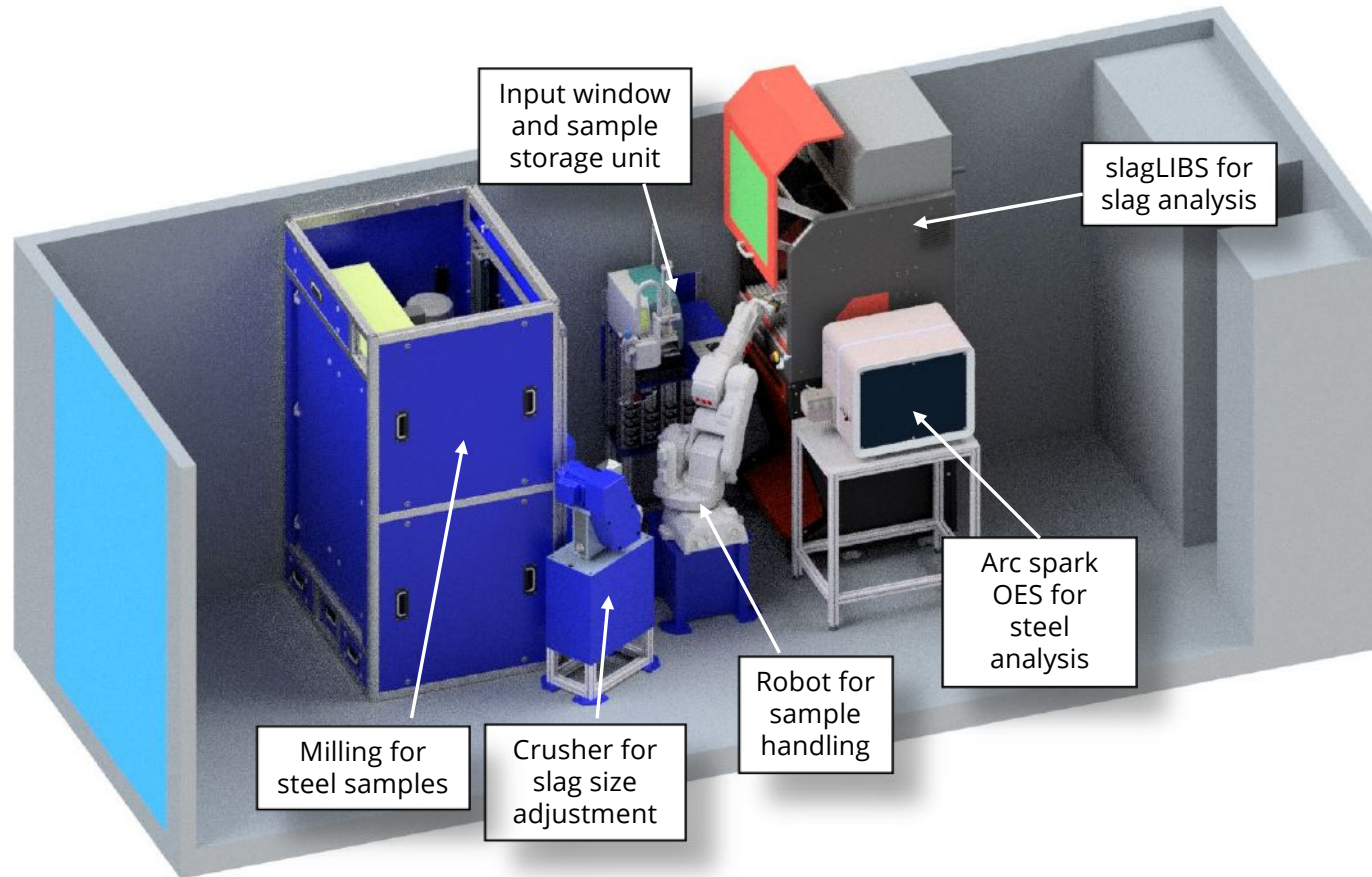
Segregation in Al



Other Al sample, 5,9wt.% Zn



slagLIBS at-line container solution with spark OES - 1



References



The reliable innovative partner to be front runners in the metals industry



Summary



LIBS is an innovative universal elemental analysis technique

fast.

LIBS is extreme fast, results within ms, >350 measurements/s



LIBS is much more precise than other process measurement techniques like XRF or neutrons



LIBS systems from Secopta are extremely robust: Low maintenance



LIBS can be used under harsh industrial environmental conditions, e.g. for primary raw materials - sorting or quality control



LIBS can be used quantitative or qualitative (classification), Secopta provides standard applications as well as individual chemometric models

Customers Benefit



High add Value for the Customer
Low Cost of Ownership



Reliable long term Partnership is our Key Value



Our local Partners are essential for our sales approach



Professional Service together with our
Japanese - German Service Team



Easy and mediate Remote maintenance possible upon request



High Quality - Made in Germany

Thank you for your attention...



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