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Turnkey Laboratories Solutions

Analytical®
Technologies Limited

Laser-Induced Breakdown Spectrometry
Original Position Analyzer

LIBS-3200

EPC / PRODUCTS / APPLICATION / SOFTWARE / ACCESSORIES / CONSUMABLES / SERVICES

Analytical Technologies Limited

An ISO 9001 Certified Company

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Pincipal of LIBS-3200

Laser-introduced breakdown spectroscopy-original position statistic distribution analysis tecnique in a combination of laser-induced breakdown spectroscopy and original position statistic distribution analysis technique. This analysis method is developed for the determination of the element distribution of a large size surface regardless of non-flat and irregular shaped materials. Irradiation from a Nd- YAG laser was focused on the sample and therefore induced plasma spectrum. Then, the LIBS statistical distribution analysis was carried out combining with a mo able excitation platform under the protection of Ar. based on unusal spectrum signals of multi-e ement by laser induced breakdown spectroscopy, quantitative and statistical information about original position in fracture sample and welding seam were collected, representing position distribution, degree of statistic segregation and maximum degree of segregation for every material element.

This method was applied to the measuring of defect samples. To measuring one-dimensional elemental distribution, we need in-depth scanning obtained by a comparison of defects and non-defective parts of the elements content. The abnormal information of elements obtained by LIBS in defect was consistent with the other two methods (scanning electron microscopy and glow spectrometry). LIBS has the advantages of small crater size, in situ analysis etc. This method was applied not only for multi-element quantitative analysis but also for identifying the abnormal elements, especially in the analysis of defects covered by coating. LIBS is a promising method of process control in production quality.

Instrument Overview

LIBS (Laser-induced Breakdown Spectroscopy) OPA (Original Position Analyzer) is a new cutting-edge analytical instrument featured with the perfect combination of LIBS and OPA. The principle of LIBS original position statistical distribution analysis technology can be described like this, the high-energy pulsed laser is focused on the sample surface, the high temperature plasma is formed due to the breakdown on the sample surface, and the sample composition and element distribution information can thus be obtained by detecting the plasma spectrum signal.

Instrument Overview

The sample surface is broken down by high-energy laser to form plasma, the plasma beam is detected by multichannel photomultiplier detection system after filtering and splitting, the type of element is obtained according to spectral characteristic and spectral line wavelength, and the intensity of corresponding spectral line after calibration is used to indicate the concentration of the analytical element. Based on single laser-induced plasma spectral theory and signal resolution extraction technology, laser micro-beam (probe) technology and continuous excitation synchronous scanning positioning technology are developed, realizing one dimensional linear scanning, one dimensional depth analysis and two-dimensional area scanning analysis. Furthermore, original information of each element corresponding to the original position of the material can be obtained accordingly, and methods of statistical analysis can be used to give quantitative characterization of material segregation, porosity, inclusion distribution, surface and internal defect analysis and other indicators. This method not only owns the advantages of non-contact analysis, micro-area analysis and depth analysis of laser spectrum, but also possesses the original position and statistical characteristics of original position statistical distribution analysis technology. The successful development of LIBSOPA provides a new technical means and quality criteria for material composition analysis, defect analysis, coating & plating analysis and so on.

Instrument Features and Technical Advantages

- A new analytical instrument featured with the perfect combination of LIBS technology and OPA technology, award a number of invention patents.
- Real-time, fast, multi-element and simultaneous analysis, C, P, s and other elements can be analyzed, the linear fitting is good.
- Analysis, small excitation spot, high spatial resolution, and realization of up to 100μm spot analysis
- High visibility, real-time observation of excited denudation status within micro-zone and paoramic dual visual field.
- Diversified samples are not affected by their sizes, states, conductivity, etc.
- Very suitable for coating, film material analysis, surface micro-damage analysis and material defect analysis
- Laser and complete machine are fully enclosed, without any radiation effects
- Suitable for aerospace, 3D printing, material gene and other frontier technologies.
- Personalized customization, special software for smart original position statistical distribution analysis function.

» Content information of each element at different locations in the material;
» Segregation degree information of each element at different locations in the material;
» Characterization of material porosity: porosity, density information;
» Inclusions analysis and composition statistical information;
» Graphic representation information

Display of one-dimensional line distribution analysis
Display of two-dimensional surface distribution analysis
Display of three-dimensional volume distribution analysis
Display of frequency distribution analysis

Technical specification

Excitation light source	
Laser :	Lamp-pumped solid-state Q-switched laser
Wavelength :	170nm - 1064 nm
Impulse frequency :	1~10Hz adjustable
Dual-visual field imaging	
Panoramic visual field :	100mm*100mm
Micro-zone visual field :	8mm*8mm
Mobile Scanning System	
Mobile resolution :	1μm
Stroke :	80mm*80mm
Denudation flare	
Size :	100μm~400μm

Optical splitting system	
focal length :	750 mm
Spectral line range :	170~800nm
Resolution :	Superior to 0.01nm

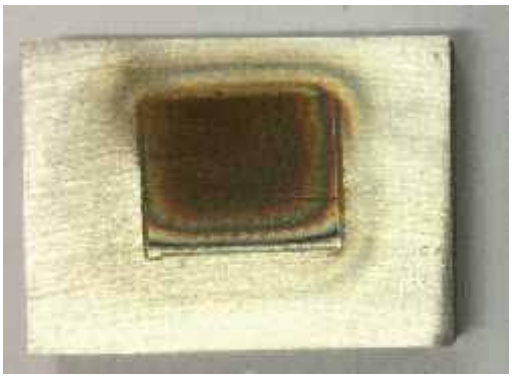
- Software automatic regulation
- High luminous holographic grating, the graduating is 2400 stripes/mm
- Paschen-Runge mount,grating

Analytical Elements

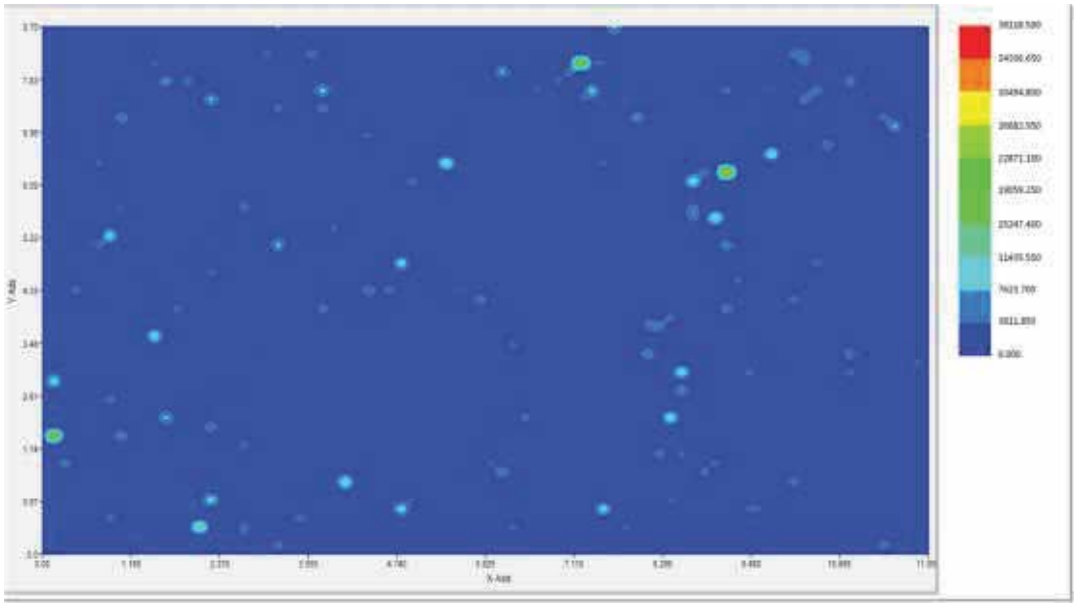
Serial No.	Element	Serial No.	Element
1	P	19	Mn
2	Cu	20	Cr
3	Sn	21	Sb
4	V	22	B
5	C	23	Ni
6	Mo	24	Zn
7	Al	25	Ti
8	Nb	26	Ni
9	S	27	Co
10	Cd	28	Zr
11	W	29	Fe
12	Si	30	Mg
13	Ti	31	Si
14	Mn	32	Ca
15	Cr	33	Al
16	Fe	34	W
17	Mg	35	Pb
18	Si	36	Ce

Feature Analysis Function

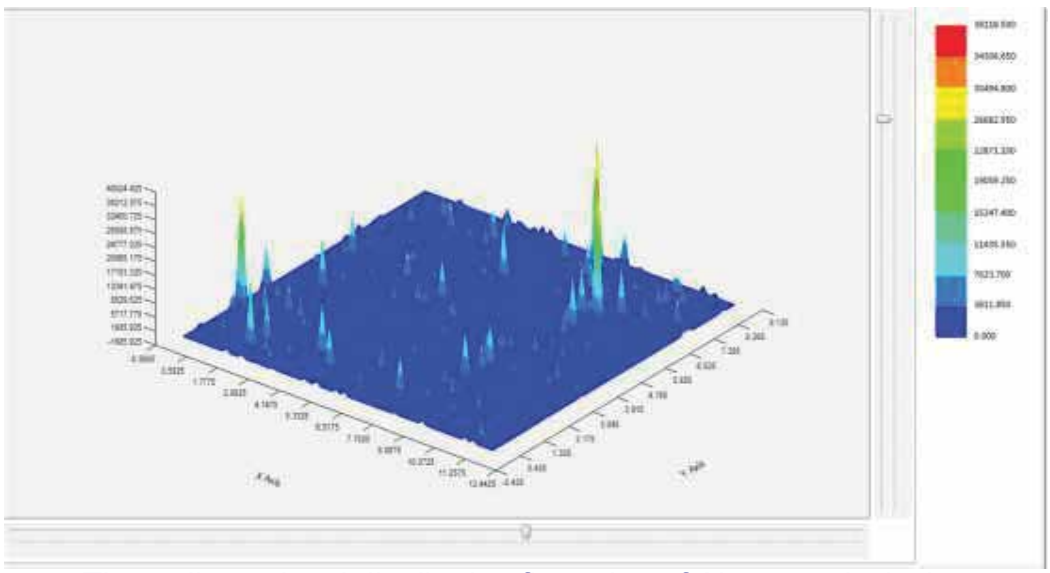
- Inclusion analysis



Al inclusion sample



Distribution floor plan of Al system inclusion



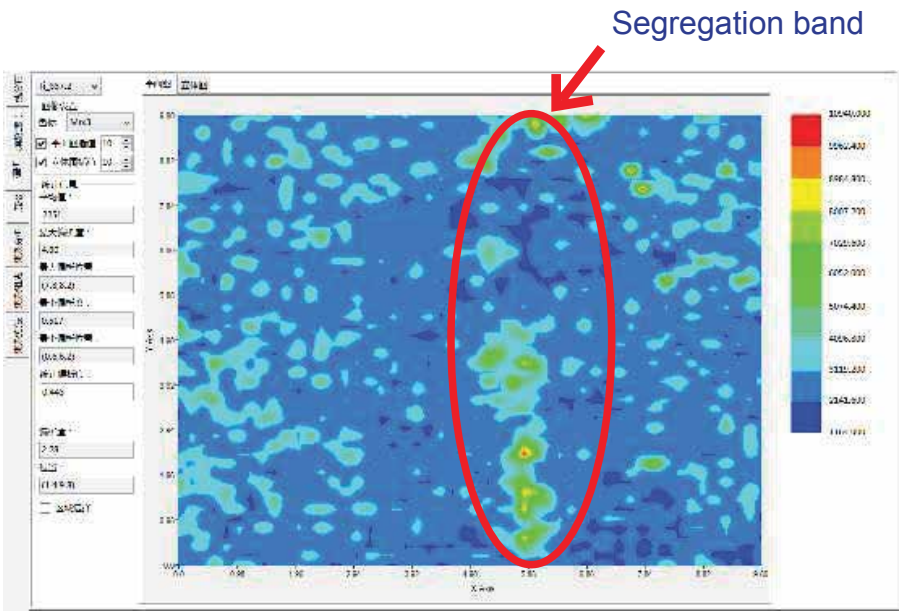
Three-dimensional distribution floor plan of Al system inclusion

Statistical overview of Al system inclusion

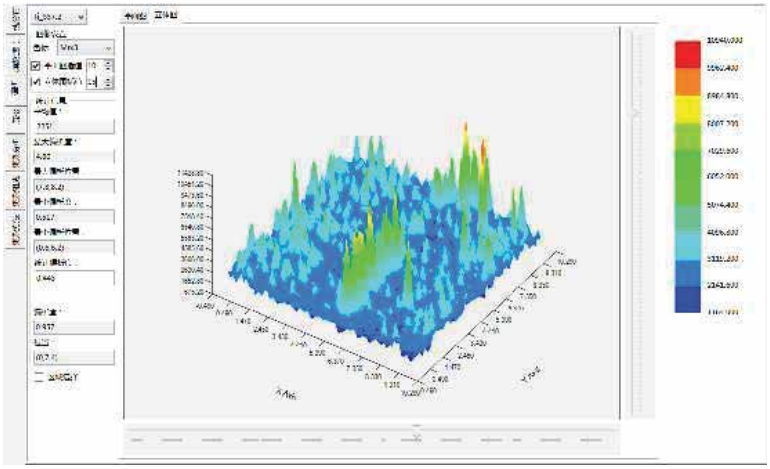
LIBS-3200		
Particle size range/μm	Scanning Result Inclusion ratio/%	Statistical results of HRVM Inclusion ratio/%
0~3	79.706	79.7%
3~5	16.288	15.58%
5~10	3.605	3.75%
>10	0.401	0.96%

• Segregation analysis

Segregation sample



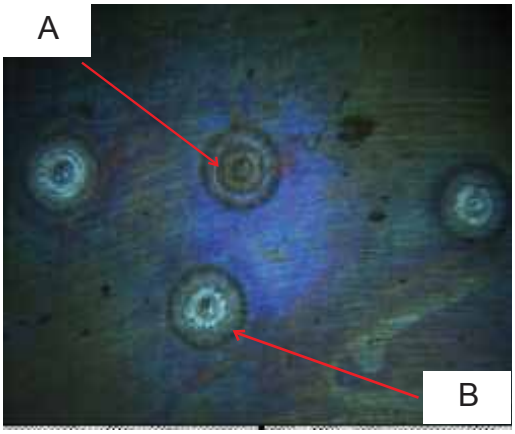
Floor Plan of Element Segregation



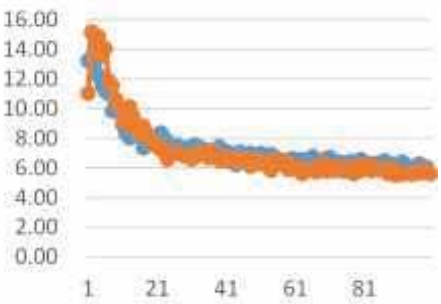
Three-dimensional Diagram of Element Segregation

• In-depth analysis

Panoramic observation



Micro-zone observation



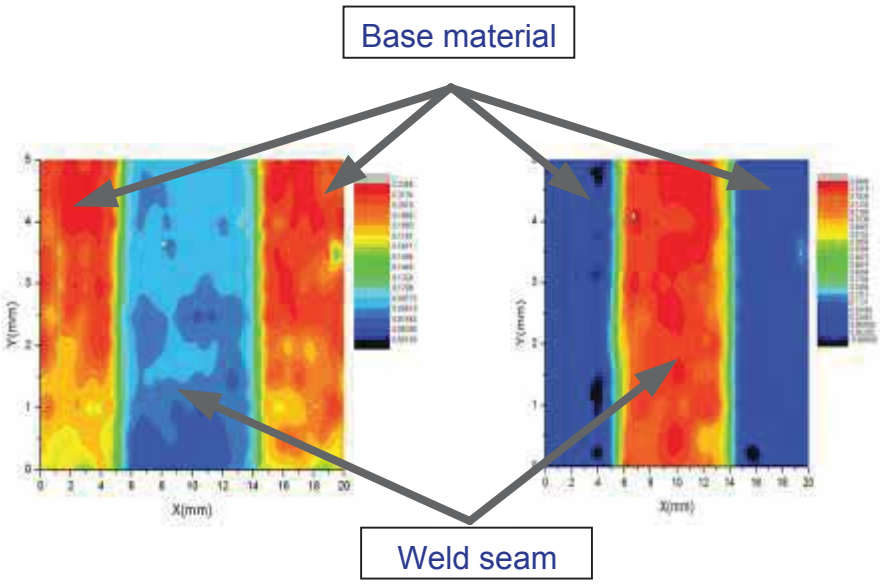
Surface Al Penetrant Sample

The relationship between pulse number and excitation depth is established, and Al permeability thickness can be obtained by the concentration-pulse number fitting curve.

Point A	Point B
Concentration	Pulse number

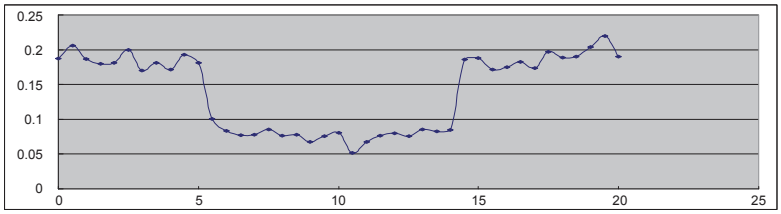
• Weld seam analysis

Weld seam of natural gas pipeline

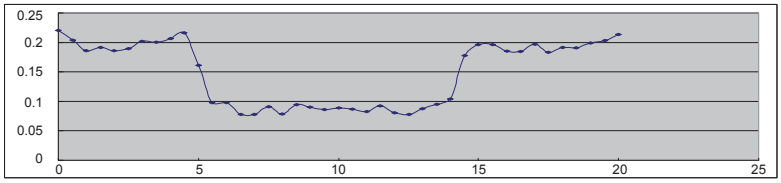


Floor Plan of Si Element Distribution

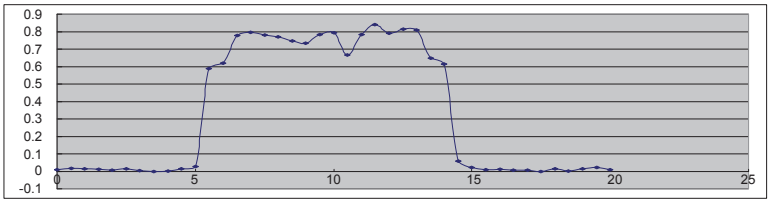
Floor Plan of Ni Element Distribution



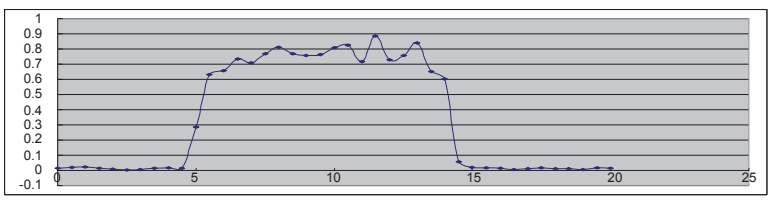
Si element content distribution along X direction when Y=1.0mm



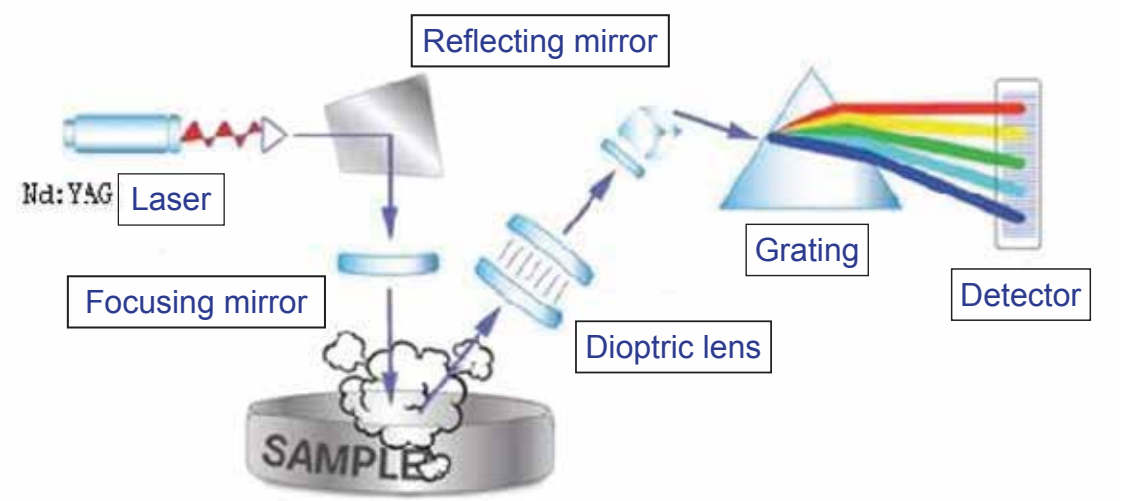
Si element content distribution along X direction when Y=2.0mm

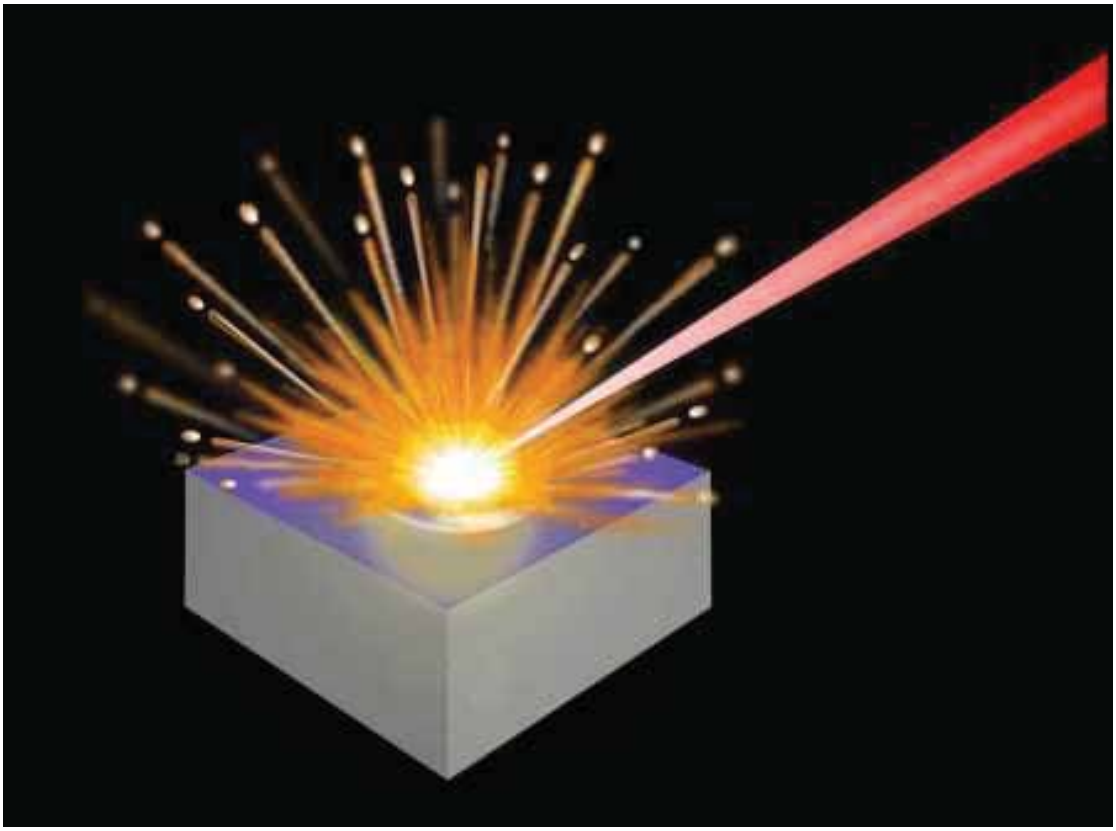


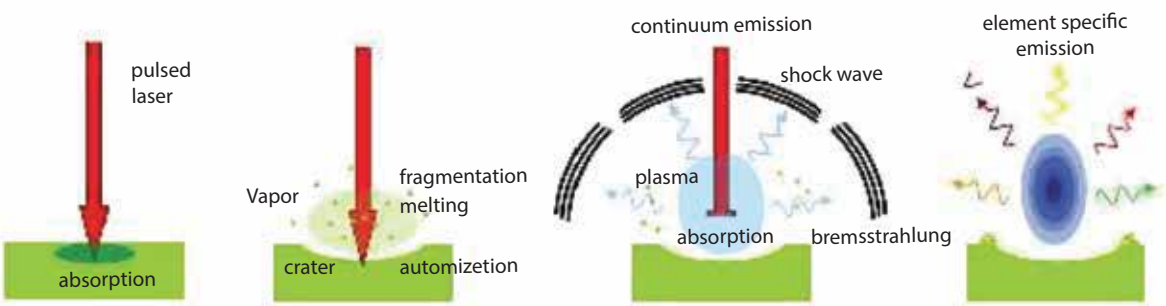
Ni element content distribution along X direction when Y=1.0mm



Ni element content distribution along X direction when Y=2.0mm


Reflecting mirror
Nd:YAG
Laser
Grating
Detector
Focusing mirror
Dioptric lens
SAMPLE




pulsed
laser
absorption
Vapor
fragmentation
melting
crater
automizetion
continuum emission
shock wave
plasma
absorption
bremsstrahlung
element specific
emission

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