CISRI NCS

Inductively coupled plasma mass spectrometer

PlasmaMS 300

National Science and Technology Project of significant scientific instrument & Equipment Development

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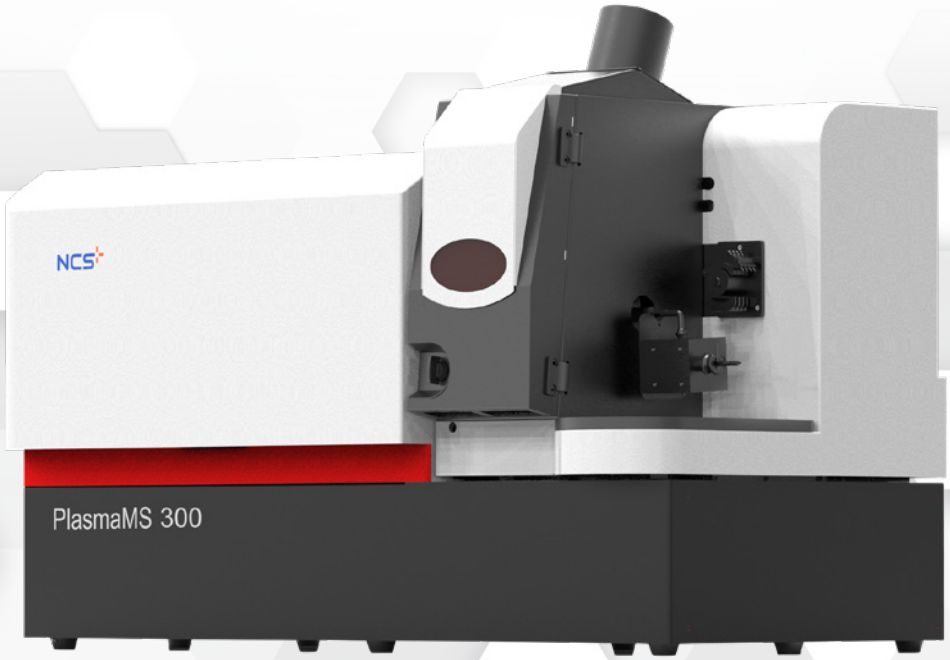


NCS Testing Technology (Germany) GmbH

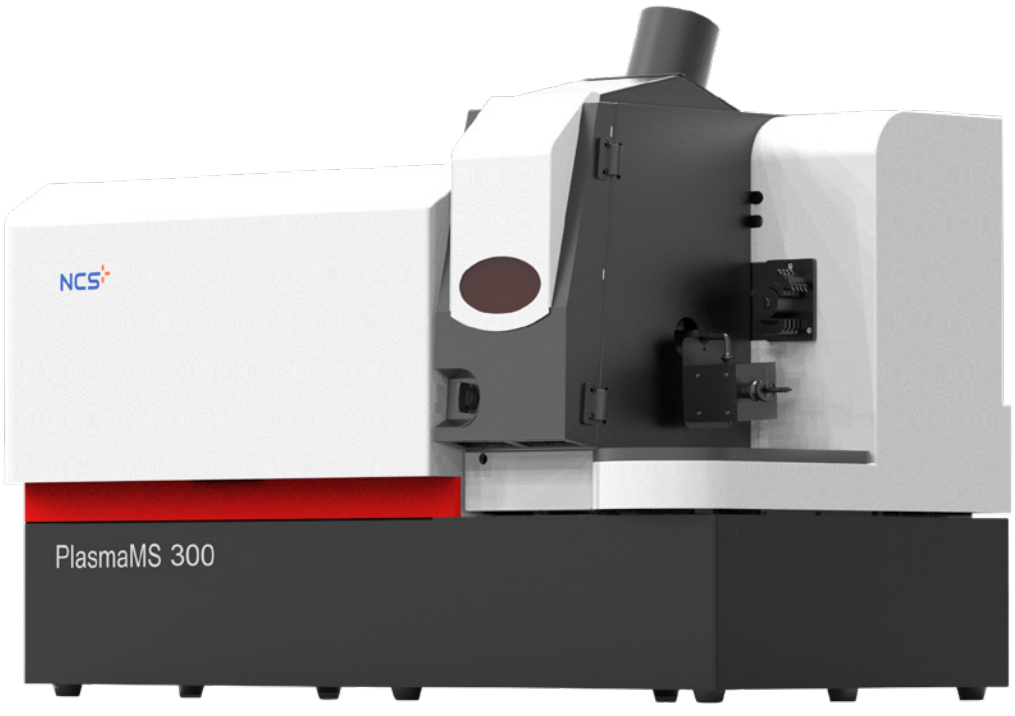
PlasmaMS 300

Inductively coupled plasma mass spectrometer

Known as the most exciting analysis technology since the 20th century, ICP-MS (Inductively coupled plasma mass spectrometry) has become one of the most effective analytical approaches for trace and ultra trace analysis on the strength of its low detection limit, low interference, high analysis accuracy, fast analysis speed, simultaneous determination of multi-elements and other outstanding analysis capabilities.

Under the support of National Science and Technology Project of significant scientific instrument & Equipment Development administrated by the Ministry of Science and Technology, NCS responds to the demands for trace analysis technology in such fields as metallurgy, environmental protection, geology, minerals and food and sets the goal of satisfying the demands of industry applications. As a result, NCS has mastered the key technologies in ICP radio frequency power supply, ion optics, quadrupole mass analyzer and successfully developed ICP-MS (Inductively coupled plasma mass spectrometer), i.e. PlasmaMS 300.

Based on PlasmaMS 300 and in cooperation with CNEAC (National Research Center for Environmental Analysis and Measurement), NRCG (National Research Center for Geoanalysis), BGRIMM (Beijing General Research Institute of Mining & Metallurgy), CISRI (Central Iron & Steel Research Institute; Central Iron & Steel Research Institute), BCPRC (Beijing Center for Physical & Chemical Analysis) and other authoritative testing organizations, NCS has developed analysis & testing methods suitable for various industries and solved such technical problems as determination of trace heavy metals in environmental media, rare earth, rare and scattered elements analysis in geology and mineral resources, valuable & harmful element analysis in secondary resources, trace chemical composition and distribution analysis in metallic materials and speciation & valence analysis of poisonous and harmful elements in foodstuffs.



Fields of Application

A
Field of Environmental Analysis and Testing

Systematic application solutions and analytical methods has been established with PlasmaMS 300, to fulfill analysis and testing requirements for heavy metal elements in surface water, waste water, soil, sediment, particulate matters in atmosphere (waste gas), solid waste and environmental samples.

B
Geological Samples Testing

As the most powerful technology for multi-element analysis of geological samples, PlasmaMS 300 featured with high sensitivity, good accuracy and strong anti-interference capability can meet the demands for rapid and accurate multi-element analysis of “Three rare” mineral elements (rare element, rare-earth element, and rare scattered element) and provide technical support for the investigation and effective utilization of "Three Rare" mineral resources.

C
Food Safety Issues

PlasmaMS 300 can effectively detect the contents of multiple metal elements in food and contact packaging materials. Furthermore, if coupled with LC, it can also effectively separate different species and forms of some specific elements, totally meet heavy metal residues analysis, heavy metal speciation and nutrient element analysis in the field of food quality and safety.

D
Metal Materials Research

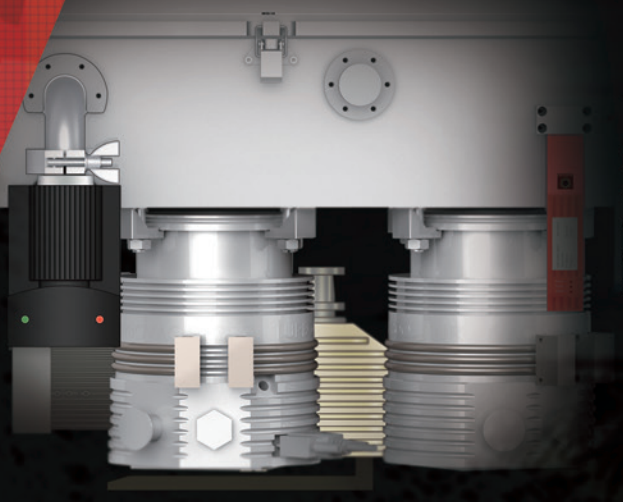
In combination with the independently-developed laser ablation sampling system (LA 300), PlasmaMS 300 can realize the analysis and characterization of composition distribution of trace elements in special-shaped non-planar materials with small size and trace elements in situ statistical distribution of trace elements in the complex material system.

Stable and good performances come from excelsior design

From partial to overall layout, PlasmaMS 300 is elaborately designed and the durability of instrument is guaranteed by optimization through the adoption of simulation and experiment and reliability demonstration with reference to national and military specifications.

Quadrupole Analyzer

High throughput quadrupole (analysis mass range: 2-260amu) can totally meet the demands for high resolution (< 0.8 amu) element analysis.
Through the application of world's leading quadrupole RF power supply technology and DDS (Direct Digital Frequency Synthesis) technology, it can realize automatic frequency matching and bring about remarkable stability and maintainability.

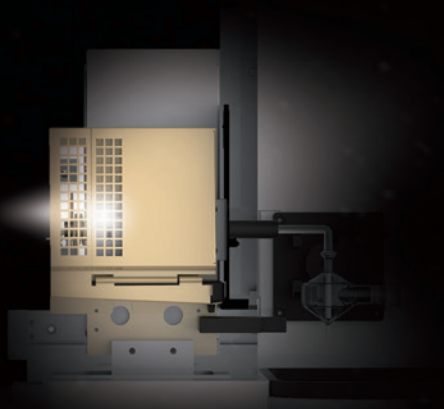


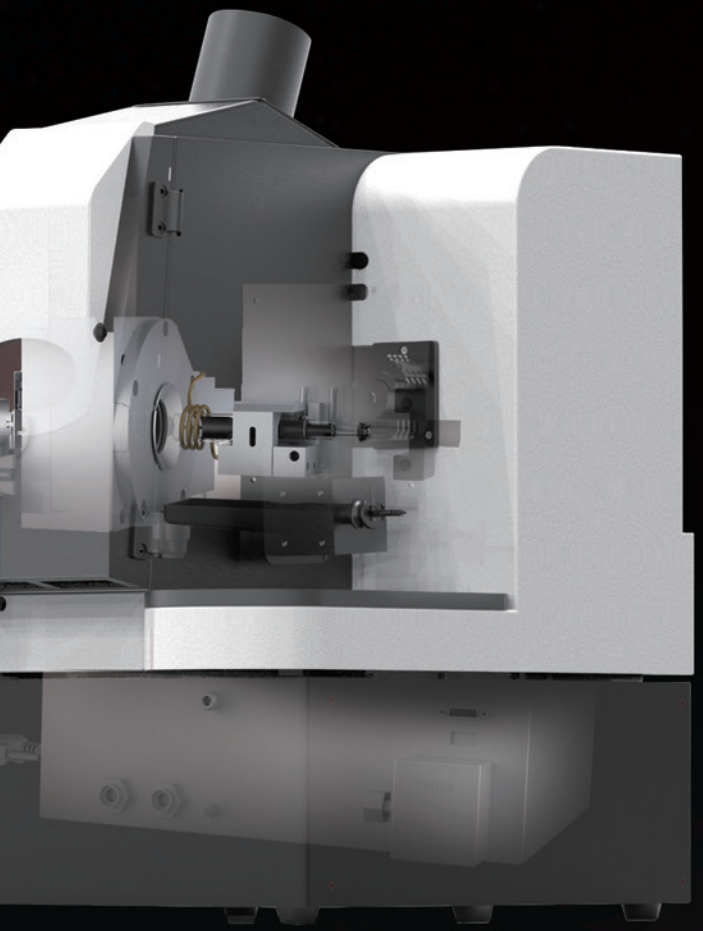
Vacuum System

High performance turbo molecular pump and external mechanical pump can quickly realize the high vacuum of instrument and ensure the signal sensitivity. Fully automatic vacuum control system can ensure the long-term stability of instrument operation.

27.12 MHz Inductively Coupled Plasma RF generator

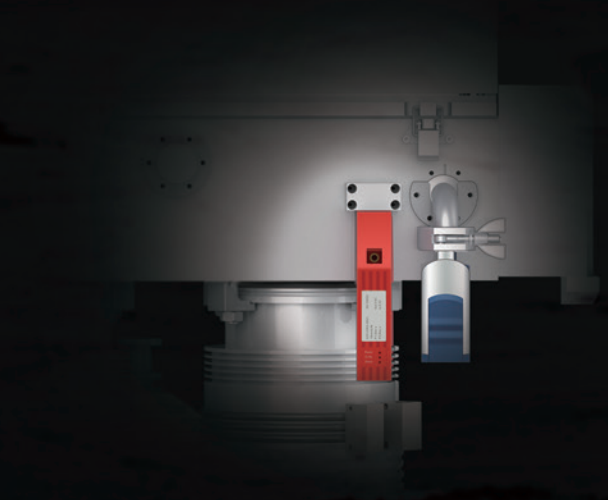
By using the solid-state RF generator with extremely high power stability and good shielding design, PlasmaMS 300 can ensure the stability of ion source and signal. In addition, the adoption of precisely-controlled three-dimensional platform realizes the automatic positioning and calibration of the torch.





Flexible switching of sampling introduction methods

The ports for coupling with such external sampling devices as laser ablation and liquid chromatography are provided, the assembly space for semiconductor cooling device is reserved and HF acid resistant sampling system (Optional Accessories) can be switched.



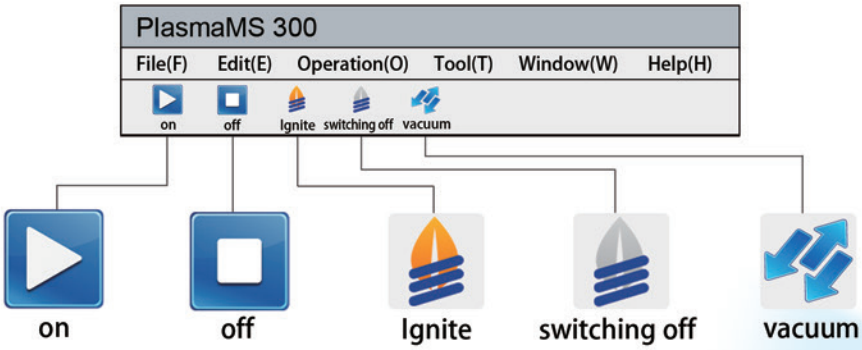
Collision cell system

The collision cell, operated by high-performance mass flow controller and gas control software, can quickly complete the helium collision model and effectively eliminate the interference.

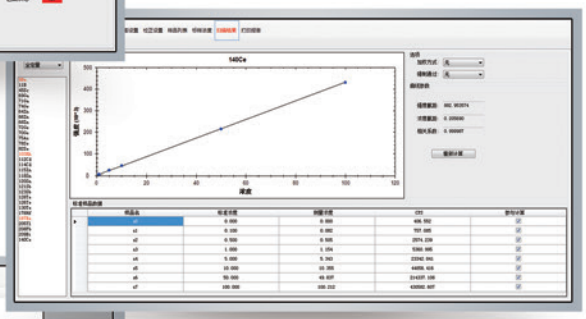
Concise, intuitive, easy to use

PlasmaMS 300 software

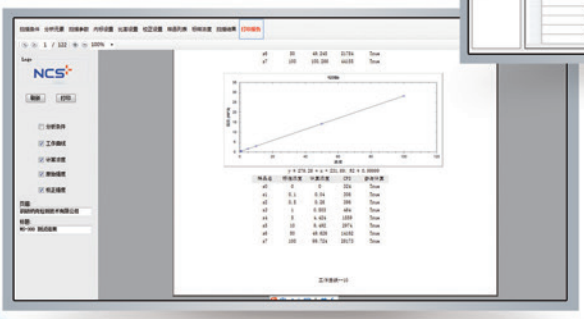
Quick and easy measurement and analysis



Configuration of experimental conditions



Standard curve plotting and sample concentration calculation



Edit, save, export and print of test report

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
H	Inductively Coupled Plasma Mass Spectrometry																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															

Lanthanoid	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinoid	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

D.L. range < 1 ppt 1 – 100 ppt 0.1 – 1 ppb

PlasmaMS 300 Product Features

Excellent reliability and stability

With sturdy and durable RF power supply, vacuum system with emergency protection and the automatic control system, and intelligent one-key operation for completing analysis and configuration, PlasmaMS 300 eliminated the human disturbance, guarantee the consistency and excellent repeatability of the instrument.

Excellent Analysis Capabilities

The solid-state ICP source with excellent matching function can effectively limit the ion diffusion during ionization process and guarantee the focusing capability and highly pass rate of ion. The ion optical system with deflection can ensure the optimal ion focusing effect, effectively reduce the background noise and thus improve the signal-to-noise ratio.

Powerful coupling technology

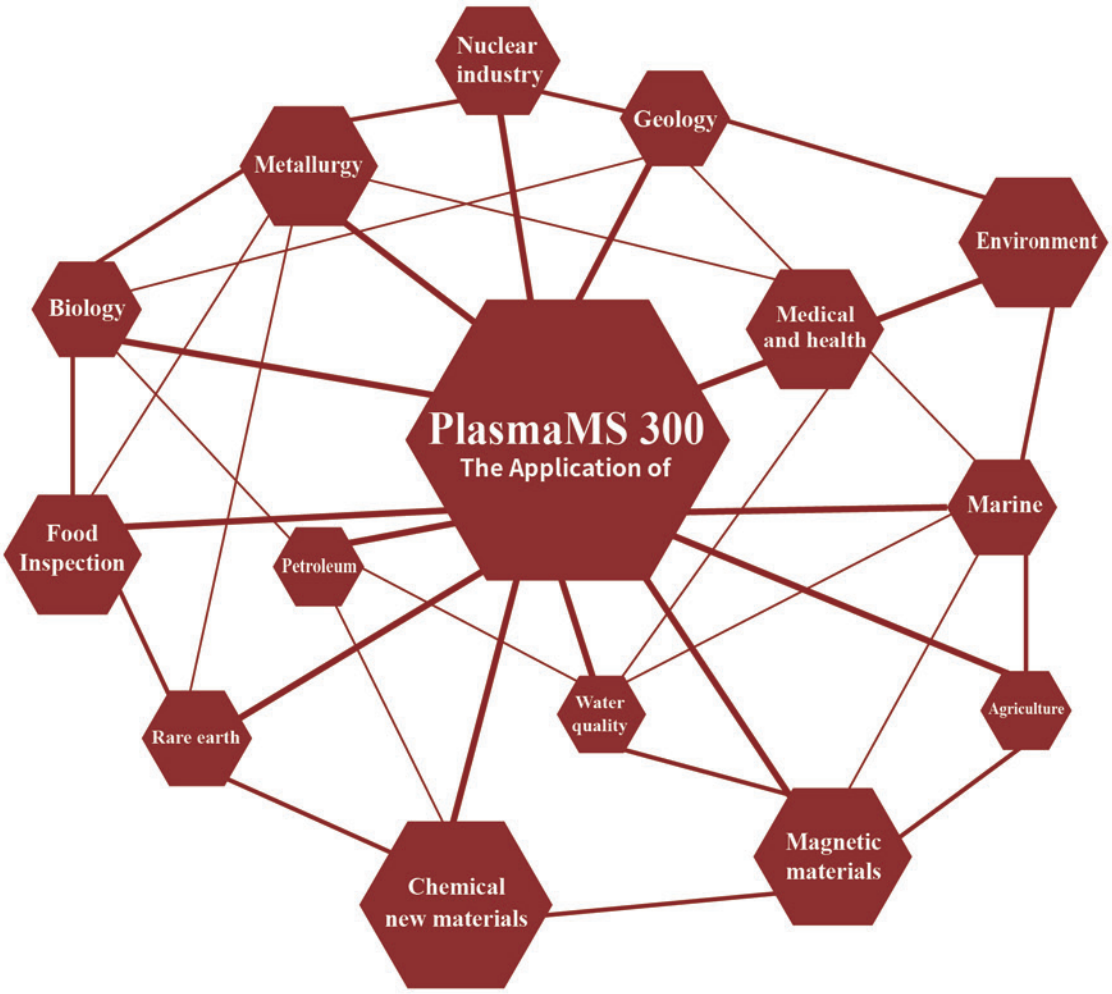
It can conveniently couple with laser ablation sampling system (LA) and liquid chromatography (LC). In combination with LA system, PlasmaMS 300 can realize the solid-state direct sampling and simultaneously determine the contents of major, minor and trace elements in aerosol samples. The coupled system avoids complicated sample preparation process, improves the sampling and testing efficiency, and expands the detection capability of PlasmaMS 300. In combination with LC, it can conduct the speciation analysis of elements in organic substance, further expand the detection capability and efficiency of PlasmaMS 300 and provide more comprehensive application solutions.

User-friendly Operation Process

The intuitive and convenient "One-click" parameter settings can improve the work efficiency of users, also provide user-defined report format according to customer requests and supply QC function and LIMS interface.

Convenient Maintenance

The easy-to-disassemble and clean cones and deflection ion optical system can reduce ion deposition and extend the maintenance cycle of instrument. Durable solid-state ICP source can ensure trouble-free use for a long time.



PlasmaMS 300
Application in the Field of Food Analysis

Determination of trace heavy metals in rice samples

In this experiment, the reference materials of GSB-22 and GBW08503b for biological component analysis are used and the reference material for rice analysis of NCS is taken as the to-be-tested sample, for the purpose of determining harmful elements of Cd, Pb, As and Cr.

Sample	Result	114Cd	75As	208Pb	53Cr
GSB-22	Measured Value	0.02	0.14	0.07	0.10
	Certified Value	0.02±0.002	0.12±0.03	0.09±0.03	0.17±0.05
GBW 08503b	Measured Value	0.17	0.38	0.35	
	Certified Value	0.15±0.04	0.32±0.07	0.34±0.13	
0400	Measured Value	0.45	0.18	0.13	0.06
	Certified Value	0.44	0.17	0.11	0.05
0401	Measured Value	0.90	0.21	0.07	0.03
	Certified Value	0.90	0.20	0.05	0.04
0402	Measured Value	0.53	0.20	0.06	0.05
	Certified Value	0.52	0.19	0.05	0.05

The experimental results show that the measured values of all elements are well consistent with that of certified values.

This application shows that PlasmaMS 300 possesses good sensitivity and excellent accuracy and fully meets the demands for testing of trace elements in food.

PlasmaMS 300
Application in the Field of Ore Material Analysis

Determination of trace impurities in Cobalt Carbonate powder

In this experiment, Cobalt Carbonate powder sample is used to determine the impurity elements of Al, Cd, Cr, Cu, Mg, Mn, Zn, Pb. Through the application of PlasmaMS 300, the test is conducted by taking 50% Co as matrix, 20ppb of Sc,Rh,Re as internal standard. The experimental results show that PlasmaMS 300 can fully meet the demands for trace elements testing in minerals.

Testing result

The testing results of Cobalt Carbonate powder are as shown in Table 1.

Analytical Instrument	Sample NO.	Analysis Item (ppb)							
		Al	Cd	Cr	Cu	Mg	Mn	Zn	Pb
PlasmaMS 300	1	70	2.82	7.6	3.67	2.40	5.30	1.08	0.14
	2	2.40	0.074	14.34	4.20	2.75	5.97	0.60	0.080
	3	0.91	0.083	3.20	3.38	2.28	1.33	0.47	0.17
Reference Value	1	63.8	2.48	6.8	2.50	1.80	4.73	0.49	0.12
	2	2.20	0.013	14.50	3.95	2.90	5.57	0.90	0.060
	3	0.80	0.053	1.38	2.72	2.40	0.68	0.50	0.11

Detection limit

The detection limit for typical mineral analysis method is as shown in Table 2.

Instrument	Element detection limit (ppb)							
Plasma MS 300	Al	Cd	Cr	Cu	Mg	Mn	Zn	Pb
	0.038	0.002	0.041	0.030	0.021	0.004	0.025	0.001

PlasmaMS 300
Application in the Field of Metallic Material Analysis

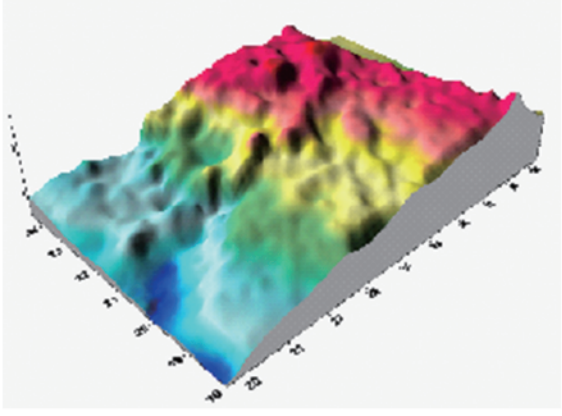
In this experiment, the performance of the LA-ICP-MS independently developed by NCS has been tested for metal analysis with standard materials.
5 pieces of low alloy steel standard samples in GSBH40068-93 is taken as the experimental samples. Among the standards, No. 1,2 ,4 and 6 in GSBH40068-93 standard samples are taken to plot the calibration curve and No. 5 sample as the to-be-tested sample.

Content Accuracy Comparison of All Elements

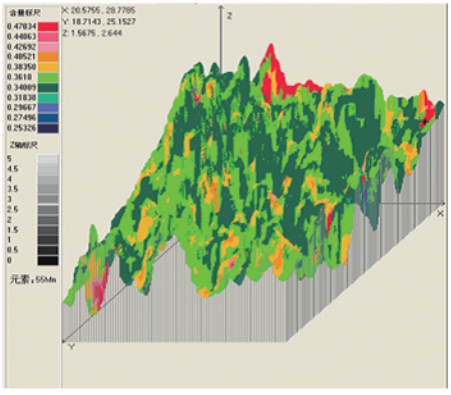
Test result comparison of GSBH40068-5-93 # sample

Non-planar material fracture

Isotope	Certified w/%	Uncertainty +/-	PlasmaMS 300-LA Measured Value w/%
Mn^{55}	1.36	0.01	1.28
Cr^{53}	0.124	0.005	0.0931
Mo^{95}	0.472	0.007	0.476
Cu^{65}	0.233	0.006	0.220
V^{51}	0.619	0.004	0.645
W^{182}	1.6	0.02	1.69
Co^{59}	0.03	0.001	0.0239
Al^{27}	0.866	0.006	0.799
B^{11}	0.0089	0.0004	0.0123
P^{31}	0.046	0.001	0.0481
Ti^{47}	0.812	0.008	0.791
Nb^{93}	0.139	0.005	0.124



Projection drawing of non-planar material fracture



Three-dimensional morphology & content contour plot of Manganese element distribution in non-planar material fracture

Coupled with laser ablation sampling system (LA 300), PlasmaMS 300 can realize solid-state direct sampling and reduce the interference of matrix interference. During the coupling, the overall performance of instrument is stable and all elements can achieve excellent linearity. The results of content accuracy comparison strongly prove the outstanding accuracy of PlasmaMS 30.
The application validates the application potential of this coupling technology in the material surface trace element distribution analysis and proves that it is a powerful detection means for ore mineral composition and surface analysis.

LA 300

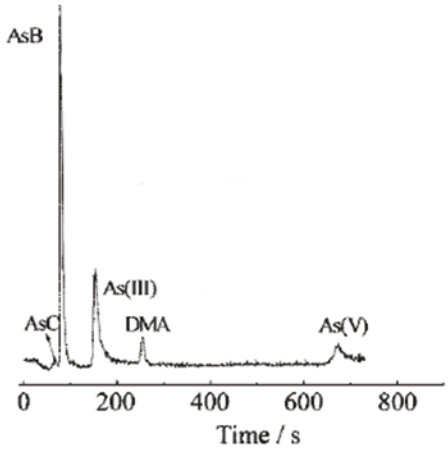
Specification Parameter

Laser	Nd:YAG@213nm
Repetition frequency	1-10Hz
Energy density	>30J/cm²
Spot size	12 different sizes from 4μm–110μm
XY stages	85mm×85mm
Resolution of movement	1um
Optical magnification	20X
Field	0.66mm*0.49mm
Nebulizer gas control	Mass Flow Control

PlasmaMS 300

Speciation analysis of organic arsenic and inorganic arsenic in dried shredded squid

	浓度μg/L						
	As总	AsC	AsB	As（Ⅲ）	DMA	MMA	As(Ⅴ)
Shredded Squid 1	1.43	0.11	0.79	0.4	ND	ND	0.15
Shredded Squid 2	1.26	0.02	0.7	0.41	ND	ND	0.13
Shredded Squid 3	1.4	0.08	0.69	0.34	0.1	ND	0.19



The experimental results show that the coupling of PlasmaMS 300 with separation instrument (e.g. Liquid chromatography, LC) can effectively solve the problem of analyzing harmful elements (e.g. Hg and As, etc) with different species and forms of some specific elements in food and contact packaging materials. It is also one of the main trends for the future application development of ICP-MS.

NCS Testing Technology Co., Ltd. (hereinafter referred to as NCS) is the wholly owned subsidiary of China Iron & Steel Research Institute Group (CISRI). The main business of NCS involves third-party testing services (including the chemical composition testing, mechanical property testing, material failure analysis, nondestructive testing and measurement calibration), development and sales of analysis and testing instruments, nondestructive testing equipments, anti-corrosion products and related engineering, certified reference materials, proficiency testing and other fields. It possesses many qualifications such as ISO9001, NADCAP, Rolls-Royce, RMP, ISO/IEC 17025 accreditation, CMA, CAL, CMC and PTP. Meanwhile, it is also the “State-Level Testing Organization for Appraisal of Science and Technology Achievements of the People's Republic of China” and “Personnel Training Centre for Analysis Technology Research and Arbitration Analysis ” authorized by Ministry of Science and Technology; the Testing Laboratory accredited by China Quality Certification Mark; the location of production license examination department of bearing steel products of the National Industrial Product Production License Office of State General Administration of the People's Republic of China for Quality Supervision and Inspection and Quarantine (AQSIQ); the open laboratory authorized by Zhongguancun High-Tech Park. NCS also provides technical support for commercial aircraft, China emergency analysis and production safety accident investigation in Beijing.

High-quality Creates Better Life

Commercial & Sales:

NCS Testing Technology (Germany) GmbH
Adress: Blindeisenweg 39, 41468 Neuss – Germany
Website: http://www.ncs-germany.com
E-Mail: info@ncs-germany.com

Manufactured:

NCS Jiangsu Testing Technology Co., Ltd
Adress: No. 158, Qianjin East Road, Kunshan Economic &Technological Development Zone, Jiansu Province, China

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