RMI

ANALYTICAL & TESTING INSTRUMENTS

- **Prodej a servis analytické přístrojové techniky**
- **Komplexní řešení problémů prvkové analýzy**

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533 41 Lázně Bohdaneč
Tel.:466921885
Fax.:466921404
E-mail: sale@rmi.cz
Web:www.rmi.cz

Nabídka firmy RMI v oblasti LIBS a LA

- www.rmi.cz
- Kompletní systémy LIBS (LEA 500, PORTA LIBS 2000)
- Spektrometrické systémy pro LIBS

  kompletní sortiment od „low cost“ systémů po „Hi Res“ Echelle systémy
- Lasery (Dvoupulzní ns Nd:YAG lasery)
- Detektory (intenzifikované CCD kamery)

LEA 500

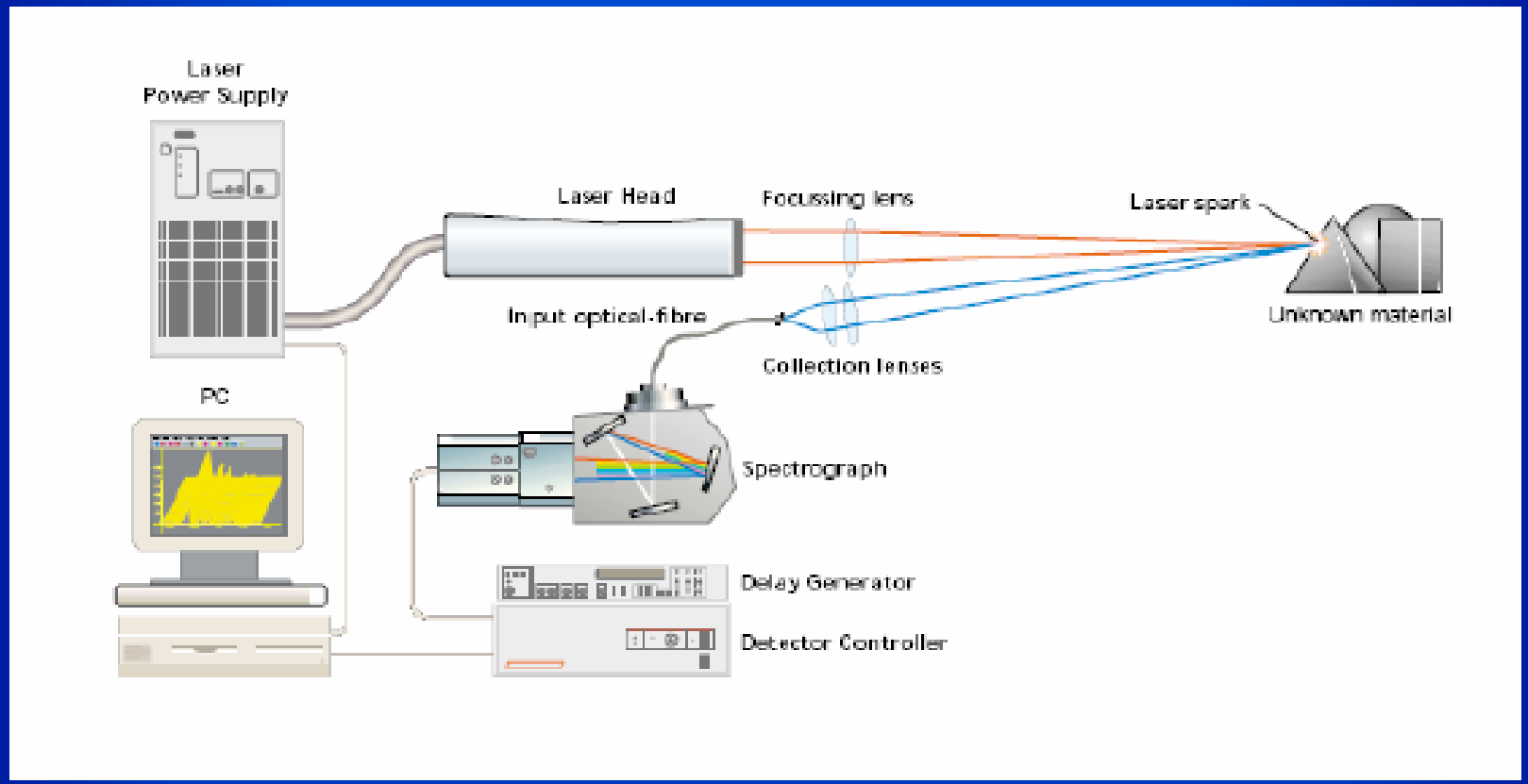
The next generation of

LIBS

Laser Elemental Analyzer

LEA-S500

Základní optické schéma systému



Laser – Nd:YAG dvoupulzní laser

Vlnová délka: 1024 nm

Energie pulzu: nastavitelná 80 – 150 mJ

Prodleva mezi pulzy: nastavitelná 0 – 20 us

Opakovací frekvence: 20 Hz

Stabilita energie pulzů: lepší jak +/- 3%

Chlazení: autonomní

Polarizace: lineární

Polarizace následných pulzů: kolmá

Laser – Nd:YAG dvoupulzní laser

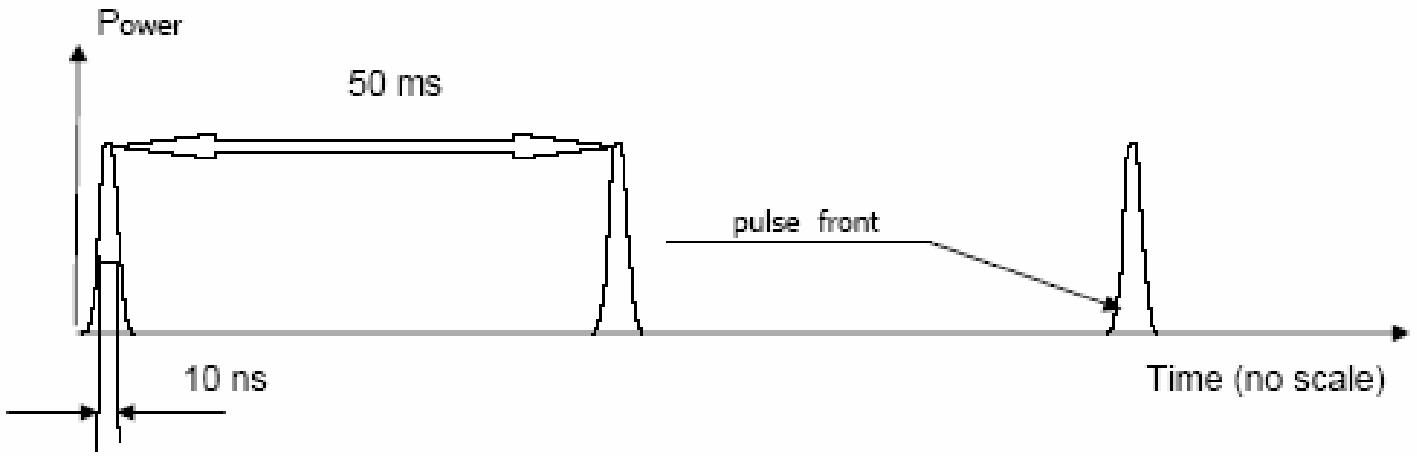
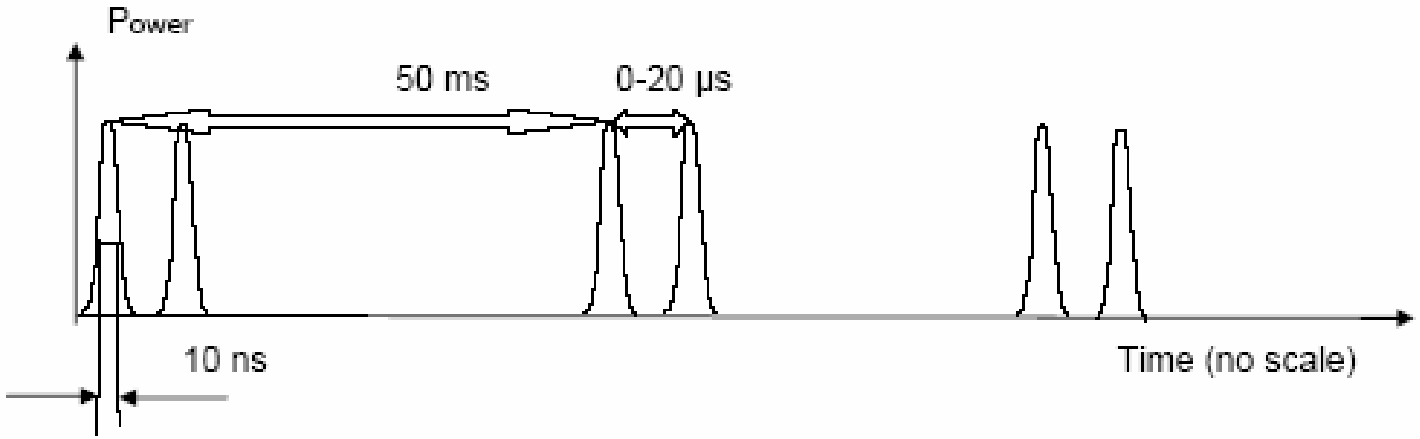
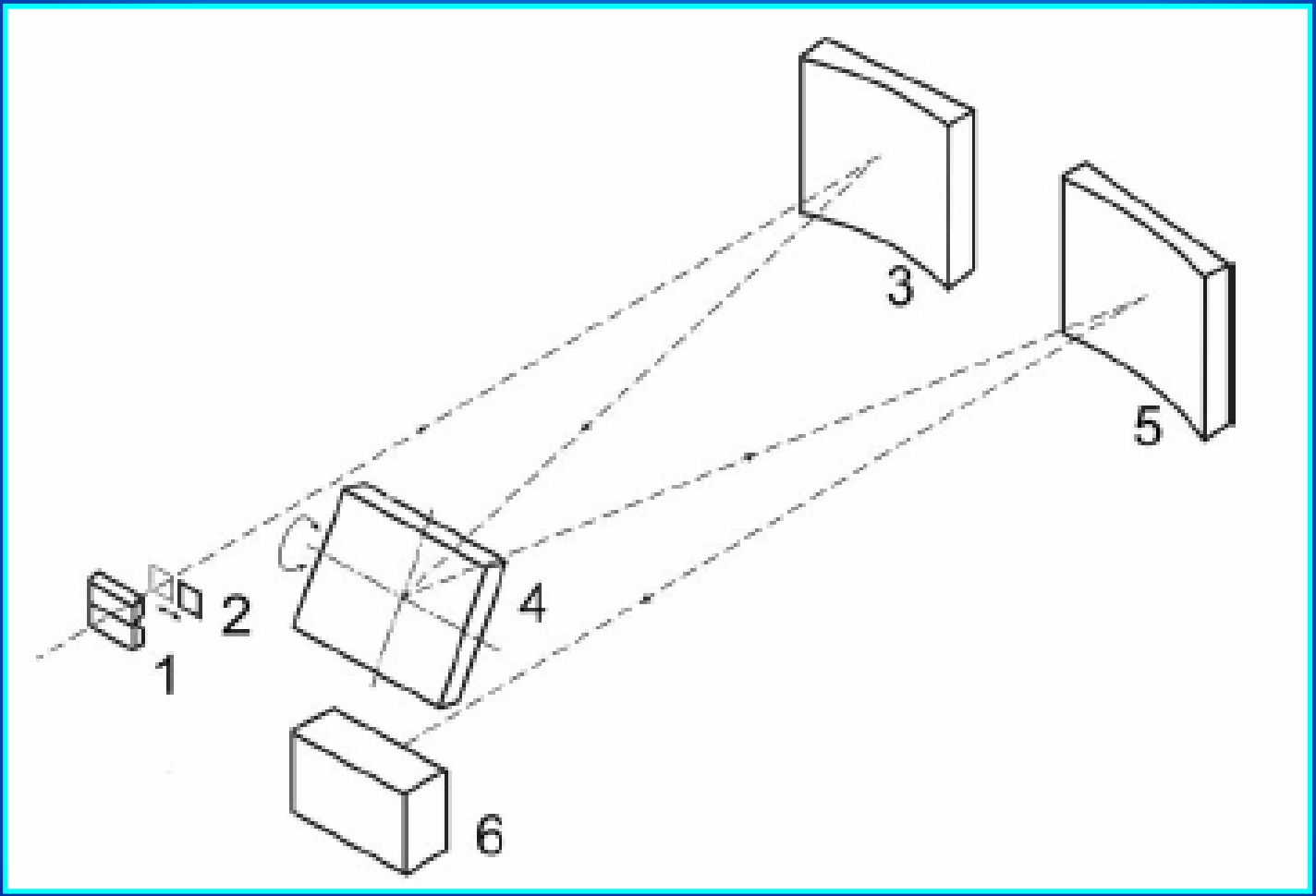


Fig.2a. Single-pulse mode of laser operation



Spektrometrický systém

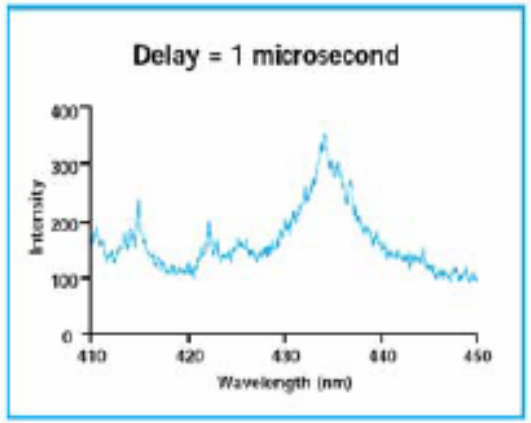


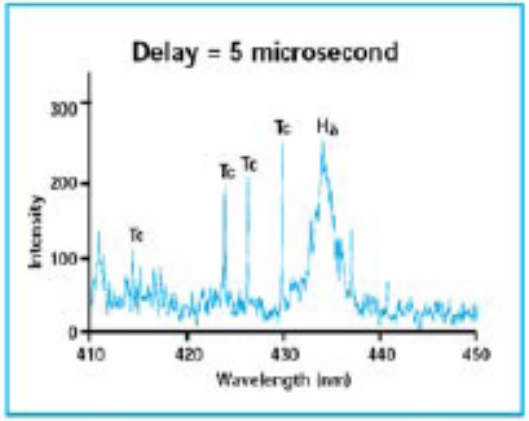
Specifikace

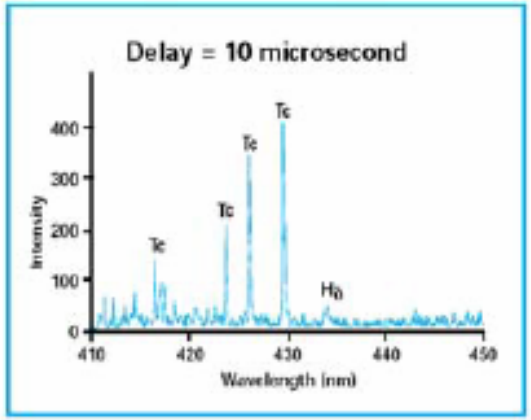
Focal length (mm):	500	500	500
Grating (grooves/mm):	1800	2400	3600
Wavelength range (nm):	170-800	170-600	170-400
Dispersion (nm/mm):	1.0	0.7	0.5
Wavelength resolution (nm):	0.028	0.020	0.014

Ar filled optics for wavelenght range to 170 nm

Detekční systém – nutná vysoká rychlost – nejlépe 1 us







Detekční systém – specifikace

„Back Thinned“ and „Front Illuminated CCD“

2048x14 pixel

Spektrální rozsah 180 – 1100 nm

Doba načítání signálu (min.) – 1 us !!!

ADC: ultra fast 14 bit

Komunikace: Ethernet 100

Vzorkový prostor

Vzorkový prostor, fokusační optika

Evakuovaný, možnost práce v Ar atmosféře

Velikost erozního spotu: 0.03 – 1.2 mm

Zobrazení povrchu videokamerou: 1.2 x 1.2 mm

Aligment laser: 1 mW, 650-680 nm

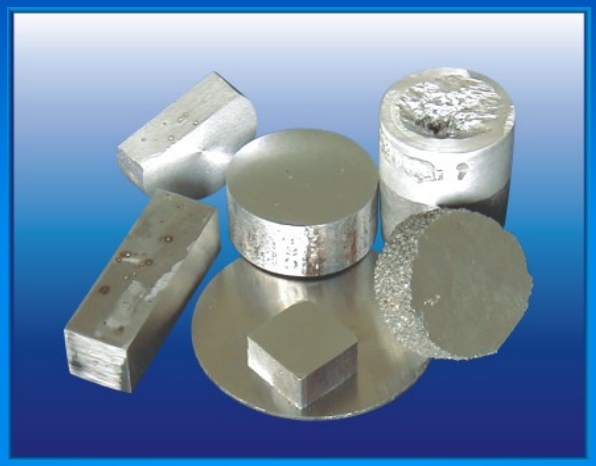
Max. velikost vzorku: 75 x 75 x 40 mm

Rozsah X – Y posunu: 5 x 5 mm

Min. krok posunu: 1 um

Analyzovatelné materiály

Cu-slitiny a čistá Cu báze



Fe-slitiny (surové Fe, ocel), Al-slitiny a čistá Al báze

Sklo, monokrystaly, drahé kameny, …

Keramika

Plasty

Další typické aplikace

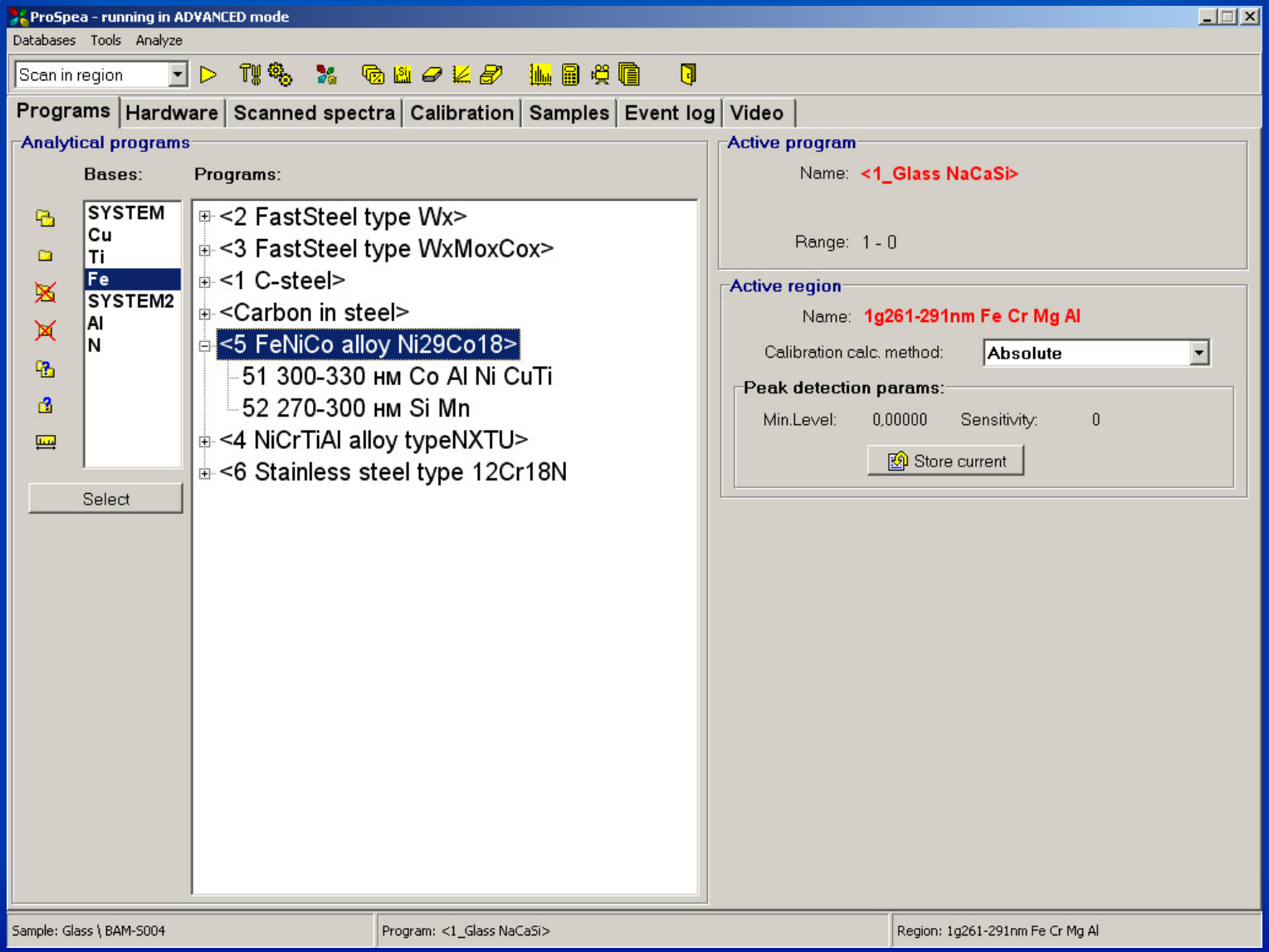
- ✓ *stopová analýza čistých materiálů*
- ✓ *lisované přášky*
- ✓ *vodivé & nevodivé materiály*
- ✓ *analýza vrstev, tenké vrstvy, tloušťka vrstev*

SOFTWARE

Win9x/2000/XP

Analytické Programy

Analytical programs



Control
of System Status

Základní nastavení

ProSpea - running in ADVANCED mode

Databases Tools Analyze

Scan in region

Programs | Hardware | Scanned spectra | Calibration | Samples | Event log | Video

Region parameters | Current device state | Global parameters

Detector

Exposure time: 10 msec

Time between scan: 10 msec

Array for scanning: 6 As active graph

Cycle

NonStop

Counter

Store Series

Counter limit: 1

Accumulation

Averaging

Summing

Count: 40

BackGround

Auto Substraction

Get

Blank flashes

Do before scan

0

Update View

Laser

Lamp parameters

Mode: Internal

Frequency: 19 Hz

Lamp energy: 5 J

Duty arc time: 30 sec

Q-SW parameters

Mode: Internal

First channel

Q-SW delay: 147 µs

Second channel

Q-SW delay: 153 µs

Single channel

OFF | Q-SW | Shutter

Lamp | Q-SW2 | Shutter2

Spectrometer

Shutter

Open | Close

Filter

Wavelength correction

WL 780,0000nm L:28 C:2 R:0

use correction

auto Change...

Slit width

35 µm

WaveLength

Current: 770 nm

Dispersion: 0,74 nm/mm

Turn Slit

13 degree

Auto Control

Vacuum

Pump

Auto Vacuum Time, msec: 7000

Auto Clean

MaxLeak is Closed Current: 0

PUMP ON | PUMP OFF

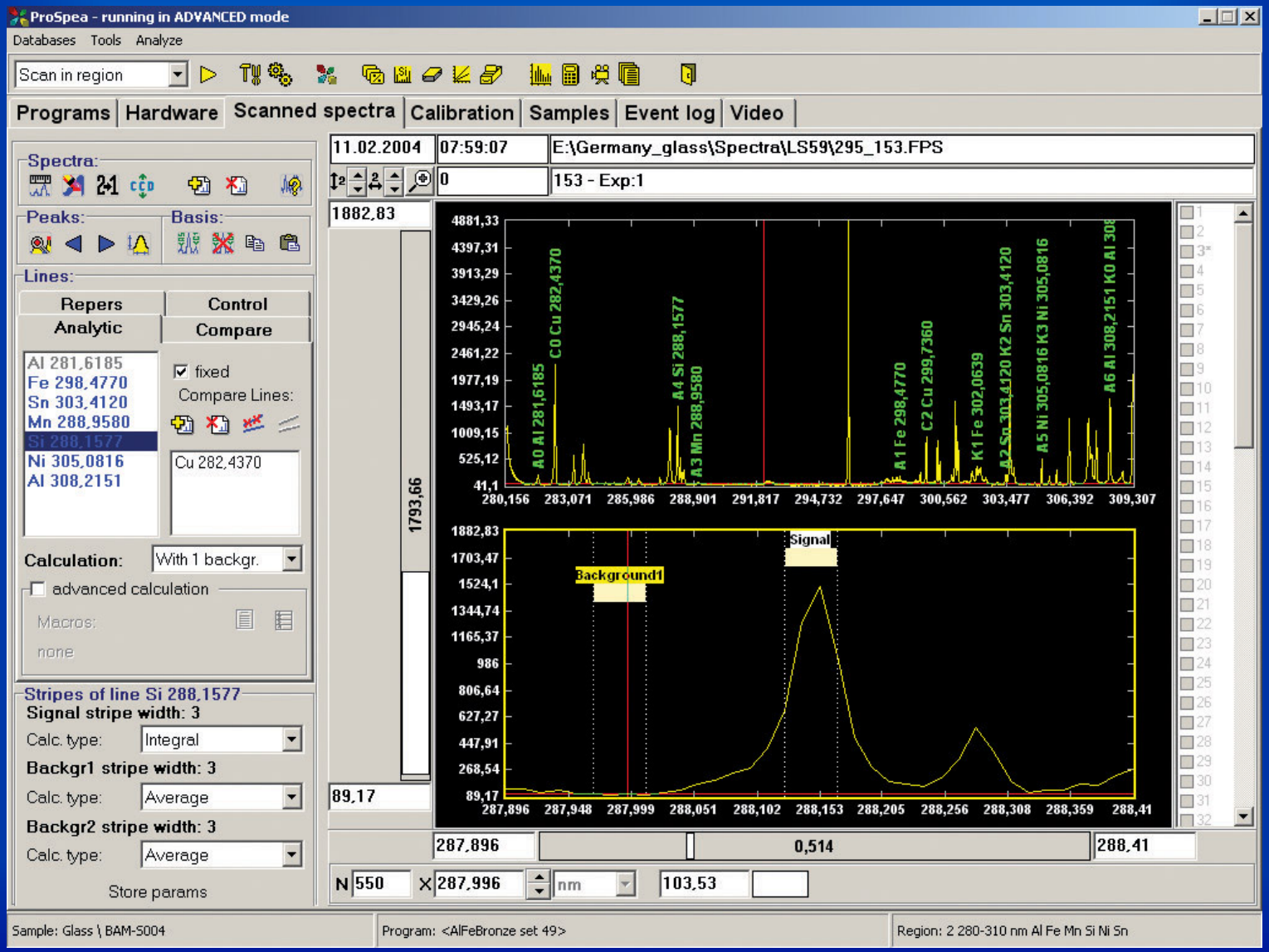
Leak

Value: 100 Set

Query | Set | Set this params to active region

Sample: Glass \ BAM-S004 | Program: <AlFeBronze set 49> | Region: 2 280-310 nm Al Fe Mn Si Ni Sn

Záznam spekter



Kalibrace

ProSpea - running in ADVANCED mode

Databases Tools Analyze

Scan in region

Programs | Hardware | Scanned spectra | Calibration | Samples | Event log | Video

Global parameters:

Calibration params

Recalibration params

Gr.Deviation,%: 2,5921

Delta C avg,%: 1,9301

Delta I,%: 0

Channels:

Al - 1
Fe - 1
Sn - 1
Mn - 1
Si - 1
Ni - 1
Al - 2

Approximation type: Line

Analitic Line: Sn 303,4120

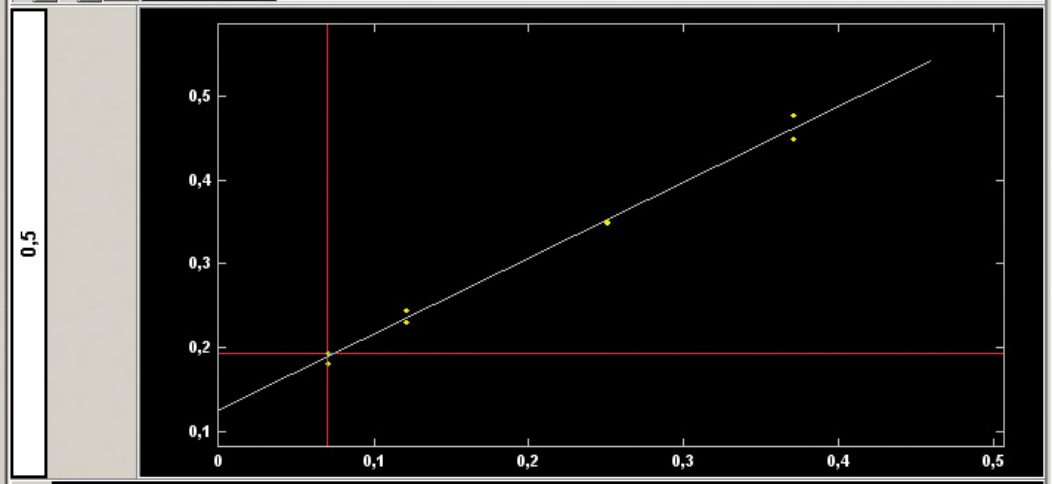
Calibration | Recalibration

Standards:

[2/2] Cu alloy set 49 / 491
[2/2] Cu alloy set 49 / 492
[2/2] Cu alloy set 49 / 493
[2/2] Cu alloy set 49 / 494
[0/2] Cu alloy set 49 / 495

30.12.1899 00:00:00

0



N 1 X 0,07 Percen 0,19

*	Standard	Ct, %	CC, %	dC, %	Intensity	dIntensity	RMSD
	494	0,0700	0,0680	2,908	0,1871	0	14,3997
	494-1	0,0700	0,0749	10,111	0,1934	3,3926	
	494-2	0,0700	0,0611	-10,176	0,1807	-3,3969	

Sample: Glass \ BAM-S004 | Program: <AlFeBronze set 49> | Region: 2 280-310 nm Al Fe Mn Si Ni Sn

Experimental Results of Observation Field

Samples Database

ProSpea - running in ADVANCED mode

Databases Tools Analyze

Scan in region

Programs | Hardware | Scanned spectra | Calibration | Samples | Event log | Video

Sample management:

Sample description:

Groups:

Aluminium

Names:

testarea
7
4
21
211
212
34
41
42
43
44
26
test
126

Point analysis | Area analysis

Dates:

23.03.2004

Programs:

Alternative
Scan-1 (5x5) - [14:42]
Scan-2 (5x5) - [14:46]
Scan-3 (5x5) - [14:51]
Scan-4 (20x20) - [14:56]

Experiments results:

view considering error

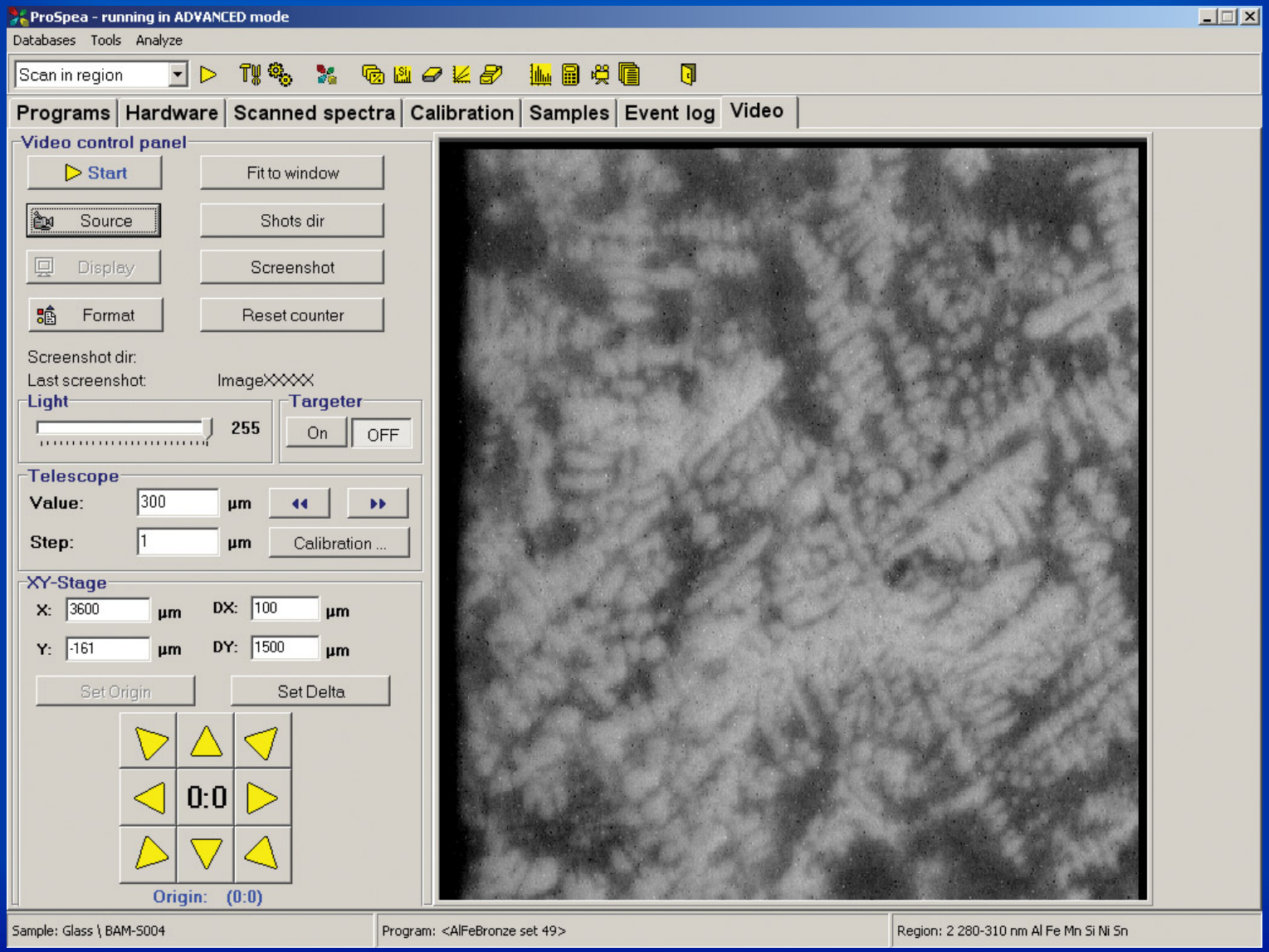
Search of analogs

N	Cu-1	Cu-2	Fe-1	Ni-1	Si-1
2	0.1827	<0	<0	0.0964	>0
3	0.2952	<0	<0	0.0986	14.9329
4	0.4083	<0	<0	0.1834	>0
5	0.8948	0.1993	0.5128	0.5623	14.6045
6	2.1999	2.2843	1.0421	1.3106	10.6242
7	0.5844	1.7356	0.3814	0.4345	14.2429
8	1.9461	1.6049	0.6181	1.1855	11.2064
9	0.4717	<0	0.5372	0.4496	15.3522
10	0.3795	<0	0.3328	0.2988	>0

Sample: Aluminium \26 | Program: <Алюминиевые литейные сплавы> | Region: 275 Fe Mg Mn Si

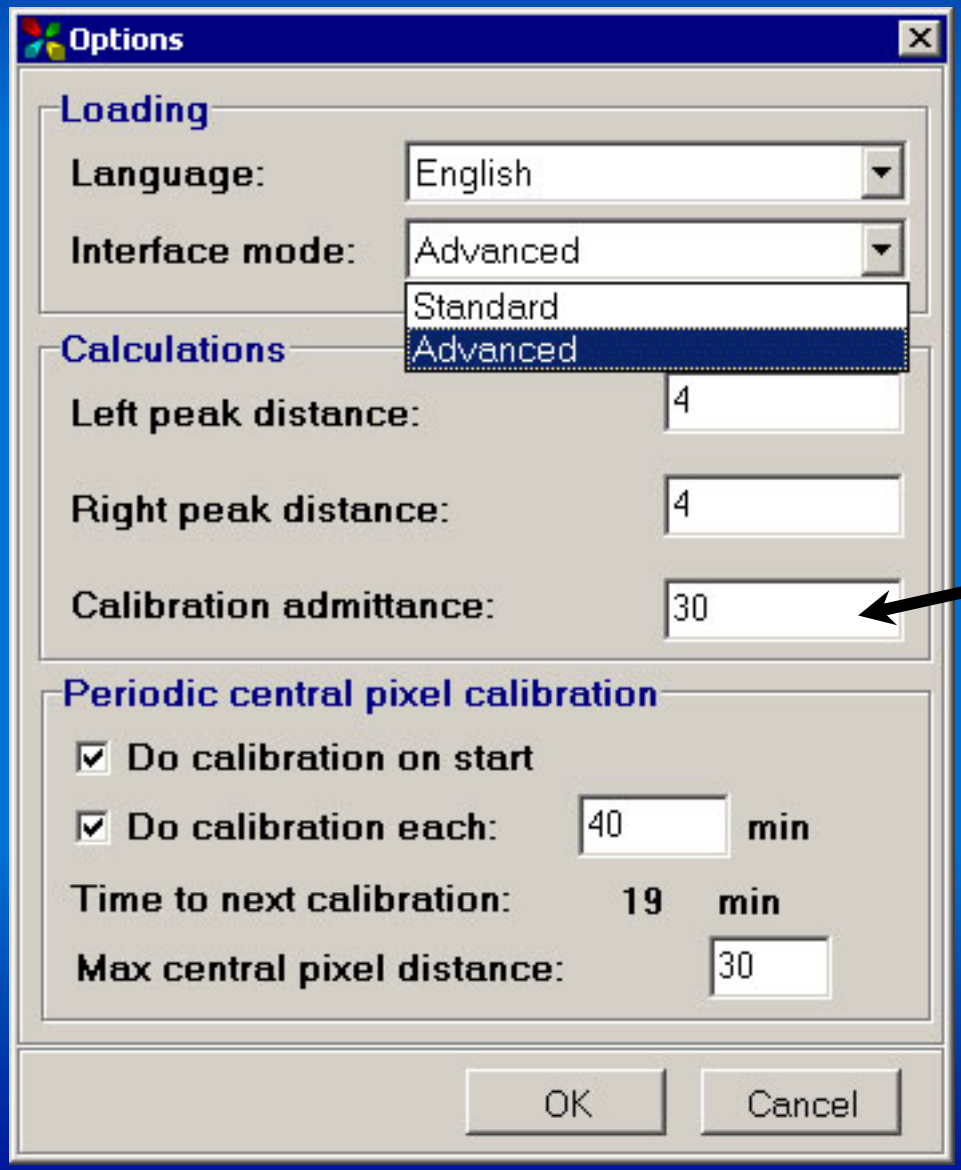
Video

Settings of Observation Field *(XY stage, surface)*



Options

Selection and Setting of Main Options



Method of Standard Additions (MSA)

Database of Standards and Analytical programs

absolute type

Etalons database

Data type
Concentr. Thicknes

Groups:
102
Pb-Sb alloy (620-74)
Cast aluminium (137-143)
Special Cast Iron
Bor
Aluminium Alloys (Mosco
Phbr
Bronse & Brass

Measure type: abs

Measure unit: %

Active etalon
Add to routine

Database edit
Group Etalon

Fix etalon names

	Name	Al	Cu	Mn	Ti	Cd	Mg	Fe	Si	Zn
1	1 val10	94.47399	3.5	0.94	0.32	0.37	0.086	0.19	0.12	0
2	2	95.066	3.85	0.42	0.2	0.16	0.052	0.032	0.22	0
3	3	93.79	4.93	0.57	0.21	0.22	0.025	0.11	0.145	0
4	4	94.012	5.45	0.27	0.027	0.081	0.041	0.04	0.079	0
5	5	99.87	0	0	0.13	0	0	0	0	0
6	131 d16	92.11299	4.71	0.47	0.06	0	1.48	0.48	0.35	0.26
7	132	93.46301	2.2	0.93998	0.012	0	0.86	0.62	1.16	0.58
8	133	93.37602	2.86	0.67	0.12998	0	2.27	0.33	0.15	0.15
9	134	92.799	4.15	0.59	0.083	0	0.64	0.65	0.62	0.32
10	135	92.886	5.13	0.22	0.11	0	0.37	0.26	0.074	0.81
11	136	92.69801	3.55	0.82	0	0	1.81	0.1	0.88	0.061
12	137	91.80399	1.73	1.08	0	0	2.8	0.69	1.48	0
13	181 amg	97.33702	0	0.02998	0.028	0	1.38	0.97	0.054	0.047
14	182	96.15104	0.23	0.12998	0.15	0	2.35	0.089	0.46	0.25998
15	183	94.74406	0.11	0.26998	0.10998	0	3.31	0.71	0.61998	0
16	184	93.82201	0.016	0.90998	0.022	0	4.45	0.12	0.099	0.3
17	185	92.61103	0.14	0.51998	0.058	0	5.7	0.53	0.32	0.076
18	186	91.72206	0.072	0.76998	0.075	0	6.73	0.28	0.14998	0.14
19	187	96.04004	0.32	1.31998	0	0	0.6	0.11998	0.93	0.36
20	188	90.98701	0.039	0.06598	0.17	0	8.53	0.15	0.024	0
21	16 al9	90.44003	0.05	0.17998	0	0	0.045	0.49	8.75	0.045
22	17	91.64005	0.1	0.36998	0	0	0.2	0.74	6.8	0.14998
23	18	92.11002	0.21	0.52	0	0	0.16	1.05	5.65	0.29998
24	19	92.63	0.38	0.58	0	0	0.52	1.43	4	0.46

Database of Standards and Analytical programs

relative type (1/S)

Etalons database

Data type
Concentr. Thicknes

Groups:
102
Pb-Sb alloy (620-74)
Cast aluminium (137-143)
Special Cast Iron
Bor
Aluminium Alloys (Mosco
Phbr
Bronse & Brass

Measure type: rel

Measure unit: %

Active etalon
Add to routine

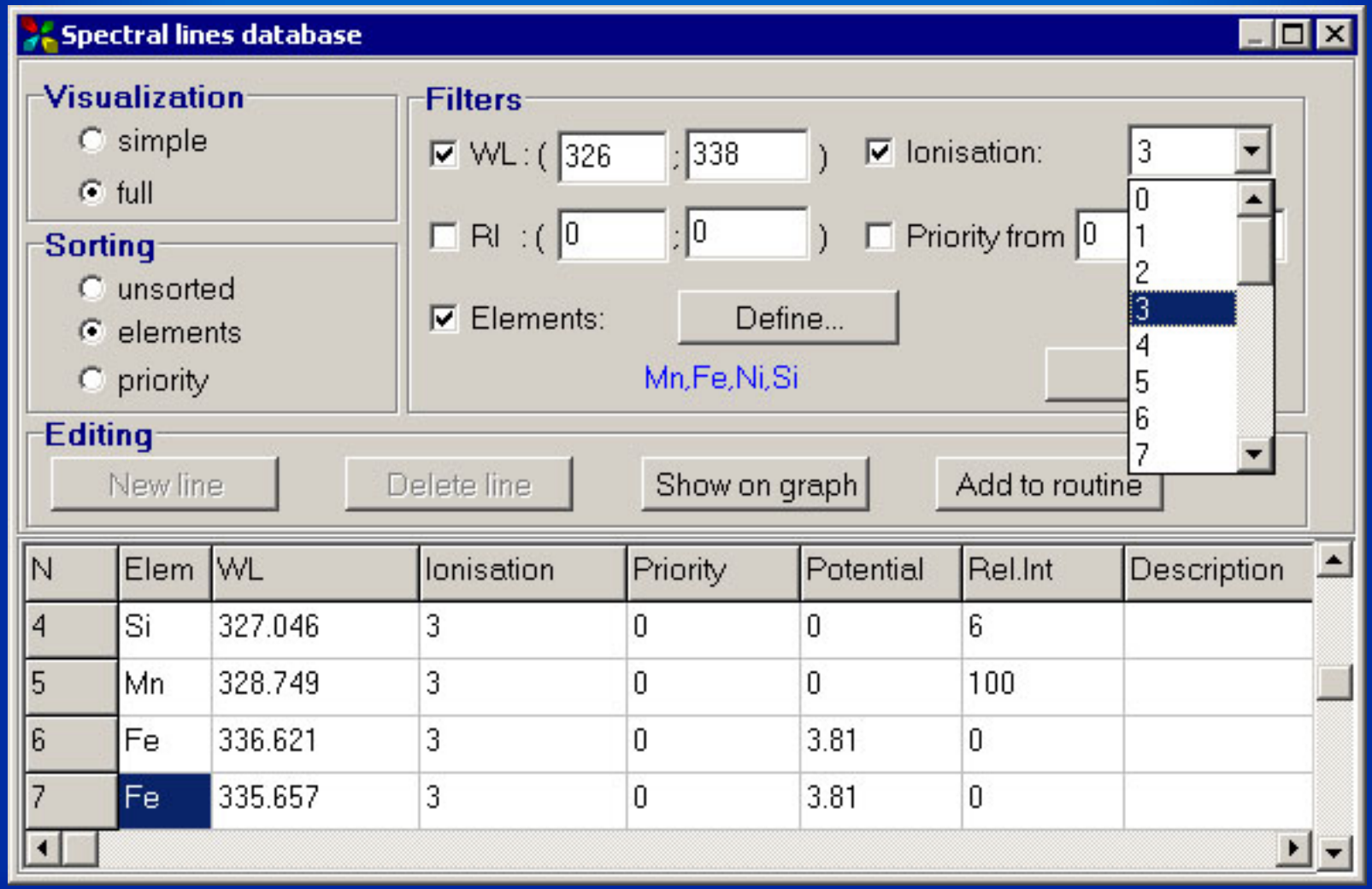
Database edit
Group Etalon

Fix etalon names

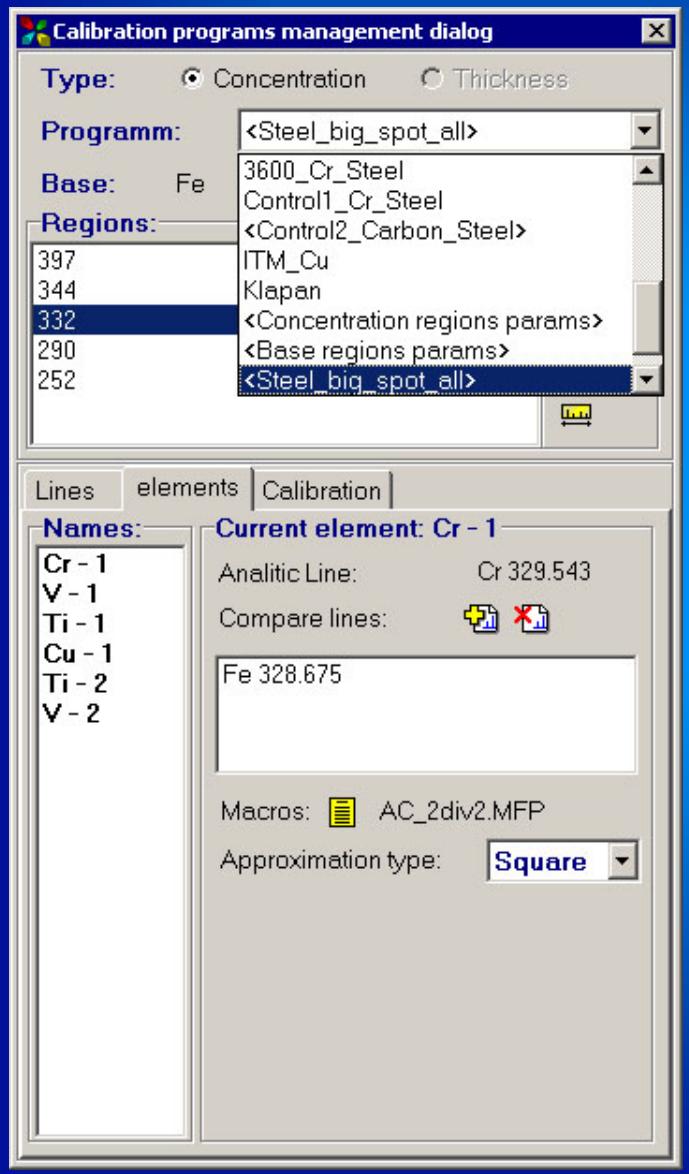
	Name	Al	Cu	Mn	Ti	Cd	Mg	Fe	Si	Zn
1	1 val10	1	0.03705	0.00995	0.00339	0.00392	0.00091	0.00201	0.00127	0
2	2	1	0.0405	0.00442	0.0021	0.00168	0.00055	0.00034	0.00231	0
3	3	1	0.05256	0.00608	0.00224	0.00235	0.00027	0.00117	0.00155	0
4	4	1	0.05797	0.00287	0.00029	0.00086	0.00044	0.00043	0.00084	0
5	5	1	0	0	0.0013	0	0	0	0	0
6	131 d16	1	0.05113	0.0051	0.00065	0	0.01607	0.00521	0.0038	0.00282
7	132	1	0.02354	0.01006	0.00013	0	0.0092	0.00663	0.01241	0.00621
8	133	1	0.03063	0.00718	0.00139	0	0.02431	0.00353	0.00161	0.00161
9	134	1	0.04472	0.00636	0.00089	0	0.0069	0.007	0.00668	0.00345
10	135	1	0.05523	0.00237	0.00118	0	0.00398	0.0028	0.0008	0.00872
11	136	1	0.0383	0.00885	0	0	0.01953	0.00108	0.00949	0.00066
12	137	1	0.01884	0.01176	0	0	0.0305	0.00752	0.01612	0
13	181 amg	1	0	0.00031	0.00029	0	0.01418	0.00997	0.00055	0.00048
14	182	1	0.00239	0.00135	0.00156	0	0.02444	0.00093	0.00478	0.0027
15	183	1	0.00116	0.00285	0.00116	0	0.03494	0.00749	0.00654	0
16	184	1	0.00017	0.0097	0.00023	0	0.04743	0.00128	0.00106	0.0032
17	185	1	0.00151	0.00561	0.00063	0	0.06155	0.00572	0.00346	0.00082
18	186	1	0.00078	0.00839	0.00082	0	0.07337	0.00305	0.00164	0.00153
19	187	1	0.00333	0.01374	0	0	0.00625	0.00125	0.00968	0.00375
20	188	1	0.00043	0.00073	0.00187	0	0.09375	0.00165	0.00026	0
21	16 al9	1	0.00055	0.00199	0	0	0.0005	0.00542	0.09675	0.0005
22	17	1	0.00109	0.00404	0	0	0.00218	0.00808	0.0742	0.00164
23	18	1	0.00228	0.00565	0	0	0.00174	0.0114	0.06134	0.00326
24	19	1	0.0041	0.00626	0	0	0.00561	0.01544	0.04318	0.00497

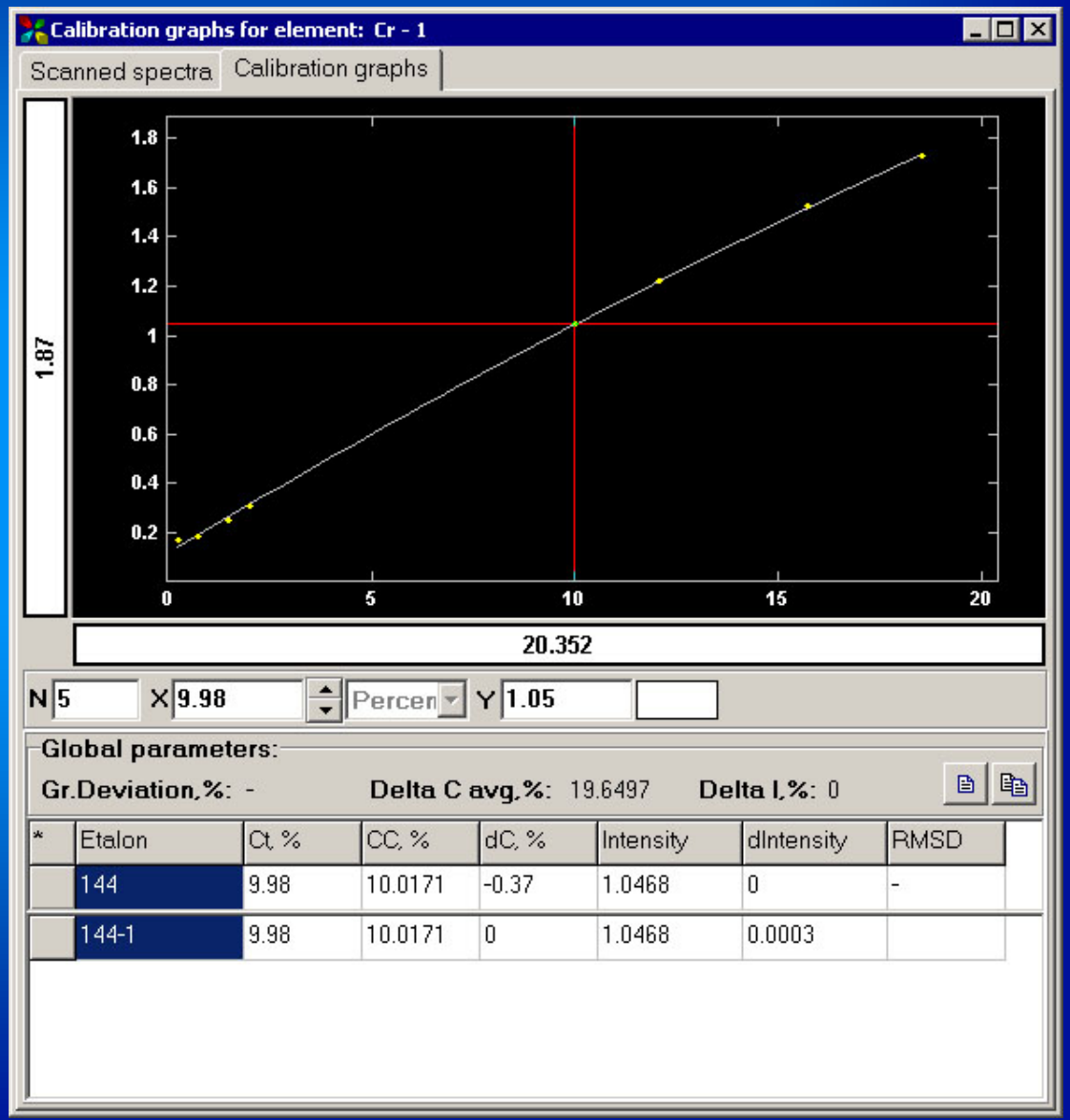
Spectral Lines Database

Wavelengths of Spectrum Lines

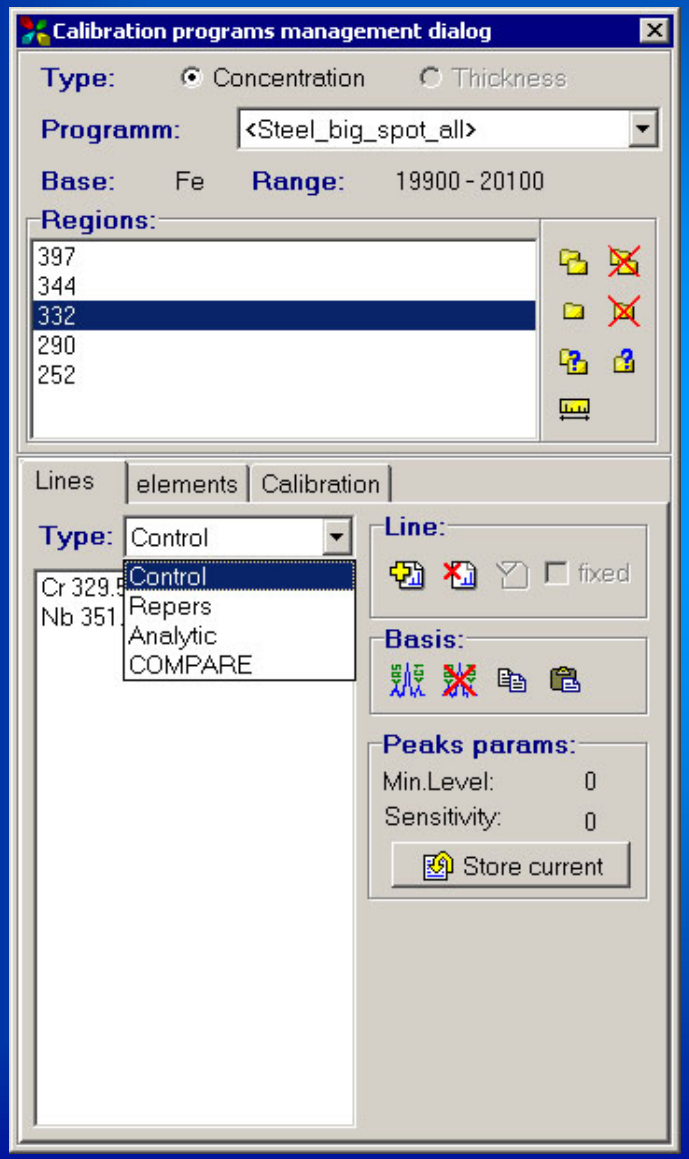


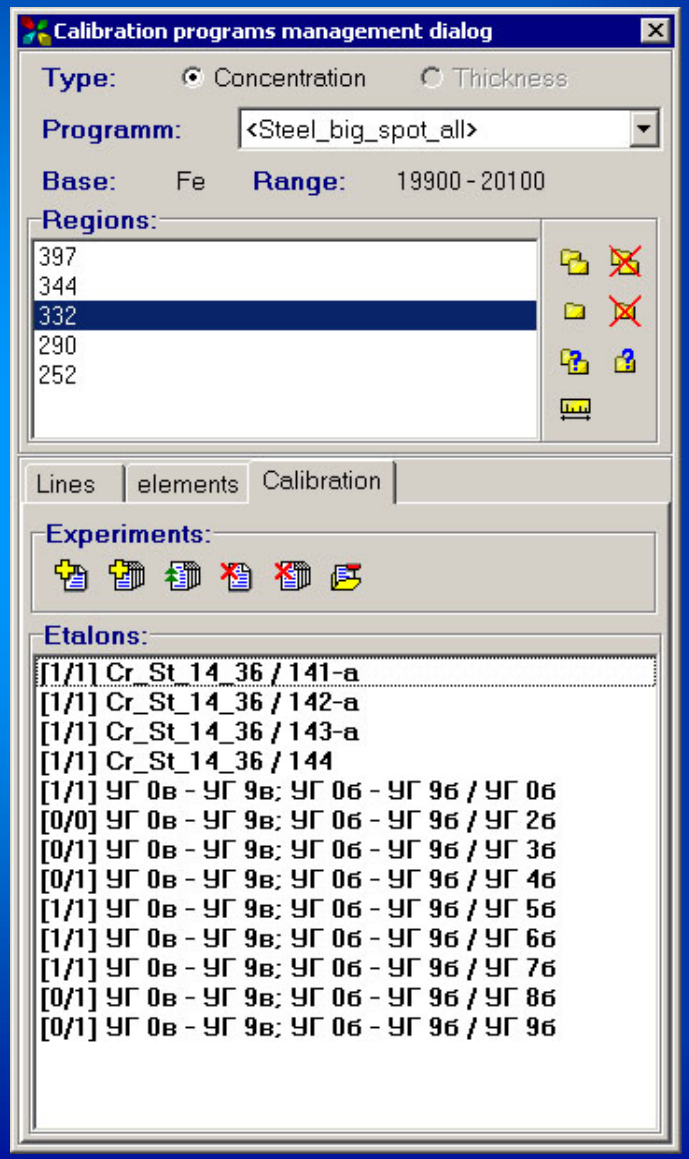
Analytical Programs



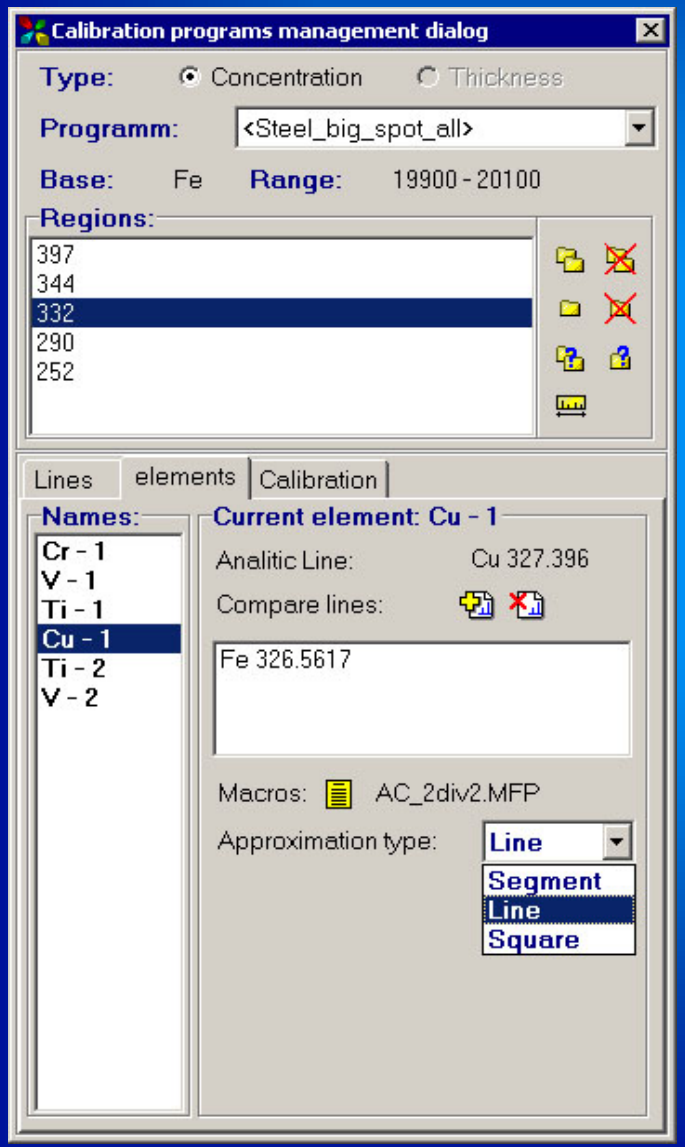


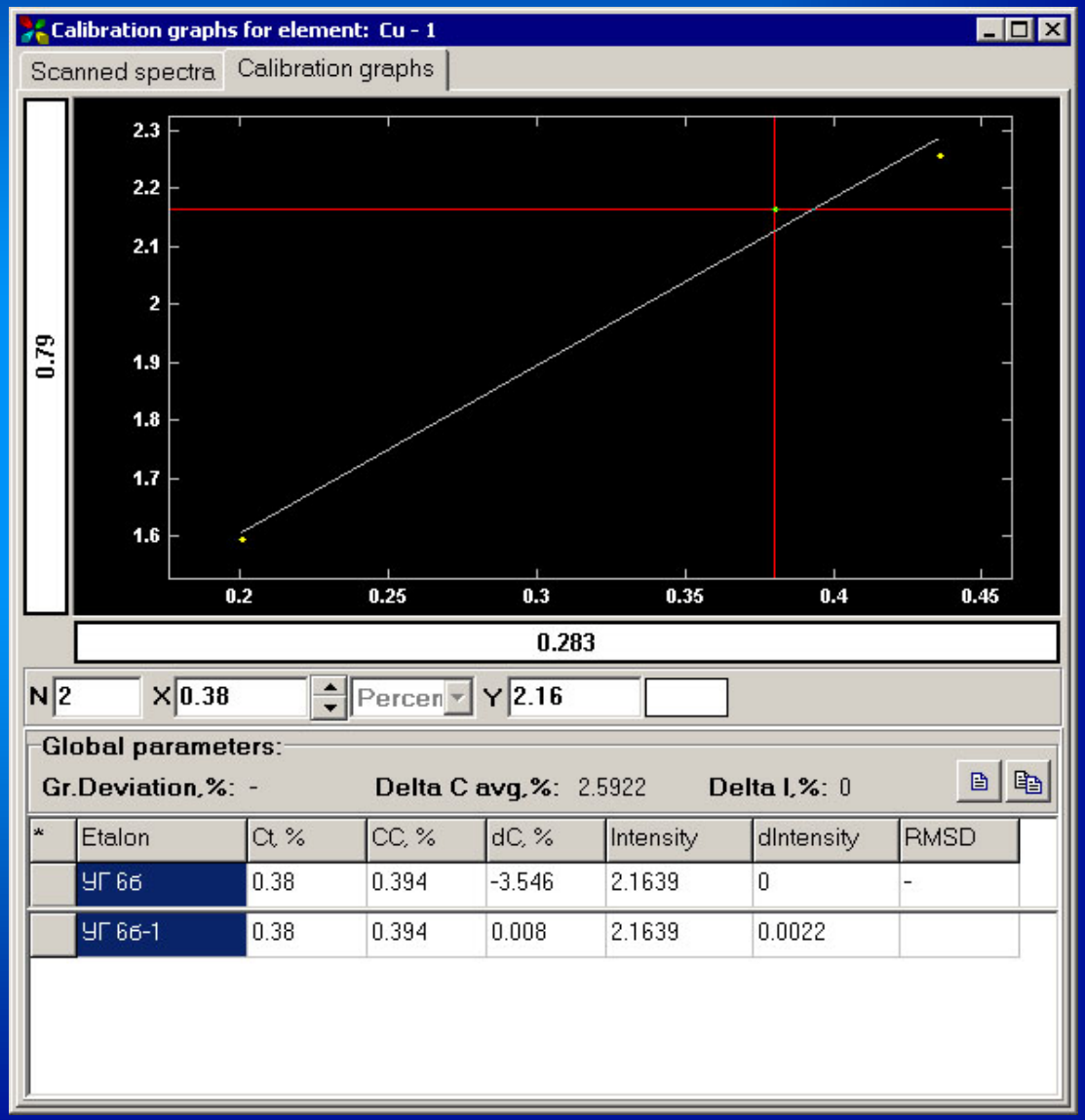
Setting of Lines and Device Calibration



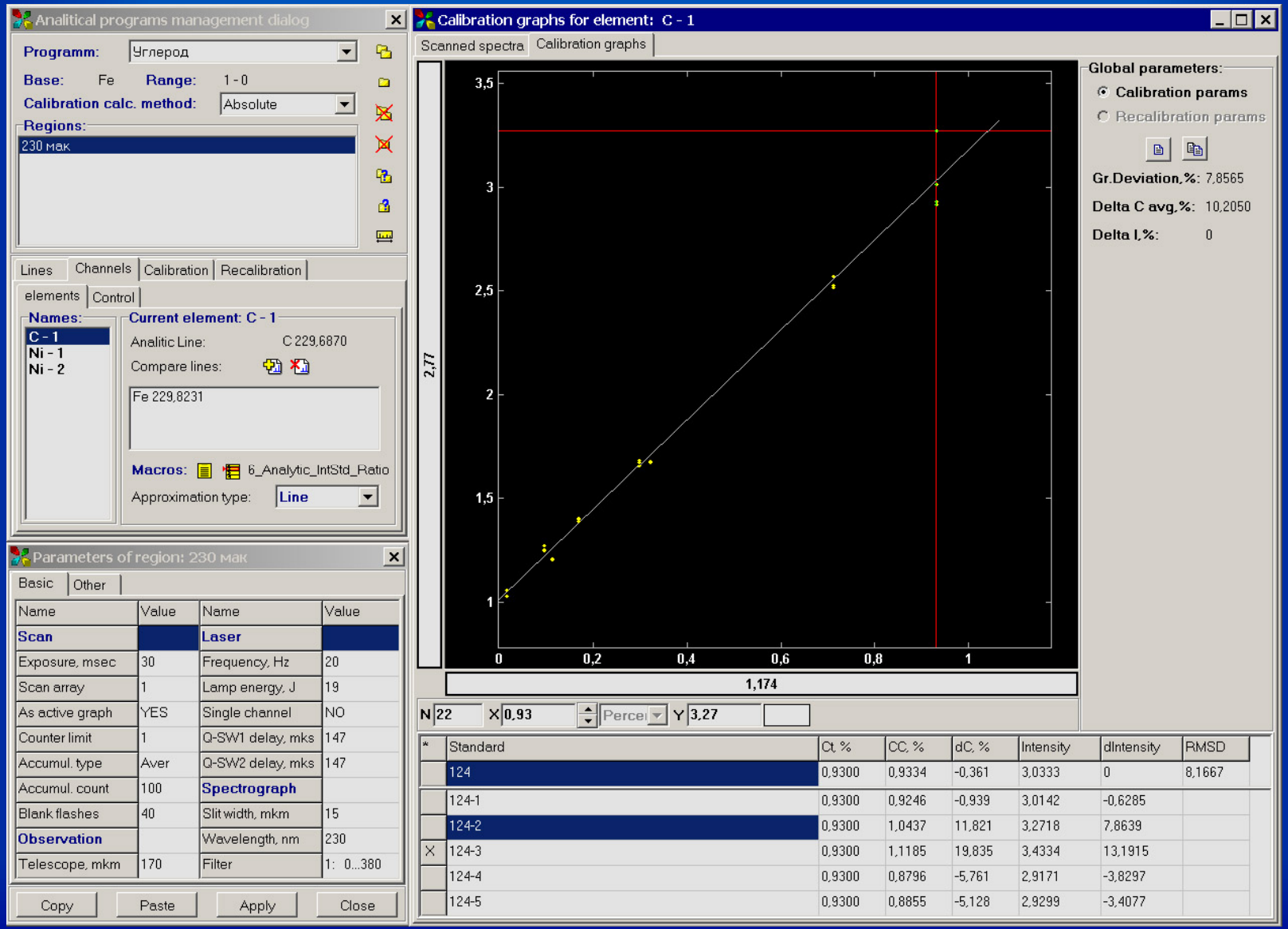


Selection of Approximation and Calibration Curve Type

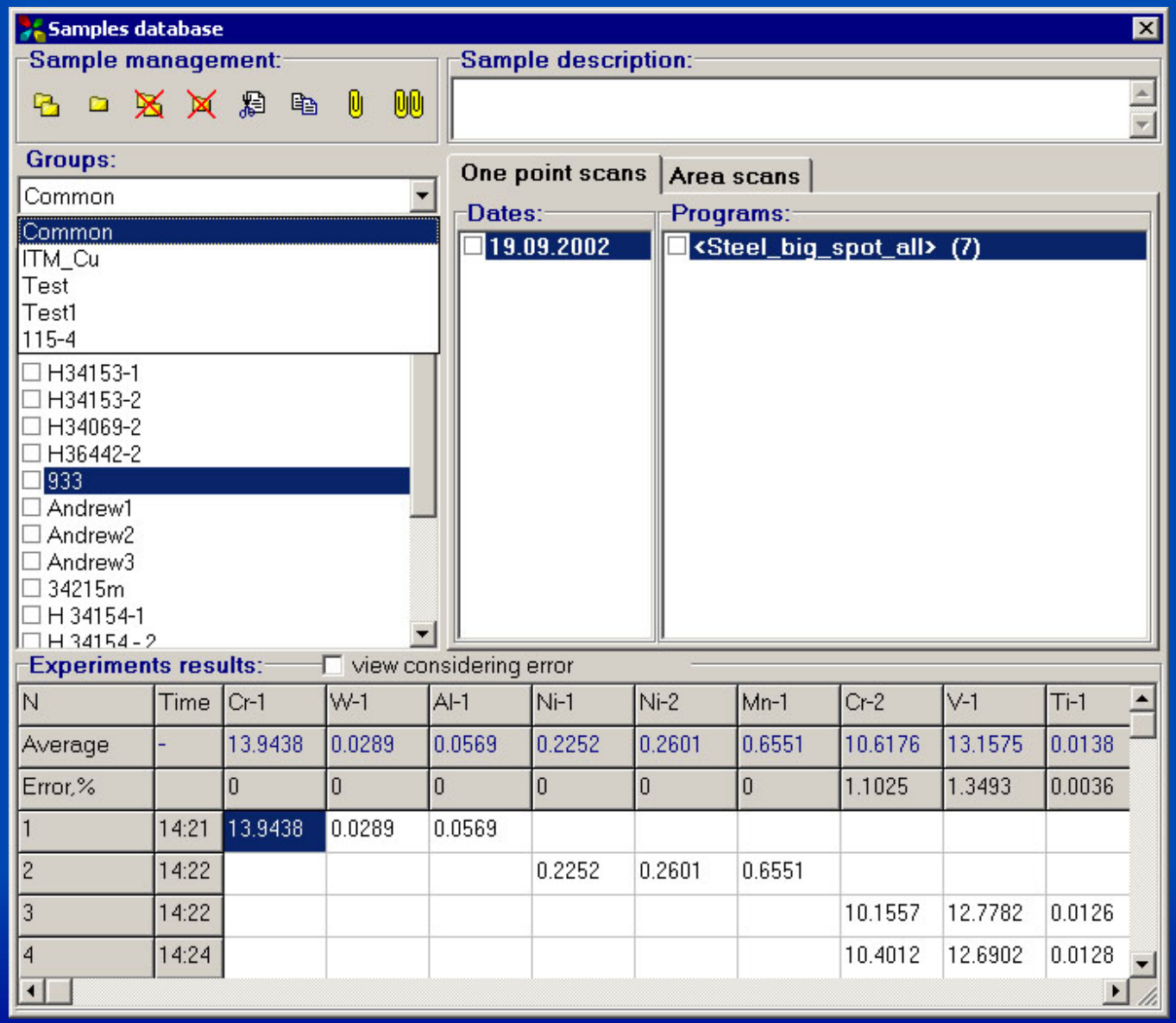




Calibration Curve for C in Steel

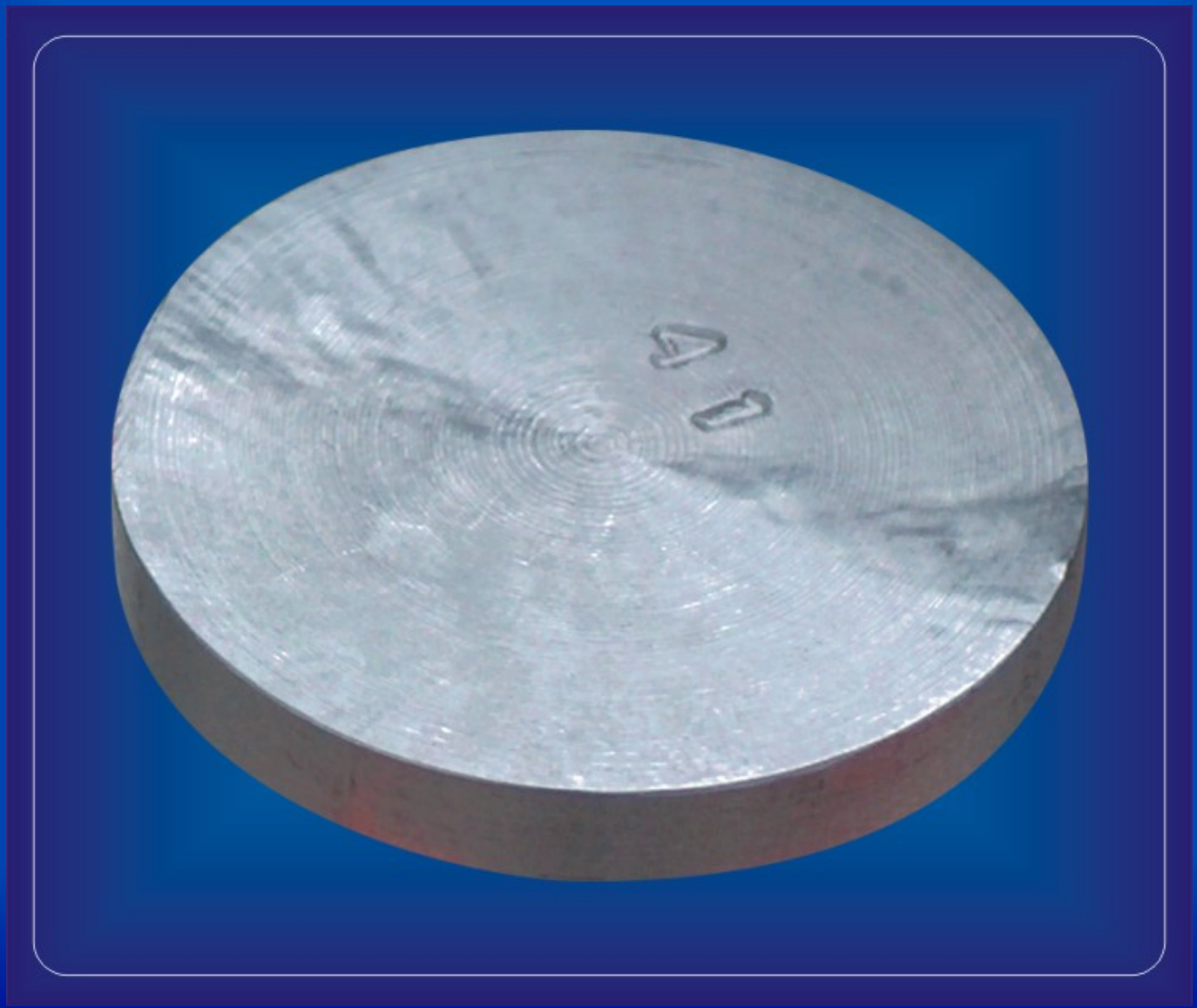


Samples Database



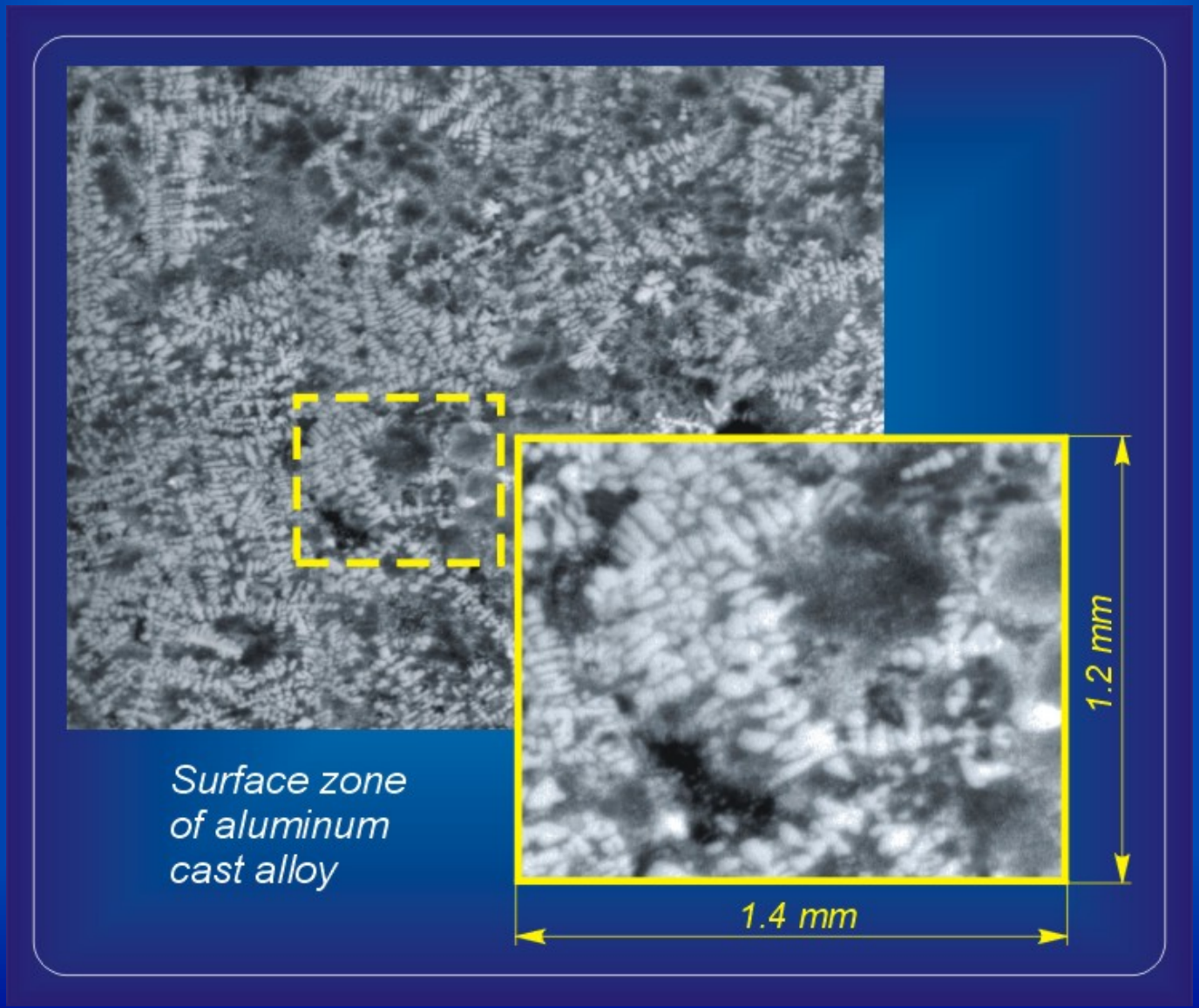
N	Time	Cr-1	W-1	Al-1	Ni-1	Ni-2	Mn-1	Cr-2	V-1	Ti-1
Average	-	13.9438	0.0289	0.0569	0.2252	0.2601	0.6551	10.6176	13.1575	0.0138
Error,%		0	0	0	0	0	0	1.1025	1.3493	0.0036
1	14:21	13.9438	0.0289	0.0569						
2	14:22				0.2252	0.2601	0.6551			
3	14:22							10.1557	12.7782	0.0126
4	14:24							10.4012	12.6902	0.0128

Sample of Aluminum Cast Alloy

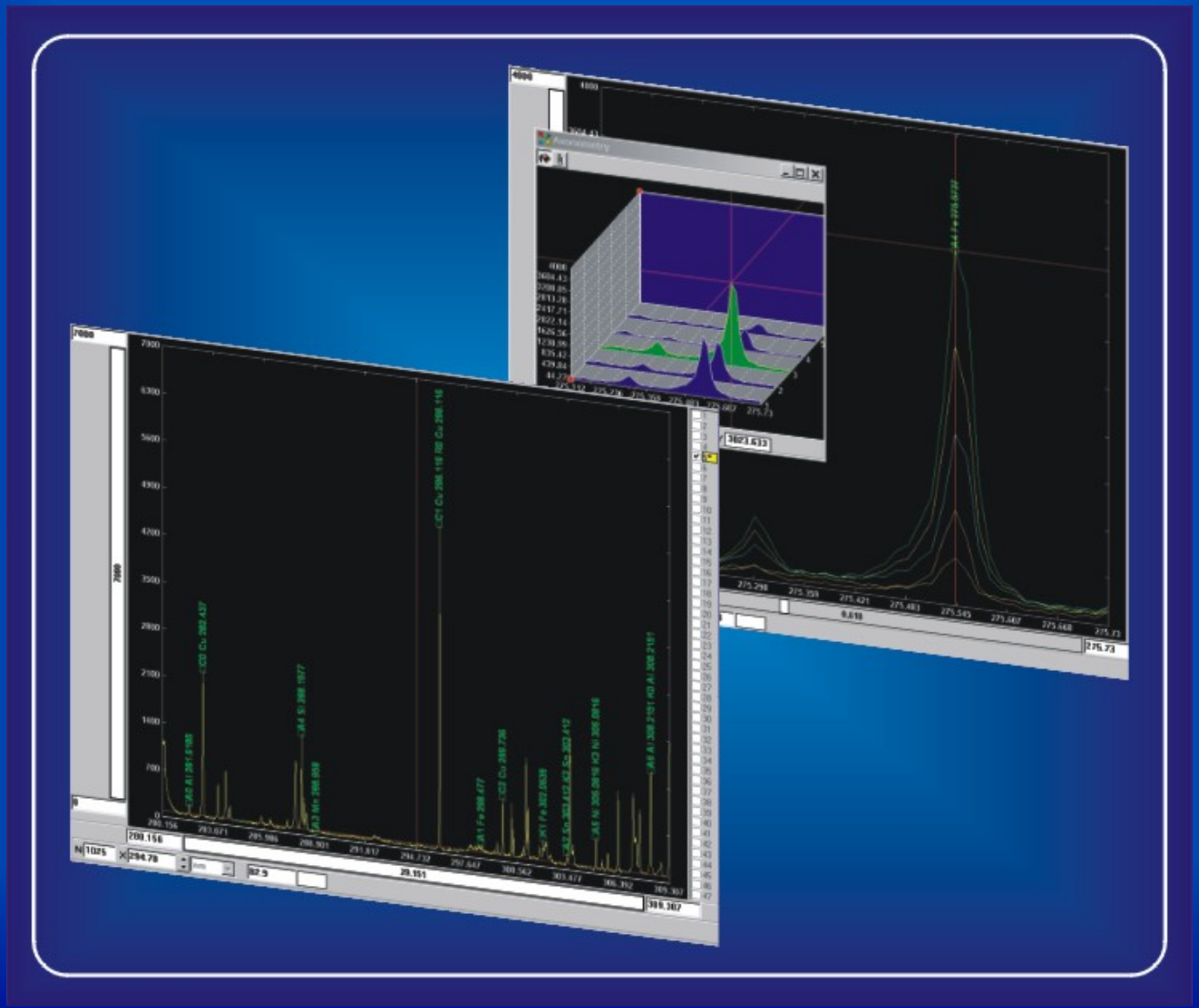


Video

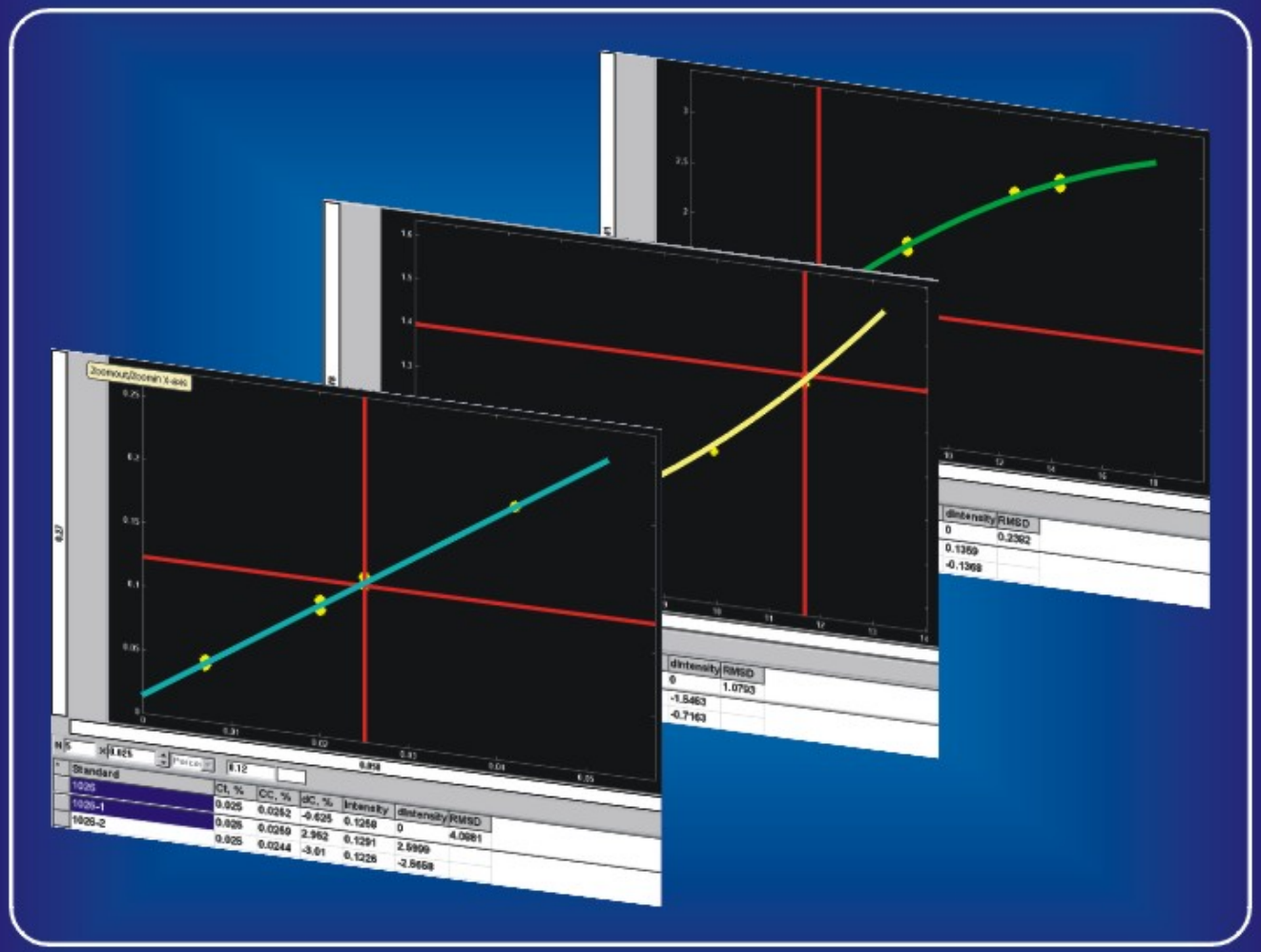
Visualization of sample surface, selection of surface zone to analyze



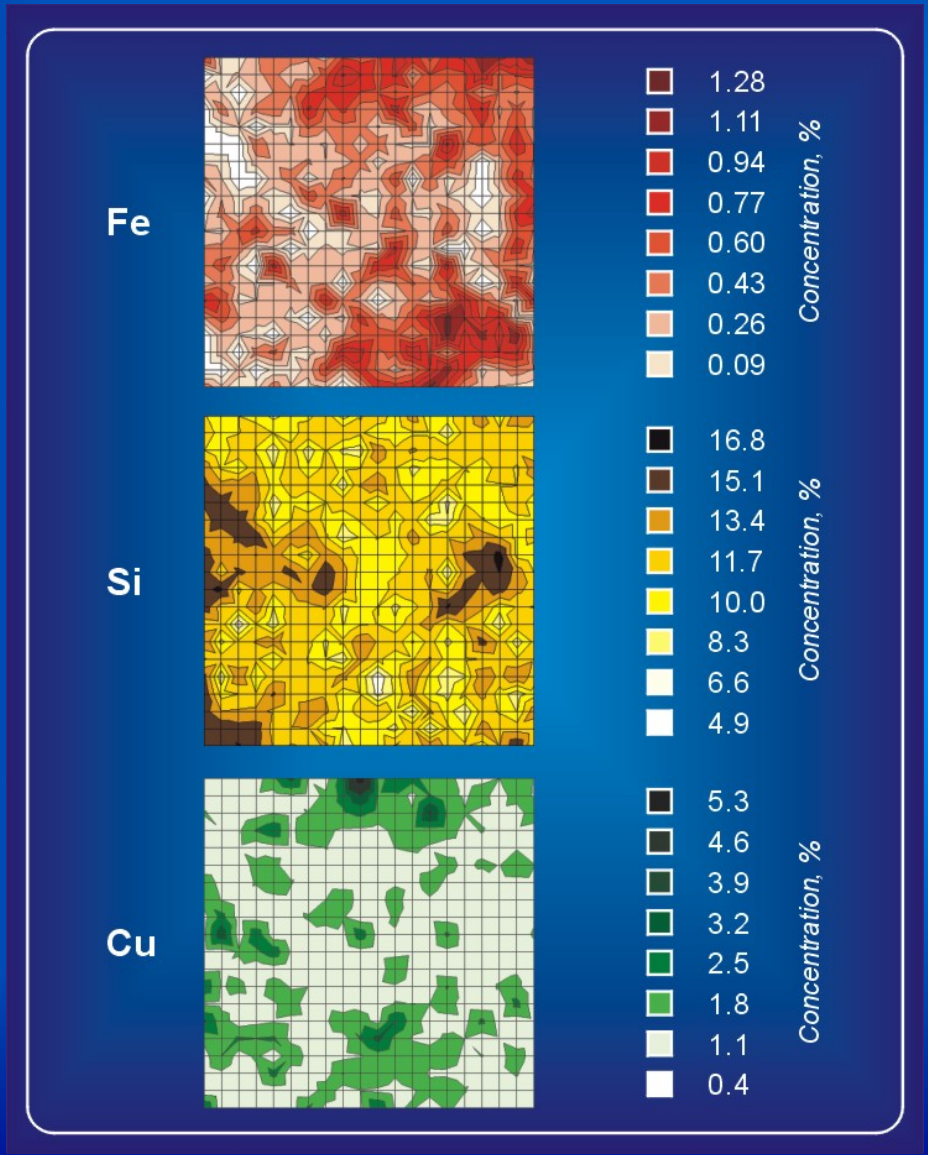
Spectrum detection and analysis



Concentration calculation via calibration curves

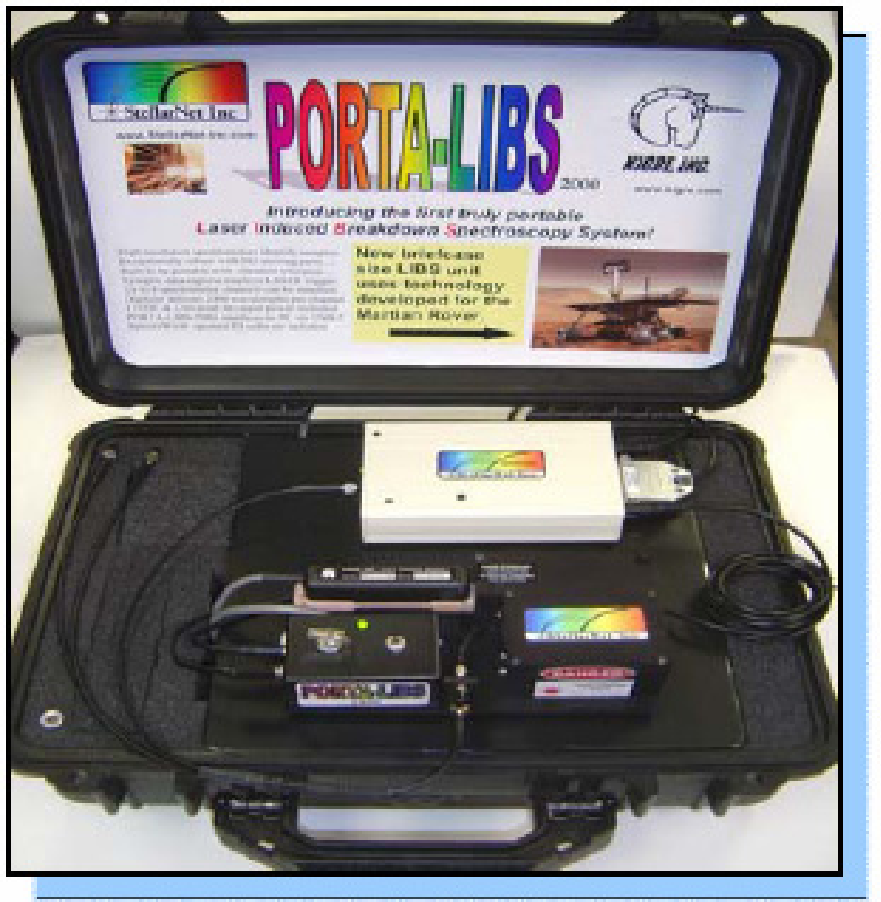


Graphic presentation of results



element distribution inhomogeneity in aluminum cast alloy

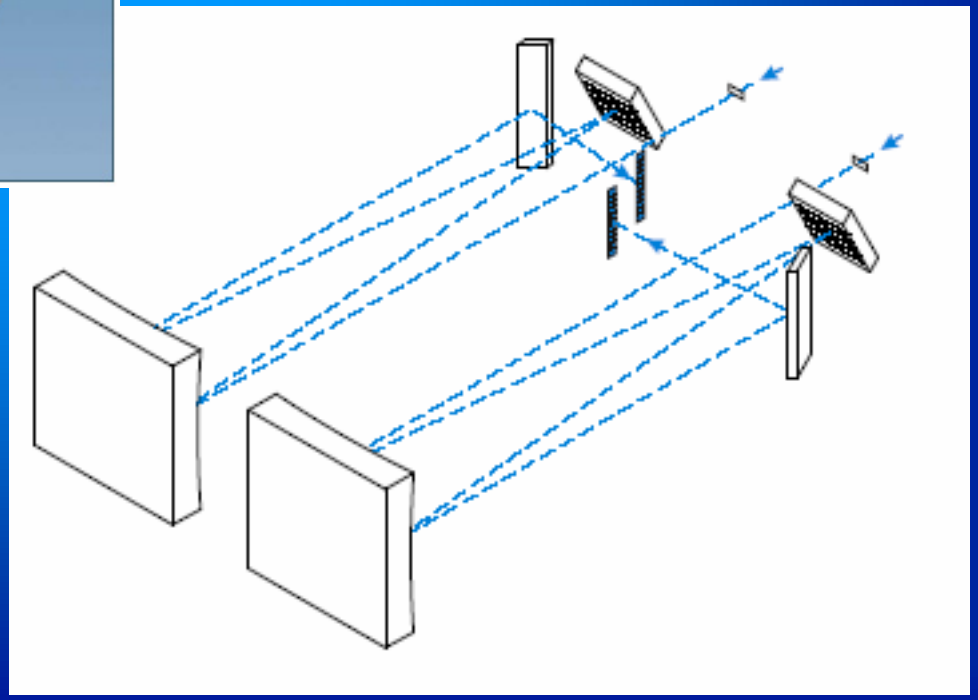
PORTA LIBS 2000



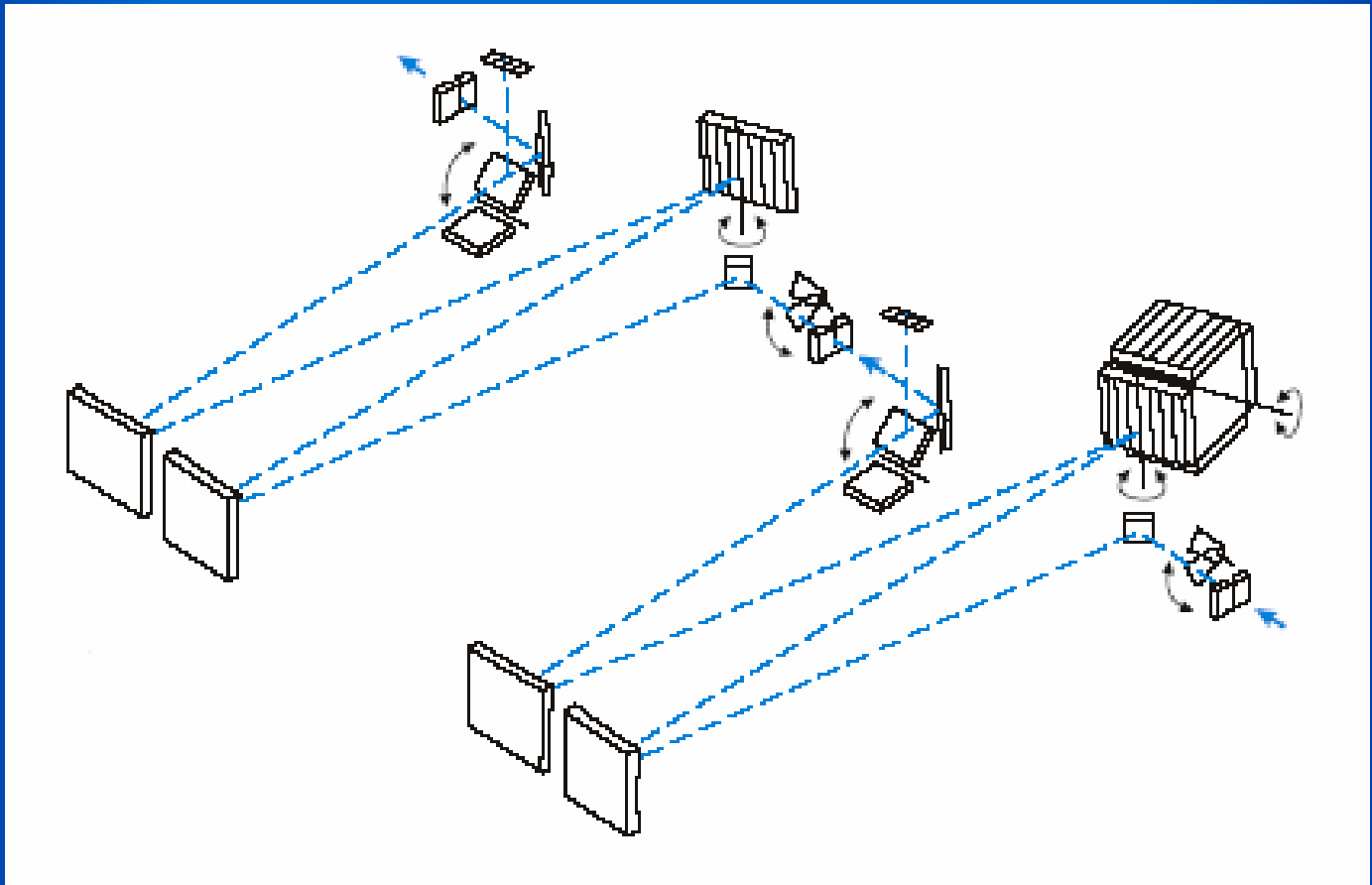
EPP2000 LSR Model	Wavelength Range in nm	Grating g/mm	Slit-14 nm res.
UV2	200-400	2400	0.20
VIS4	400-600	2400	0.20
VIS4b	600-800	2400	0.20
NIR3b	800-1000	1800	0.20

EPP2000 LHR model	Wavelength Range in nm	Grating g/mm	Slit-7 nm res.
UV3	200-300	1800	0.10
UV3b	300-400	1800	0.10
VIS3	400-500	1800	0.10
VIS3b	500-600	1800	0.10
VIS3c	600-700	1800	0.10
NIR3	700-800	1800	0.10
NIR2	800-925	1200	0.10

Solar T*II* optické systémy



Solar T*II* optické systémy



PROSCAN – detekční kamery

LOTIS T*II* *Lasery*

LOTIS TII

Nd:YAG Lasers

LS-2130 Pulsed Nd:YAG Laser

LOTIS T*II* *Dvoupulzní lasery*

LOTIS TII *Dvoupulzní dvoubarevné*

LS-2134D-C4 Double Pulsed Nd:YAG Laser

Specification

Parameter		Value
Energy, mJ	1064 / 532 / 266 nm	200 / 100 / 30
Pulse duration (FWHM, at 1064 nm), ns		14–16
Pulse repetion rate, Hz		1–10
Beam divergence, mrad		≤1
Beam diameter, mm		6,3
Delay between laser pulses*, μs		1–80
Jitter**, ns		±1.0
Energy stability*** (1064 nm), %		±3.0
Size L x W x H, mm (Weight, kg)	Laser head	755 x 270 x 113 (21.0)
	Power supply	363 x 364 x 192 (16.5)
	Cooling system	363 x 364 x 192 (15.5)
	Remote control	105 x 175 (0.5)
Power requirements		Single phase, 220±20 V, 50–60 Hz, 600 W

* 1 μs steps, other steps (1–100 ns) are available on request
** with respect to external trigger of Q-switch
*** shot to shot for 99% of pulses

LOTIS TII *Dvoupulzní lasery*

s vyšší opakovací frekvencí – 50 Hz

LOTIS TII

Nd:YAG Lasers

LS-2136D-5 Double Pulsed High Repetition Rate Nd:YAG Laser

Specification

Parameter		Value
Energy, mJ	1064 / 532 nm	105 / 52
Pulse duration (FWHM, at 1064 nm), ns		14–16
Pulse repetion rate, Hz		1–50
Beam divergence, mrad		≤1
Beam diameter, mm		5
Delay between laser pulses*, μs		1–80
Jitter**, ns		±1.0
Energy stability*** (1064 nm), %		±3.0
Size L x W x H, mm (Weight, kg)	Laser head	755 x 270 x 113 (23.0)
	Power supply	446 x 449 x 177 (20.0)
	Cooling system	446 x 449 x 266 (23.0)
	Remote control	105 x 175 (0.5)
Power requirements		Single phase, 220±20 V, 50–60 Hz, 2000 W

* 1 μs steps, other steps (1–100 ns) are available on request
** with respect to external trigger of Q-switch
*** shot to shot for 99% of pulses

LOTIS T*II* *Lasery*

LOTIS TII

Nd:YAG Lasers

LS-2134UTF

Pulsed Nd:YAG Laser with VRM and Built-in Harmonics

Specification

Parameter		Value
Energy, mJ	1064 / 532 / 355 / 266 nm	270 / 170 / 60 / 40
Pulse duration, ns	1064 / 532 / 355 / 266 nm	7–8 / 6–7 / 5–7 / 5–6
Pulse repetion rate, Hz		1–15
Beam divergence, mrad		≤0.8
Beam diameter, mm		≤6.0
Jitter*, ns		±1.0
Pointing stability, mrad		0.1
Energy stability** (1064 nm), %		±3.0
Size L x W x H, mm (Weight, kg)	Laser head	653 x 185 x 113 (14.0)
	Power supply	363 x 364 x 192 (15.5)
	Cooling system	363 x 364 x 192 (12.5)
	Remote control	105 x 175 (0.5)
Power requirements		Single phase, 220±20 V, 50–60 Hz, 750 W

* with respect to external trigger of Q-switch
** shot to shot for 99% of pulses

LOTIS TII *Lasery 213 nm*

LOTIS TII

Nd:YAG Lasers

LS-2134UF-5

Pulsed Nd:YAG Laser with VRM and Built-in Harmonics

Specification

Parameter		Value
Energy, mJ	532 / 213 nm	170 / 6
Pulse duration, ns	532 / 213 nm	6–7 / 5–6
Pulse repetion rate, Hz		1–15
Beam divergence, mrad		≤0.8
Beam diameter, mm		≤6.0
Jitter*, ns		±1.0
Pointing stability, mrad		0.1
Energy stability** (1064 nm), %		±3.0
Size L x W x H, mm (Weight, kg)	Laser head	653 x 185 x 113 (14.0)
	Power supply	363 x 364 x 192 (15.5)
	Cooling system	363 x 364 x 192 (12.5)
	Remote control	105 x 175 (0.5)
Power requirements		Single phase, 220±20 V, 50–60 Hz, 750 W

* with respect to external trigger of Q-switch
** shot to shot for 99% of pulses

Solar T*II* *Lasery*

WIDELY-TUNABLE Ti:SAPPHIRE LASER

Widely-Tunable
Ti:Sapphire Laser

MODELS

CF 131A
CF 131MA

- Widely-tunable from IR to UV (950-189 nm)
- All solid-state
- Narrow and super narrow linewidth
- Pollution-free
- PC control (Model CF131A)

950-690 nm → 470-350 nm → 315-235 nm → 235-205 nm → 207-189 nm

LOTIS T*II* - lasery

WIDELY-TUNABLE PULSED Ti:SAPPHIRE LASER

Widely-Tunable
Pulsed Ti:Sapphire Laser

MODEL

CF 125

- High efficiency
- Built-in SHG
- Wide tunable range with single cavity optics set

TUNABLE LASER PARAMETERS	
Active medium:	Ti:Sapphire
Tuning range	
at fundamental:	690-1000 nm
at second harmonic:	350-500 nm
Pump conversion efficiency in the maximum of tuning curve	
at fundamental:	</= 25%
at second harmonic:	</= 8%
Linewidth:	0,1-0,2 nm
Beam divergence:	< 1,5 mrad
Overall size (LxWxH):	538x150x72 mm
Weight:	6,5 kg
PUMP PARAMETERS	
Wavelength:	532 nm
Pulse energy (max):	300 mJ
Pulse duration:	8-20 ns
Power (max):	15 W
Pulse repetition rate (max):	50 Hz
Beam diameter (max):	9 mm

LOTIS T*II* - lasery

QUASI-CW Ti:SAPPHIRE LASER

Quasi-CW
Ti:Sapphire Laser

MODEL

CF 231

- KHz pulse repetition rate
- Narrow linewidth
- Wide spectral range
- Built-in SHG

- High-quality output is generated in a computer-optimized aberration-free cavity. Low threshold generation is provided by extra-quality optics in use.
- The output coupler is adapted to variation of the Ti:Sapphire gain. A single set of cavity optics provides the extremely wide 695-960 nm tuning range.
- The built-in SHG unit with cylindric optics and an efficient nonlinear crystal extend the tunability range from 350 to 475 nm.

LOTIS T*II* - lasery

SOLID STATE RAMAN SHIFTER

Solid State
Raman Shifter

MODEL

CRS 14

CRS14 SOLID STATE RAMAN SHIFTER FOR CONVERSION OF
Nd:YAG LASER OUTPUT

LOTIS T*II* - lasery

AUTOMATIC OPTICAL PARAMETRIC OSCILLATOR

Extremely Widely-Tunable
Automatic Optical
Parametric Oscillator

MODEL

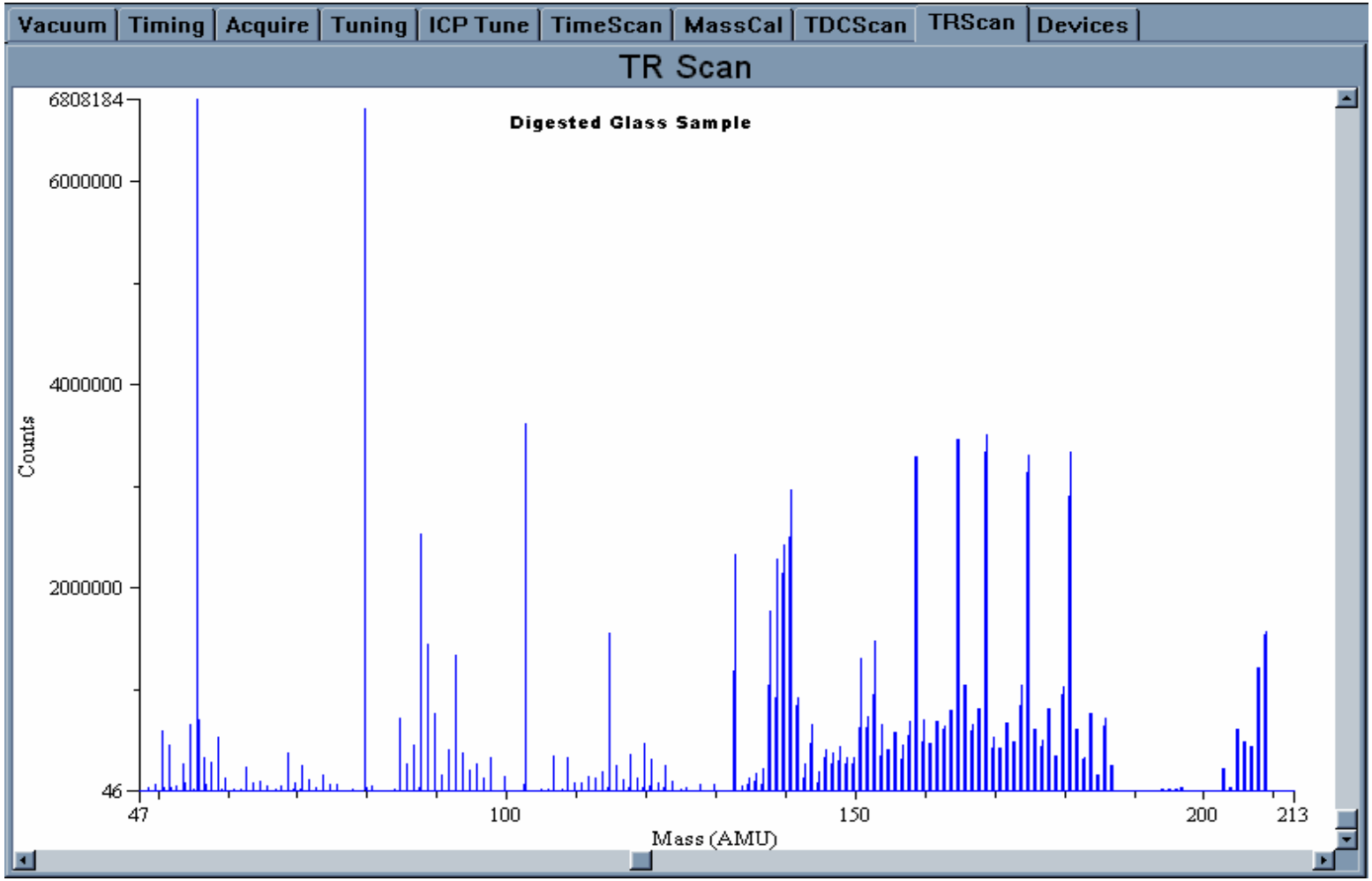
COPO 2200A

- 210-340 nm/420-690 nm/730-2200 nm tuning range
- Automatic operation and wavelength control
- Availability of adaptation to a variety of pump lasers

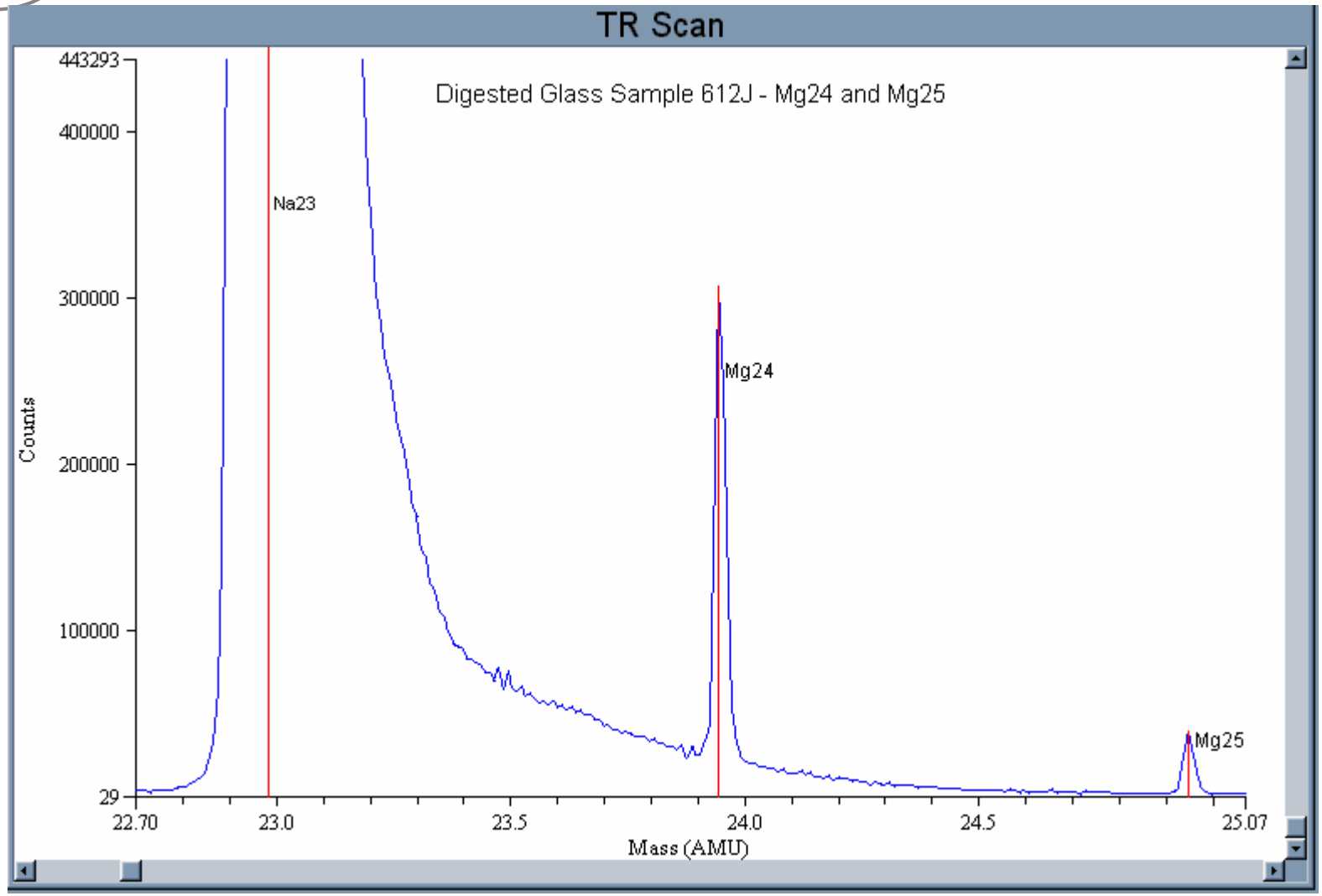
LA-oTOF-MS

OptiMass 9500

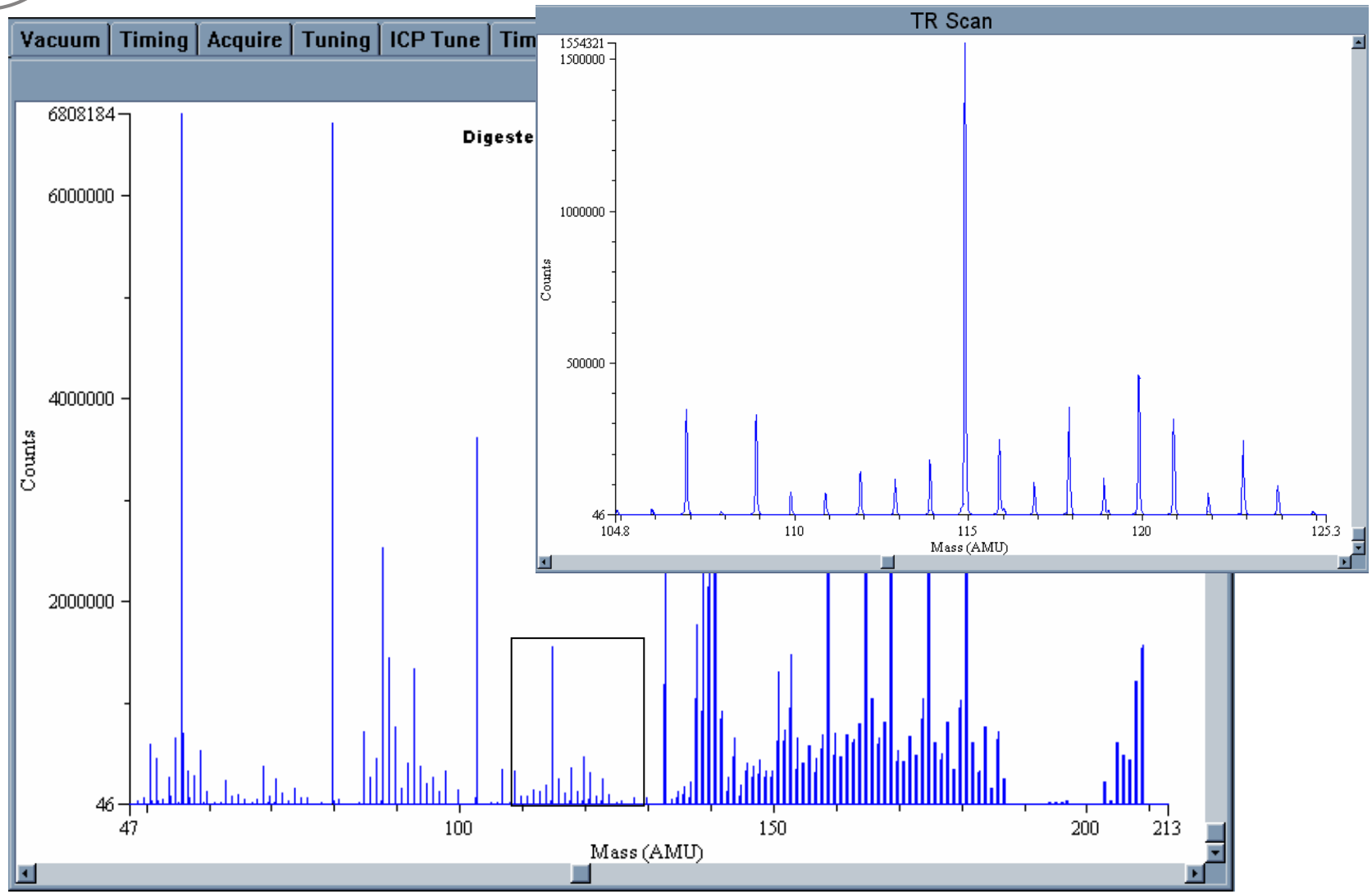
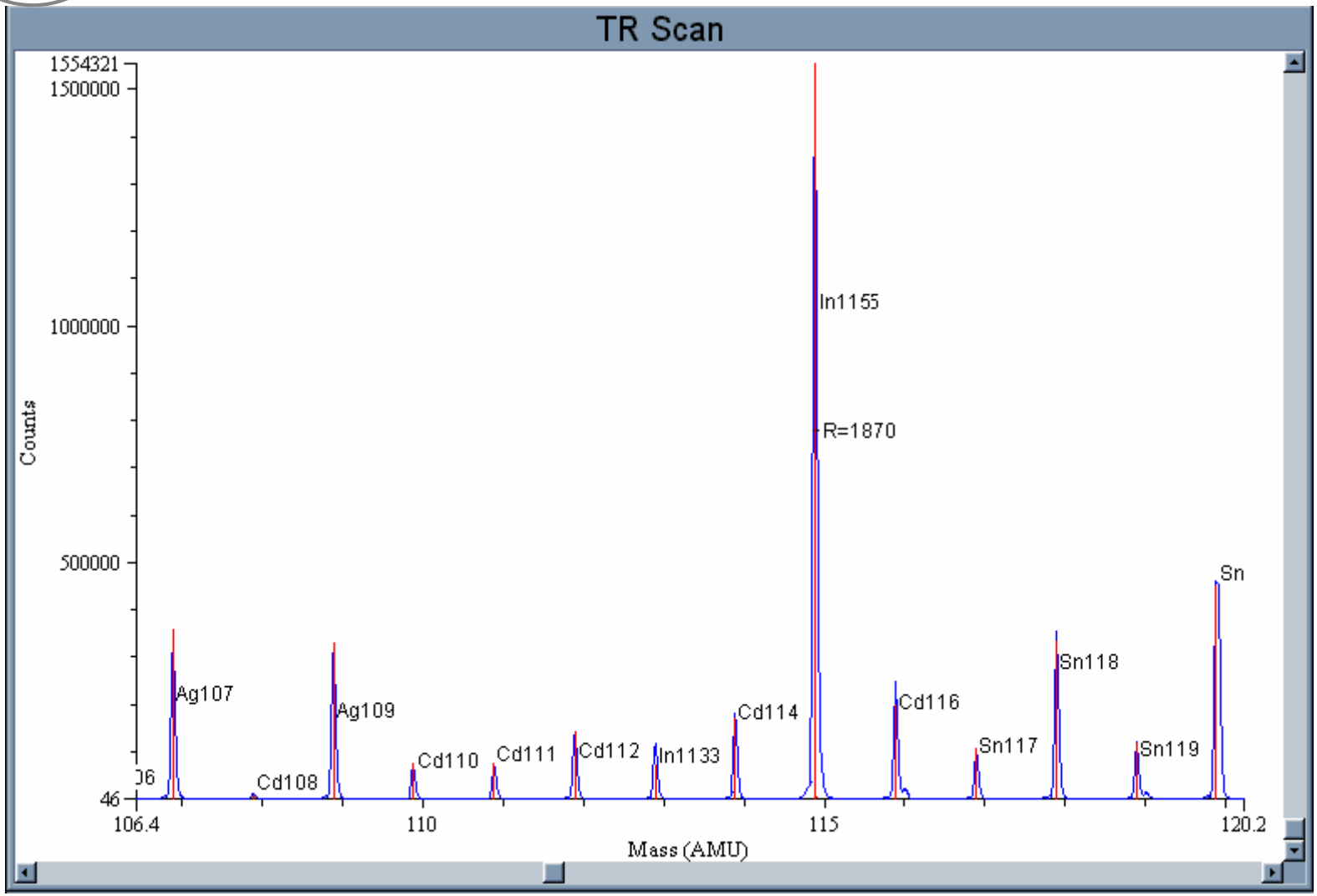
Kompletní spektrum rozloženého vzorku skla.



Kompletní spektrum rozloženého vzorku skla.



Co je v tomto vzorku ?



Prvkový „otisk prstu“