

Products Information

# NANO Divsion Products

محصولات بخش نانو آریافن ورزان

**AFV**

Aria Fan Varzan

"To Make a Better Life by Applied Science"

پیشگام در راهکارهای نانوتکنولوژی

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## درباره آریافن ورزان

شرکت آریافن ورزان به شماره ثبت ۸۸۶۵۲۳ بخشی از هولدینگ علمی **فاندا** می‌باشد که بیش از یک دهه در زمینه‌های مختلف علوم کاربردی به شکل تخصصی فعالیت داشته است. ساختار سازمانی این مجموعه به گونه‌ای طراحی گردیده که تیم‌های تخصصی با تحصیلات مرتبط در سه حوزه کشت سلولی و پزشکی بازساختی، نانومترولوژی و پلاسماتکنولوژی در قالب یک مجموعه با یکدیگر در تعامل باشند. طی یک دهه گذشته زیرساخت‌های کاری این مجموعه به شکل مدرن و منطبق بر استانداردهای روز دنیا رشد نموده تا علاوه بر تجربه فعالیت موثر در حیطه علوم یادشده حجم دانش و علم قابل توجهی را به واسطه روابط بین‌المللی و داخلی کاری خود در مجموعه گردآوری و از آن در فرایندهای کاری روزانه خود استفاده نماید. هم‌اکنون این مجموعه قریب به ۴۰ نیروی کار آزموده با تحصیلات بالا را به شکل سازماندهی شده‌ای در خود جای داده و به واسطه همین نظم نیز موفق به دریافت گواهی ایزو ۹۰۰۱:۲۰۱۵ برای فرایندهای کاری خود گردیده است.



ARIA FAN VARZAN is a part of FANDA Group

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Aria Fan Varzan

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Products Information

# Q.One NMR System

## One-Stop Solutions for NMR Spectrometer

**AFV**

Aria Fan Varzan

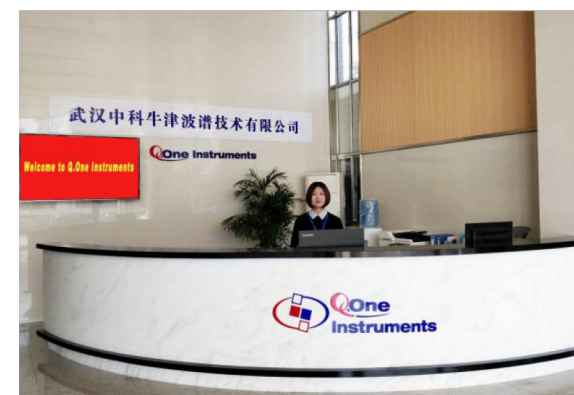
"To Make a Better Life by Applied Science"

## Company Introduction

Q.One was established in 2013 for NMR console manufacturing, under the name of ZhongKe-Niujin MR Tech Co. Ltd., with key NMR electronic and software technologies transferred from Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences. In 2016, we started to establish our magnet factory in Wuhan with technologies transferred from Oxford Instruments plc and magnets in our Wuhan factory. Also in 2016, we, together with our Swiss colleagues, set up a subsidiary company, Q.OneTec AG, in Switzerland for innovative NMR probe R&D and high quality industrial scale manufacturing. The expertise of our motivated team ensure the quality of NMR probes delivered to our customers.

The MAS probes can be provided by our partner, NMR Institute(NMRI), in Tallinn, Estonia. Q.One is a one-stop solution provider for your NMR systems.

Quality has always been our top priority, as has been embedded in the name of our company. Our company has been certified to ISO 9001 in 2014 and ISO 13485 in 2017. Our goal is to provide affordable, high quality and innovative NMR spectrometers, together with full services to all users worldwide.



## Quantum-IPlus

### 400 and 600 MHz NMR Spectrometers

#### Superconducting Magnet

- Oxford Instruments technology
- Actively Shielded
- Long cryogen hold time
- High stability, high homogeneity

#### Probe

- Made by Q.OneTec
- High sensitivity, broadband observation
- Ultra fast Smart Tune/ Match
- Customized probes on request

#### Console

- Fully digital & modular design
- GHz intermediate frequency technology
- CAN bus-based distributed architecture
- Support multi-receiver configuration



#### Software

- Expandable modular design
- Automatic, accurate 3D gradient shimming
- Highly automated experiment functionality
- Automated experiments setup through web

## Quantum-IPlus

### 400 and 600 MHz Magnets & NMR Console

#### AS400

- Actively-shielded magnet
- Helium / Nitrogen hold time: 180 / 14 days
- 54 mm room temperature bore
- Low field drift, Low fringe field
- Anti-vibration legs available

#### AS600

- 14.09 T Actively-Shielding magnet
- Helium / Nitrogen hold time: 120 / 15 days
- 51 mm room temperature bore
- Low field drift, Low fringe field
- Include the air spring insulator with vertical damping



#### Console

- Digital & modular design
- CAN-based distributed control system
- GHz IF technology
- Excellent spectral purity and linearity
- Standard 2 RF channels, expandable to 3 channels
- Optional multi-receiver configuration

#### Broadband Preamplifier

- Low-noise design
- Supports STM (Smart Tune and Match)
- Touch screen for interactive display and switching



## High Resolution Probes

Outstanding NMR Performance for Everyone



### Q.OneTech Automated Probe

- > Compatible with all available system architectures
- > Broadband channel range: 31P-15N, expandable to 19F
- > 1H channel tunable to 19F
- > Ultra fast & high precision Smart Tune and Match
- > Temperature range from -70 to 120 °C
- > 400 / 600 MHz observe probes
- > Custom designs on request



### Q.OneTech Manual Probe

- > Broadband channel range: 31P-15N
- > 1H channel tunable to 19F
- > 13C sensitivity optimized
- > Broad VT range
- > Convenient positioning of tuning and matching knobs



### NMRI MAS Probes

- > Broadband channel range: 31P-15N
- > From 10 to over 150 kHz spinning
- > Optimized kHz/mL rotor design
- > H/C/BB & low E
- > High-resolution spectrometer compatible
- > Remote magic-angle adjustment
- > In-situ reaction support
- > 10-650K temperature range
- > Multi-modal MAS controller

## Accessories and Services

### Auto Sample Changer

- 24 or 60 slots
- Highly miniaturized design
- Compatible with 300 to 600 MHz magnets
- Detachable and optional extra sample tray for sample exchange during operation

### Liquid Cryogen Level Meter

- Compact design
- Regular automatic recording
- Clear OLED screen
- Compatible to other magnets

### System Upgrades

- Fair prices and flexible options. Upgrade your spectrometer with our console (and probe) to keep it at peak performance.

### System Relocation

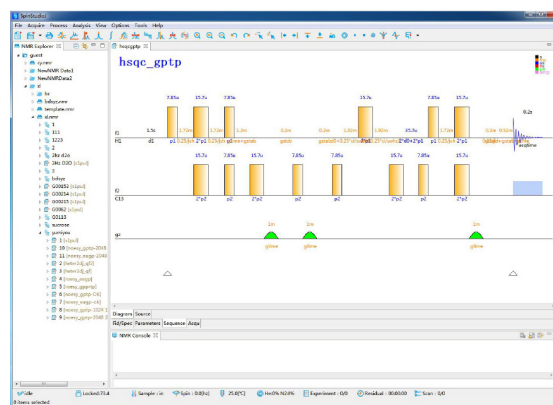
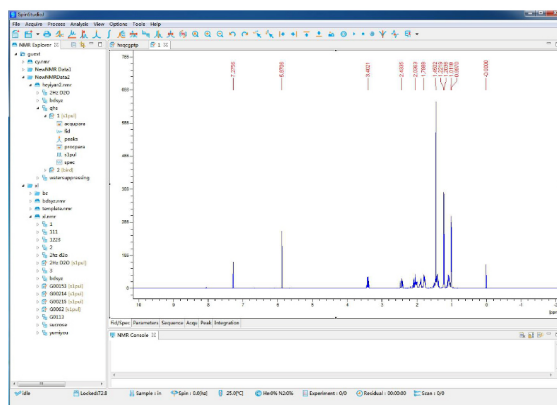
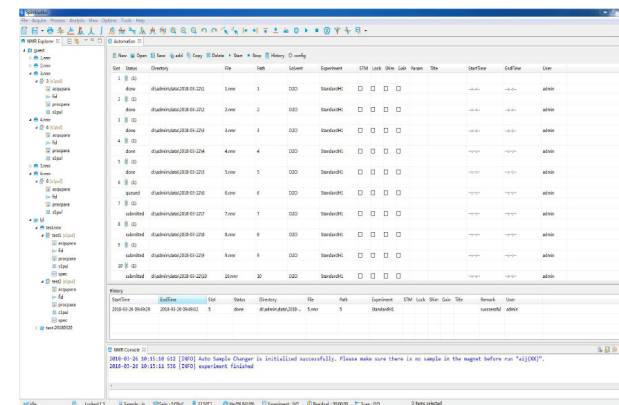
- Fair prices, considerate service. Relocate your spectrometer to fit it into your new lab.





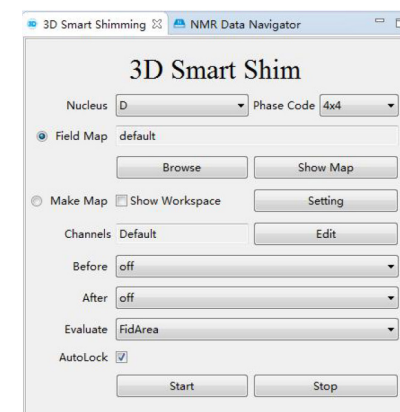
# SpinStudioJTM

## Professional NMR Data Acquisition & Processing Software

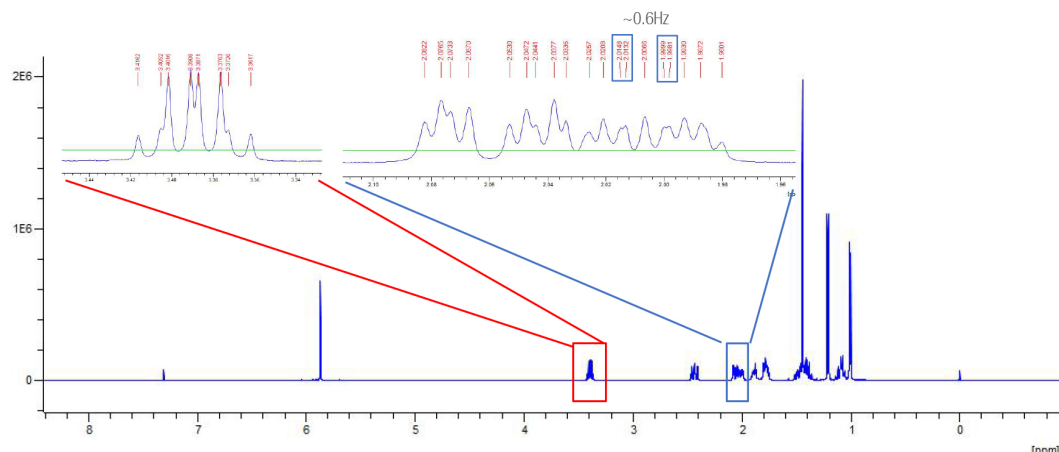
Exp	Name	Directory	File	Ref	Label	Experiment	STM	Lock	Shim	Gain	Time	Offset	RefTime	RefOffset	User
1	1D														
2	2D														
3	3D														
4	4D														
5	5D														
6	6D														
7	7D														
8	8D														
9	9D														
10	10D														

- Full functionality of spectrometer control
- Complete data acquisition and processing functionality
- Fully automatic, highly accurate 1D & 3D gradient shimming technology
- Highly automated experiment
- Automatic spectral analysis
- Data is Mnova compatible
- Automated experiments can be setup through web interface



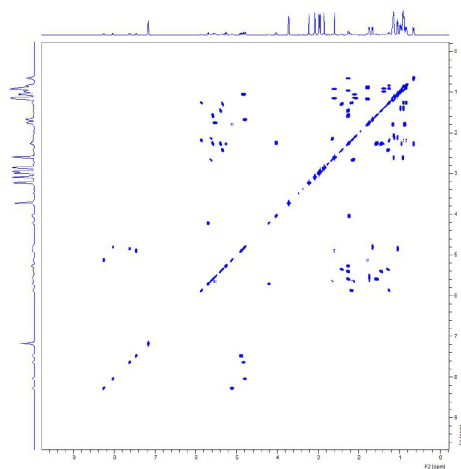
## Application

### Outstanding Results with QOne NMR Spectrometer

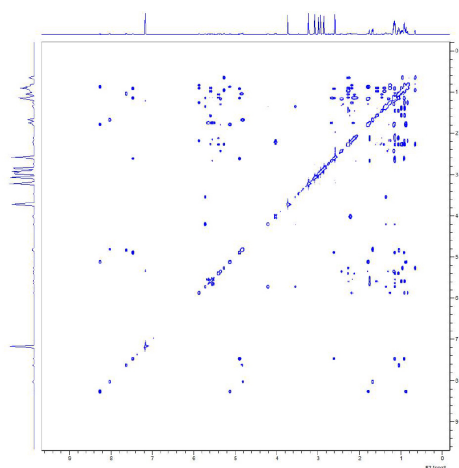


## Application

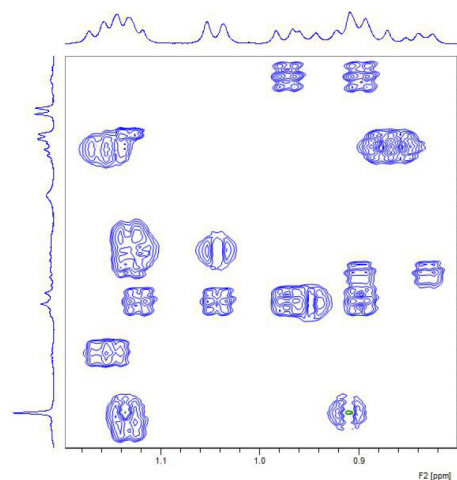
### Outstanding Results with QOne NMR Spectrometer



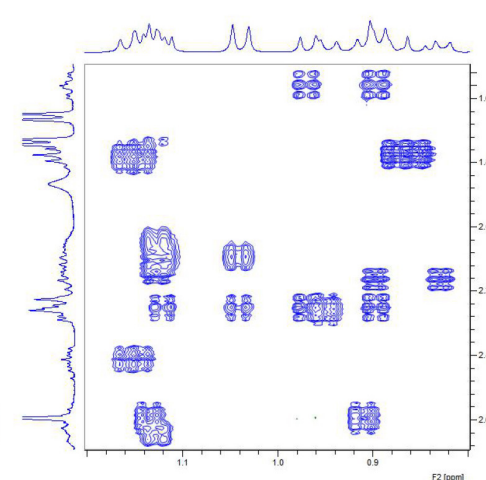
<sup>1</sup>H-<sup>1</sup>H COSY of cyclosporin-A



<sup>1</sup>H-<sup>1</sup>H TOCSY of cyclosporin-A

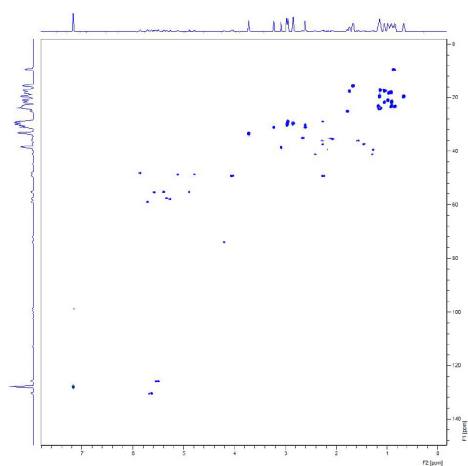


Comparison of expanded regions of TOCSY (left) and ZQF-TOCSY (right) of cyclosporin-A

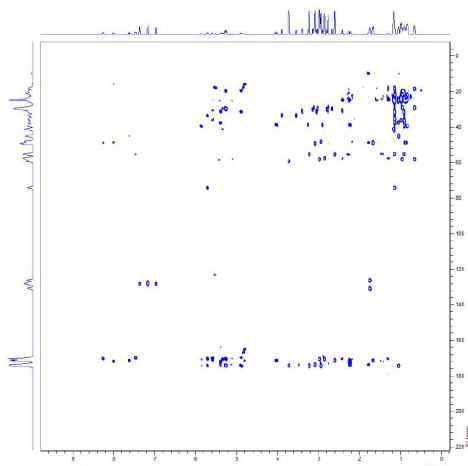


## Application

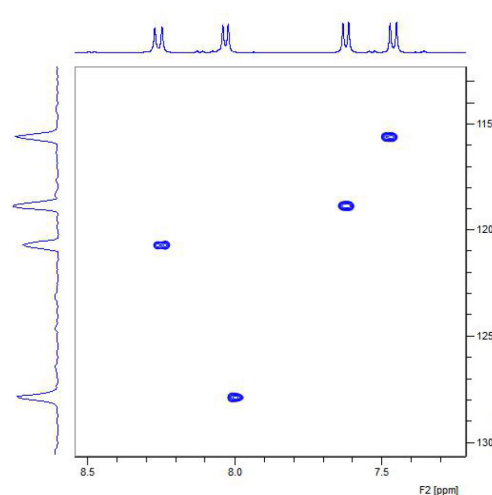
### Outstanding Results with QOne NMR Spectrometer



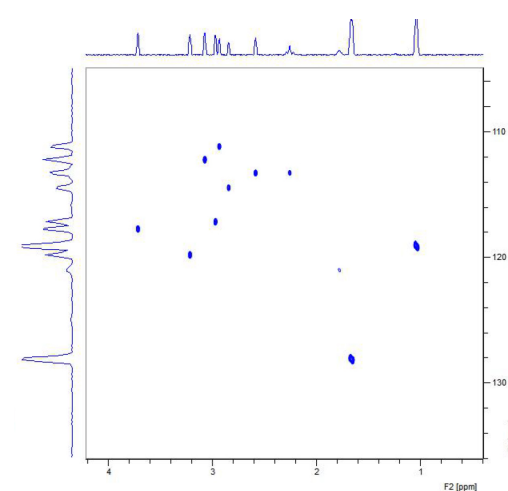
$^1\text{H}$ - $^{13}\text{C}$  HSQC of cyclosporin-A



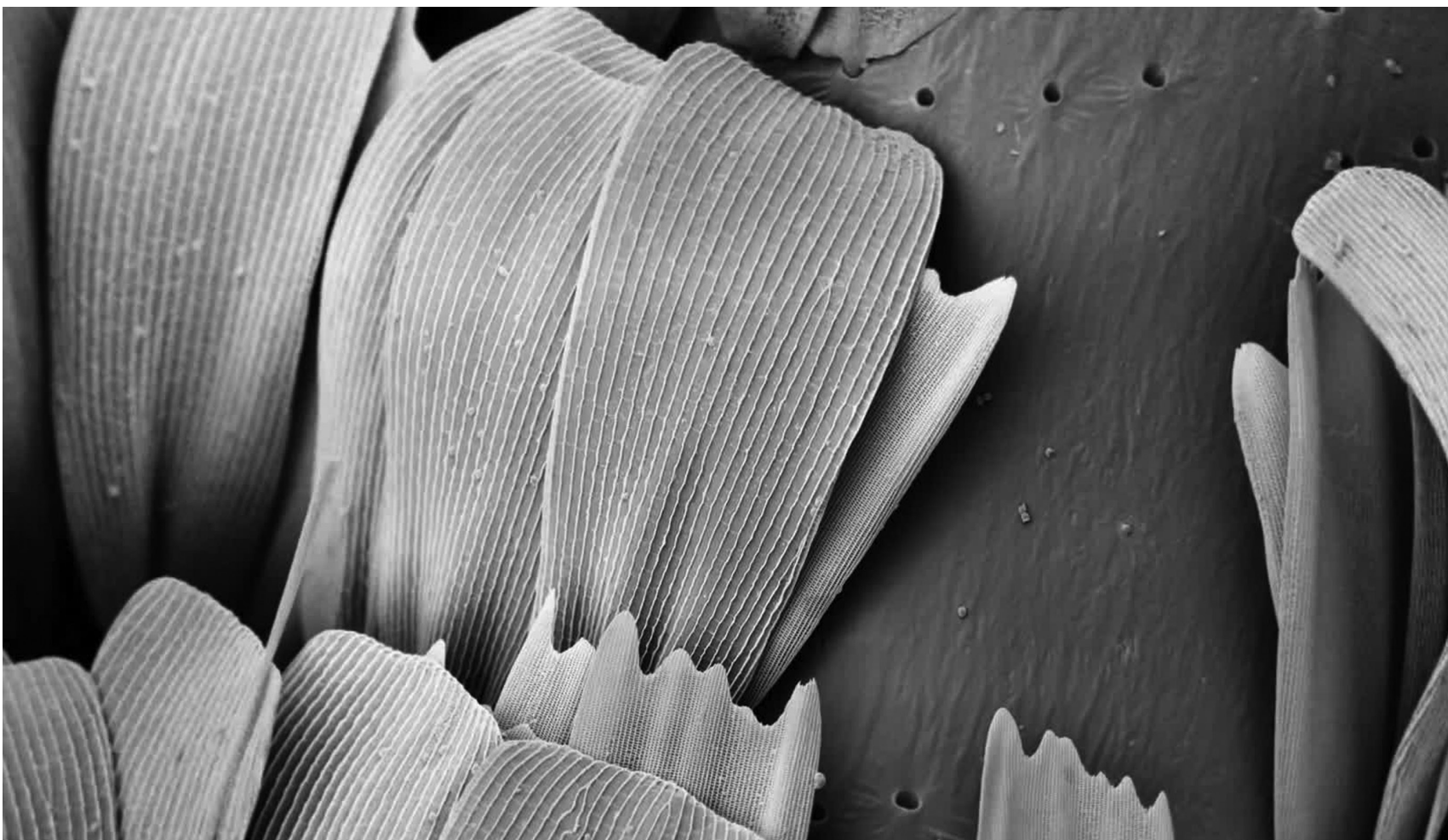
$^1\text{H}$ - $^{13}\text{C}$  HMBC of cyclosporin-A



$^1\text{H}$ - $^{15}\text{N}$  HSQC of cyclosporin-A



$^1\text{H}$ - $^{15}\text{N}$  HMBC of cyclosporin-A



Products Information

## KYKY Microscope Series

**AFV**

Aria Fan Varzan

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## History



The first KYKY DX-3 Scanning Electron Microscope



AMRAY-KYKY 1000B Scanning Electron Microscope joint developed with AMRAY (US)



KYKY-2800 upgraded version of KYKY-2000 Awarded by BCEIA



EM6000 Series Tungsten Filament Scanning Electron Microscope with integrated automatic operation function



Based on EM8000F upgraded tube beam current acceleration and low voltage imaging mode



China first TEM KYKY DX-4



First digital Scanning Electron Microscope with image processing function KYKY2000



EN3200 digital scanning Electron Microscope



China first FEG SEM EM8000F



## Who?

KYKY TECHNOLOGY CO., LTD., was founded in 1958, which invented the first set of turbo pump, commercial helium leak detector and scanning electron microscope in China, has been dedicated to providing comprehensive vacuum solutions to the partners all over the world in the last half-century.

KYKY's main products cover the field of turbo pumps, vacuum leak detector, vacuum measurement and coating systems.

KYKY also supplies vacuum technology solutions, consultation and services to our customers all over the world and plays a more and more important role in scientific research, solar cell, coating, lighting, semi-conductor, etc.



## SEM6200

- Affordable SEM
- English Operation Panel
- Full set of automated software
- Modification Service Available
- Bestseller SEM



## SEM6200

### > EM6200 Eco Tungsten Filament SEM Information

Item		EM6200 Std Tungsten Filament SEM
Resolution		4.5nm @ 30KV (SE) 6nm @ 30KV (BSE)
Magnification		Negative Magnification: 15X ~ 250000X Screen Magnification: 30X ~ 500000X
Electron Gun		Tungsten Heated Cathode - Pre Centered Tungsten Filament Cartridge
Accelerating Voltage		0 ~ 30KV
Lens System		Three-Level Electromagnetic Lens (Tapered Lens)
Objective Aperture		Molybdenum Aperture Adjustable Outside Vacuum System
Specimen Stage Travel Range	X (Auto)	Five Axes Stage
	Y (Auto)	0 ~ 50 mm
	Z (Manual)	0 ~ 50 mm
	R (Manual)	0 ~ 25 mm
	T (Manual)	360°
		-5° ~ 90°
Max Specimen Diameter		150 mm
Detector		High Vacuum Secondary Electron Detector (With Detector Protection)
Modification		Stage Upgrade; EBL; STM; AFM; Heating Stage; Cryo Stage; Tensile Stage; Micro-Nano Manipulator; SEM+Coating Machine; SEM+Laser
Accessories		CCD, LaB6 X-Ray Detector (EDS), EBSD, CL, WDS, Coating Machine
Vacuum System		Turbo Molecular Pump; Rotation Pump
Electron Beam Current		10pA~0.1 μA
PC		Customized Dell Work Station

## SEM6900

- High resolution
- Upgradeable LaB
- Huge Sample Stage
- Multiple Modification scheme
- Full set of automated software
- Low maintenance cost



## SEM6900

### > EM6900 Std Tungsten Filament SEM Information

Item		EM6900 Std Tungsten Filament SEM
Resolution		3nm @ 30KV (SE) 6nm @ 30KV (BSE)
Magnification		Negative Magnification: 6X ~ 300000X Screen Magnification: 12X ~ 600000X
Electron Gun		Tungsten Heated Cathode - Pre Centered Tungsten Filament Cartridge
Accelerating Voltage		0 ~ 30KV
Lens System		Three-Level Electromagnetic Lens (Tapered Lens)
Objective Aperture		Molybdenum Aperture Adjustable Outside Vacuum System
Specimen Stage		Five Axes Stage
Travel Range	X (Auto)	0 ~ 80 mm
	Y (Auto)	0 ~ 60 mm
	Z (Manual)	0 ~ 50 mm
	R (Manual)	360°
	T (Manual)	-5° ~ 90°
Max Specimen Diameter		175 mm
Detector		High Vacuum Secondary Electron Detector (With Detector Protection) Semiconductor Four Segmentation Back Scattering Detector
Modification		Stage Upgrade; EBL; STM; AFM; Heating Stage; Cryo Stage; Tensile Stage; Micro-Nano Manipulator; SEM+Coating Machine; SEM+Laser
Accessories		CCD, LaB6 X-Ray Detector (EDS), EBSD, CL, WDS, Coating Machine
Vacuum System		Turbo Molecular Pump; Rotation Pump
Electron Beam Current		10pA~0.1 μA
PC		Customized Dell Work Station

## SEM8000

- Schottky electron gun, high brightness, good monochromaticity, small beam spot, long life duration
- With E-beam tube acceleration optional stage deceleration
- Stable beam current, low energy spread
- Non-conducting sample observe without sputtering in low voltage
- Easy, convenient and friendly operation interface
- Huge five axes motorized stage





## SEM8000 F

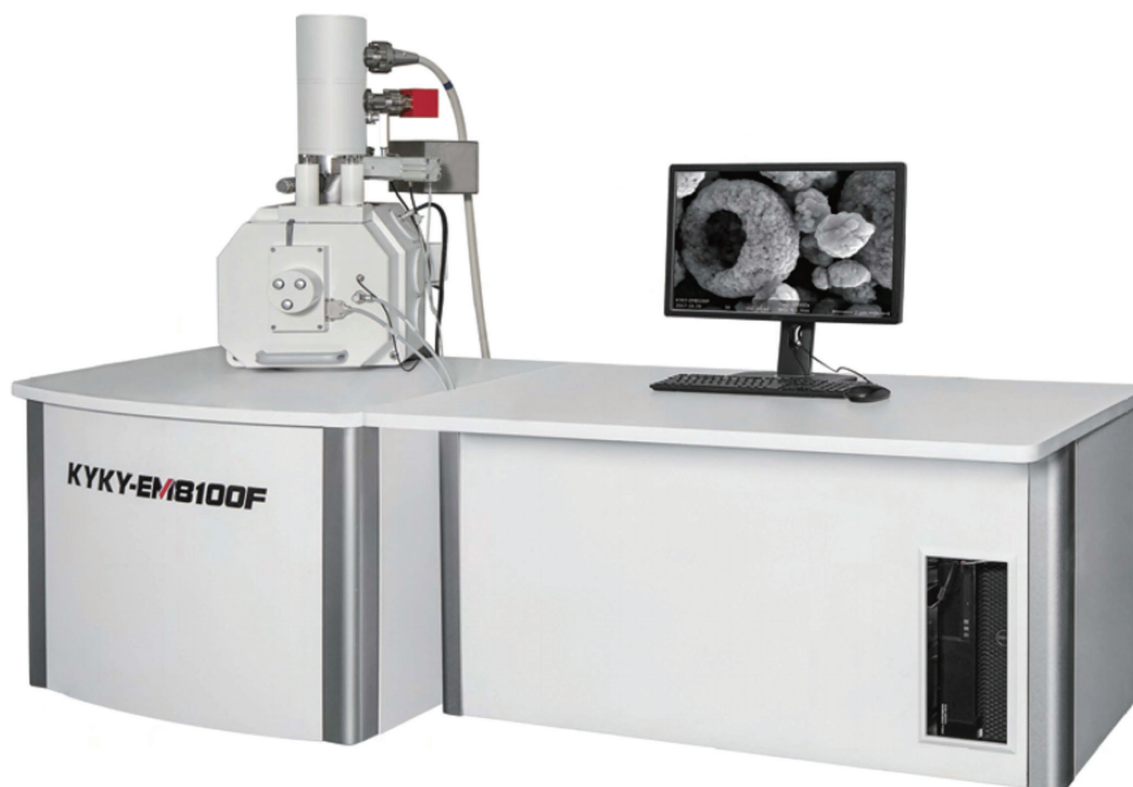
> EM8000F

> FEG SEM

Item		EM8000F Pro FEG SEM
Resolution		1.5nm @ 30KV (SE) 8nm @ 3KV (BSE) 1.5nm @ 30KV (SE) 8nm @ 3KV (BSE)
Magnification		15X ~ 500000X
Electron Gun		Schottky Emission Electron Gun
Automatic Function		Focus, Brightness/Contrast, Astigmatism, Beam Alignment
Accelerating Voltage		0 ~ 30KV
Vacuum System		Two Ion Pump (Agilent), One Turbo Pump (Edwards), One Rotation Pump (Edwards)
Detector		SE, BSE, EDS (Optional), EBSD (Optional)
Specimen Stage		Manual/ Automatic
Travel Range	X (Auto)	0 ~ 150 mm
	Y (Auto)	0 ~ 150 mm
	Z (Manual)	0 ~ 50 mm
	R (Manual)	0 ~ 360°
	T (Manual)	-5° ~ 90°

## SEM8100 Pro

- Schottky electron gun, high brightness, good monochromaticity, small beam spot, long life duration
- With E-beam tube acceleration Optional stage deceleration
- Stable beam current, low energy spread
- Non-conducting sample observe without sputtering in low voltage
- Easy, convenient and friendly operation interface
- Huge five axes motorized stage



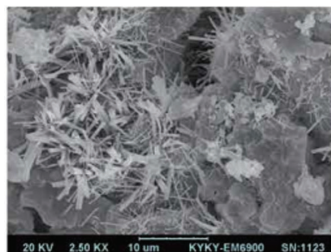
## SEM8100 Pro

### > EM8100F Pro FEG SEM

Item		EM8100F Pro FEG SEM
Resolution		1nm @ 30KV (SE) 3nm @ 1KV (SE) 2.5nm @ 30KV (BSE)
Magnification		15X ~ 800000X
Electron Gun		Schottky Emission Electron Gun
Accelerating Voltage		0 ~ 30KV
Vacuum System		Ion Pump; Turbo Molecular Pump; Rotation Pump; Getter Pump
Detector		High Vacuum Secondary Electron Detector (With Detector Protection) Semiconductor Four Segmentation Back Scattering Detector
Travel Range	X (Auto)	0 ~ 150 mm
	Y (Auto)	0 ~ 150 mm
	Z (Manual)	0 ~ 60 mm
	R (Manual)	360°
	T (Manual)	-5° ~ 75°
Max Specimen Diameter		320 mm
Modification		Stage Upgrade; EBL; STM; AFM; Heating Stage; Cryo Stage; Tensile Stage; Micro-Nano Manipulator; SEM+Coating Machine; SEM+Laser etc.
Accessories		CCD, LaB6 X-Ray Detector (EDS), EBSD, CL, WDS, Coating Machine etc.

## Applications

### Construction Material:



Concrete

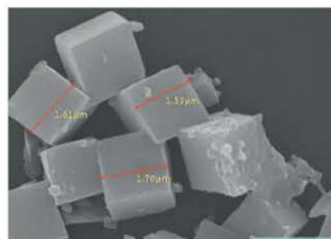


Refractory Brick

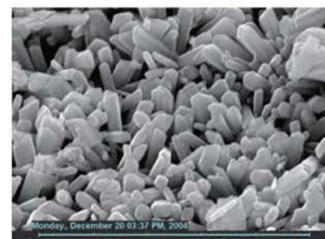


Cernet Powder

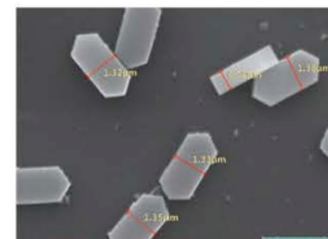
### Ceramic Material:



Molecular Sieve

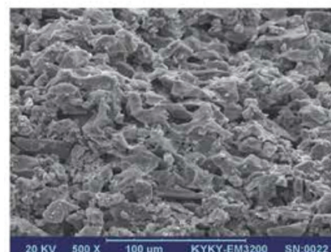


Ammonium Tetramolybdate

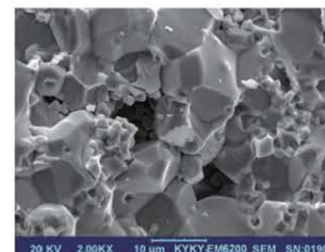


Catalyst

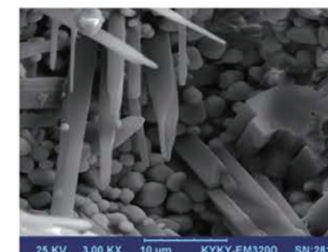
### Chemical Material:



Filtering Ceramic



Ceramic Grain



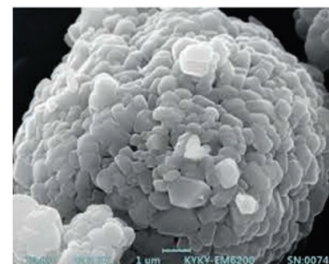
Zirconia

## Applications

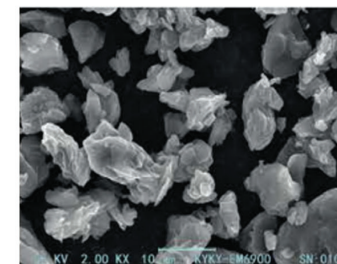
### Battery Material:



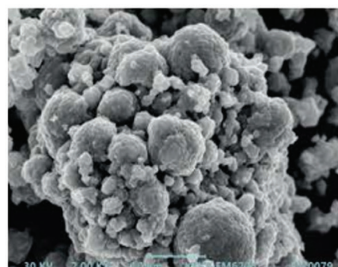
Lithium Cobalt Oxides



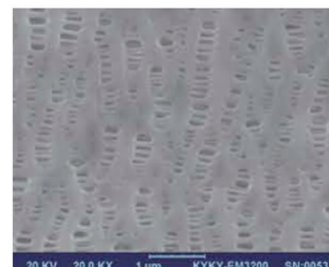
Tenary Material



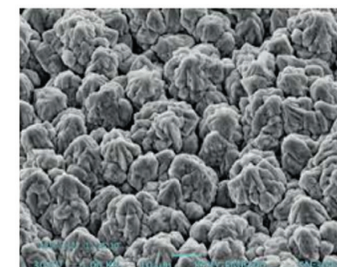
Natural Graphite



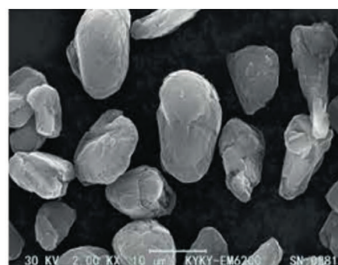
Tenary Material



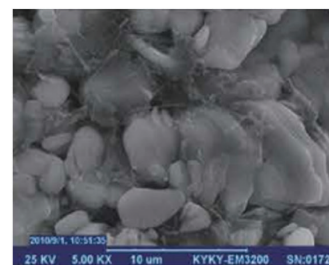
Diaphragm



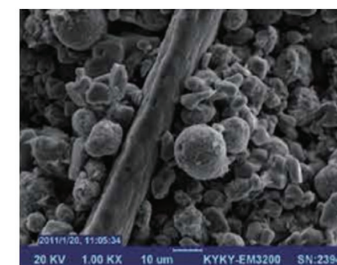
Copper Clad Surface



Dalanium Graphite



Battery Pole Piece

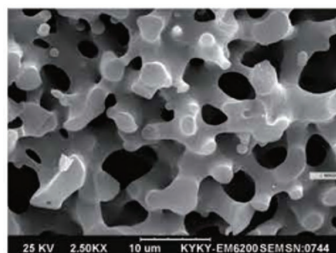


Battery Pole Piece Cut

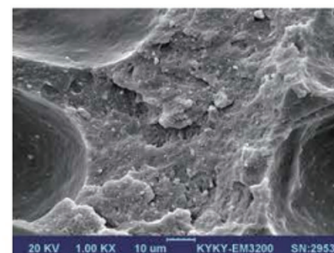


## Applications

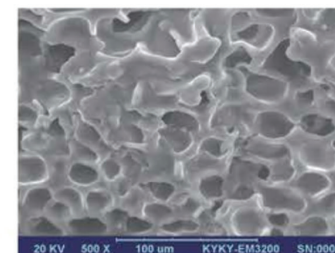
### Composite, Macromolecule:



Monolithic Silica Column

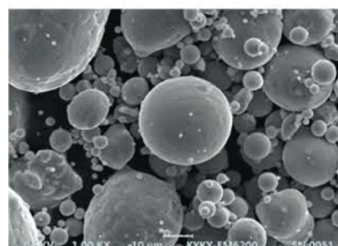


Plastic

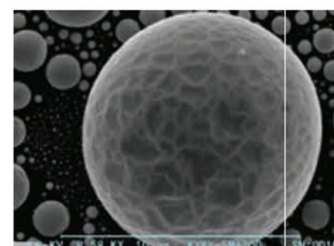


Rubber Bubbly Rot

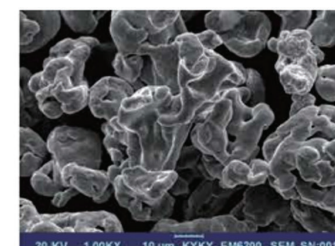
### Powder Metallurgy Material:



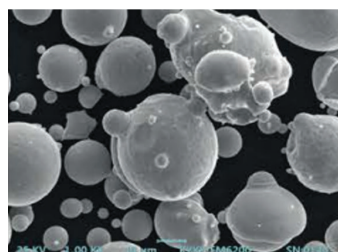
Aluminite Powder



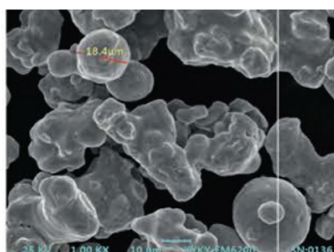
Globular Tin Powder



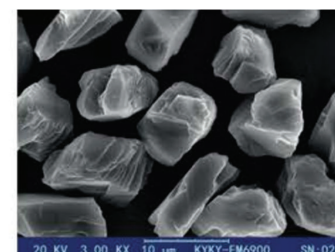
Sponge Iron Powder



Stainless Steel Powder



Iron Powder



Diamond Powder





Products Information

## Raman Confocal Microscope

AFV

Aria Fan Varzan

"To Make a Better Life by Applied Science"

## Leader in Raman & NanoRaman TERS

Deeply involved in Raman spectroscopy for decades, HORIBA Scientific has been providing an extensive array of Raman instruments for diverse applications. High quality and trustworthy performance make HORIBA the leader in Raman instrumentation. The LabRAM HR Evolution is the latest spectrometer in the proven LabRAM Series.

In fact, in the last ten years alone, scientists have generated more than 23,000 articles based on results acquired on LabRAM systems.

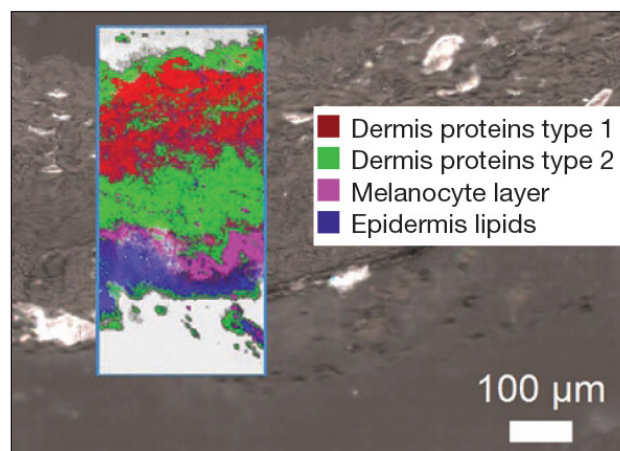
The LabRAM HR systems are ideally suited to both micro and macro measurements, and offer advanced confocal imaging capabilities in 2D and 3D. The true confocal microscope enables the most detailed images and analyses to be obtained with speed and confidence.

Highly versatile, each LabRAM HR is a flexible base unit which can be expanded with a range of options, upgrades and accessories to suit all budgets and applications. Specialized dedicated and/or customized solutions can be supplied where required, so whatever spectral resolution, laser wavelength or sampling regime is needed, HORIBA Scientific can provide the best solution.

With guaranteed high performance and intuitive simplicity, the LabRAM HR Evolution is the ultimate instrument for Raman spectroscopy.

### Life sciences

Disease diagnosis, dermatology, cell screening, cosmetics, microbiology, protein investigations, drug interactions and many more: the LabRAM HR offers new characterization methods for life sciences.



High resolution multivariate image of a skin cross section showing the different constituents of epidermis. Courtesy of O. Piot and M. Manfait, Faculty of Pharmacy, University of Reims Champagne Ardenne, France

Raman spectroscopy provides key information about chemical composition and material structure.

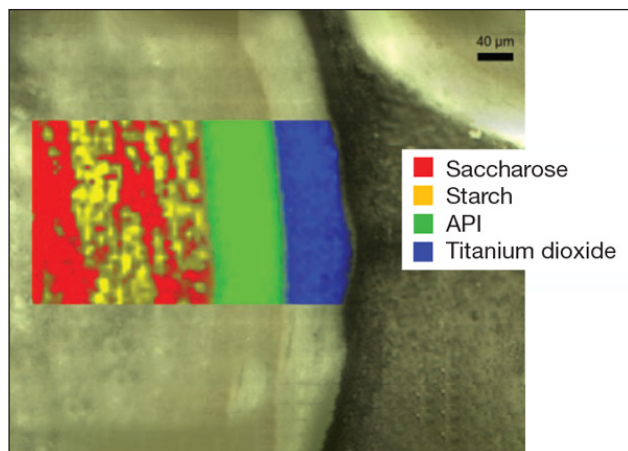
The Raman effect results from the interaction of laser light with molecular vibrations within the sample, and is highly sensitive to small changes in chemistry and molecular environment.

## Cutting-Edge Applications

### With the LabRAM HR

#### Pharmaceuticals

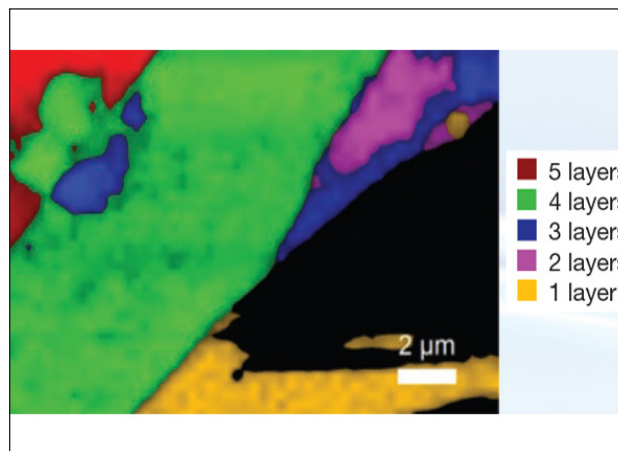
Active pharmaceutical ingredients (API) and excipients mapping and characterization, polymorph identification, phase determination: the high information content of the Raman spectrum affords researchers and QC technicians deeper insight into the performance and quality of their materials.



API, excipients and coating of a pharmaceutical drug delivery bead

#### Materials

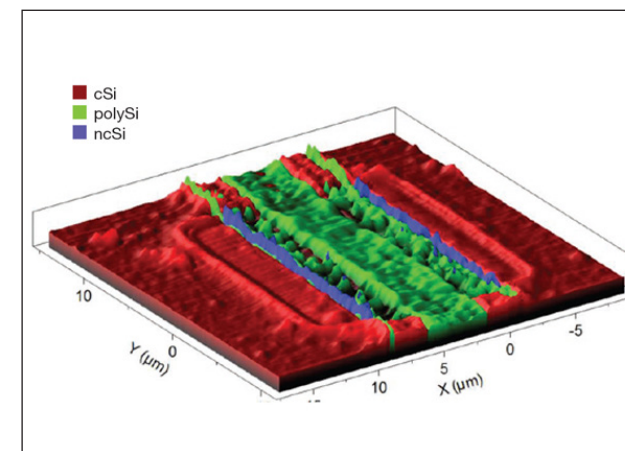
Graphene and 2D materials, polymers and monomers, inorganics and metal oxides, ceramics, coatings and thin films, photovoltaics, catalysts: the LabRAM HR Evolution contributes to a better knowledge of materials and is a reliable tool for routine analysis.



API, excipients and coating of a pharmaceutical drug delivery bead

#### Semiconductors

Stress/strain measurements, alloy composition, ultra-thin cap layer characterization, imaging of etched chip structures, band gap analysis. Raman and photoluminescence (PL) studies of semiconductor materials enable specialists to collect crucial information about the composition and behavior of their components.



Raman imaging of a silicon chip with crystalline, poly and amorphous silicon regions.

## Cutting-Edge Applications

### With the LabRAM HR

- Ultra fast Raman imaging with SWIFT™ and DuoScan™ technologies
- Diffraction limited spatial resolution
- Unequalled spectral resolution with high efficiency long focal length spectrometer
- Wide spectral range capability due to a unique achromatic design, and compatibility with multiple lasers and detectors
- Fully automated system, with powerful software control
- Flexible platform for NanoRaman™, photoluminescence, SEMvironment.

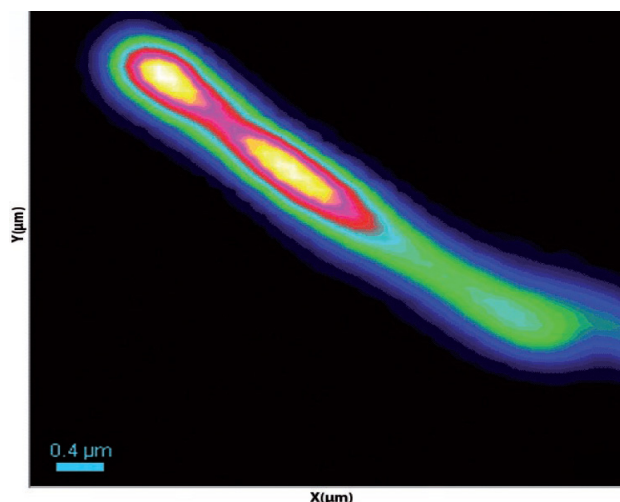
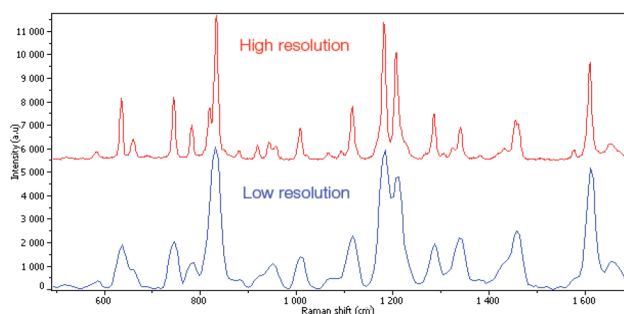




## A High Performance and Easy-to-Use Raman System

### Ultra-Fast Confocal Imaging

- The DuoScan™ imaging technology is a confocal imaging mode, with high precision, ultra-fast rastering mirrors creating variable sized laser macro-spots, and also allowing nano-step mapping from deep UV to NIR, without moving the sample.
- The SWIFTTM module couples the LabRAM HR's high optical throughput with optimized detector-stage coordination to make fast confocal Raman mapping a reality. High resolution images can be acquired in seconds, even on a macro-scale!
- The SWIFTXS pushes the speed of confocal Raman imaging to the next level. The SWIFTXS module integrates HORIBA's newest Synapse™ EMCCD detector, combining unmatched speed and ultra-sensitivity. This allows sample throughput up to 1400 spectra per second. Now that's Supercharged Raman!



ZnO nanowires imaged with the LabRAM HR micro PL laser 325 nm and 40x NUV objective Courtesy of laboratorio SENSOR, Università di Brescia e IDAR-CNR, Italy.

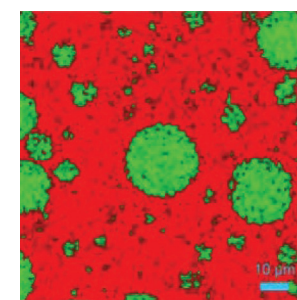
### High Spatial Resolution

The optimization of all optical components results in the highest spatial resolution at the diffraction limit. The high spatial resolution of the LabRAM HR Evolution enables users to analyze nano-objects like nanowires.

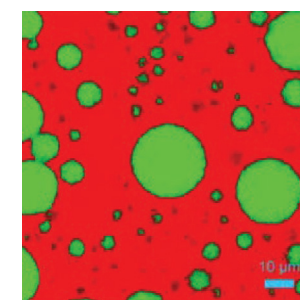
### High Spatial Resolution

With its high throughput 800 mm single stage spectrometer, the LabRAM HR Evolution combines high sensitivity with the highest spectral resolution on the market. The spectra show the importance of the spectral resolution. The 800 mm focal length allows subtle sample information such as crystallinity, polymorphism, strain, H-bonding and other band shape analysis to be characterized with ease.

### Standard Mode vs SWIFTXS - Polymer Blend Mapping



Standard Mode



SWIFTXS

10 000 spectra  
Scan range = 100 μm x 100 μm  
Step size = 1 μm  
Enhanced contrast with SWIFTXS

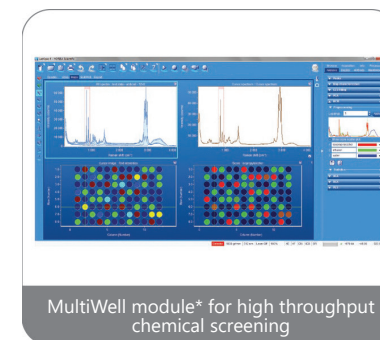
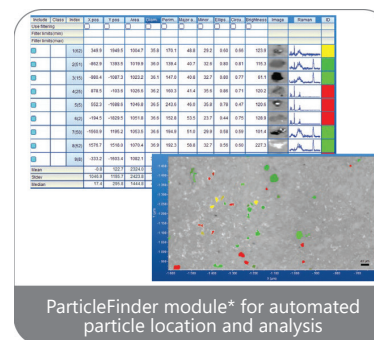
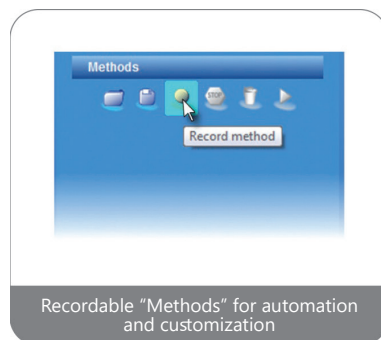
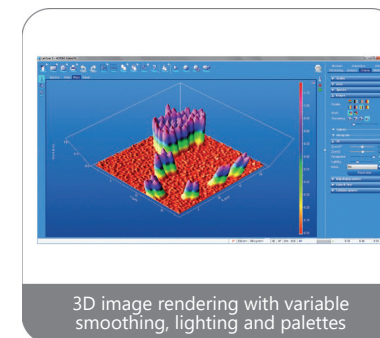
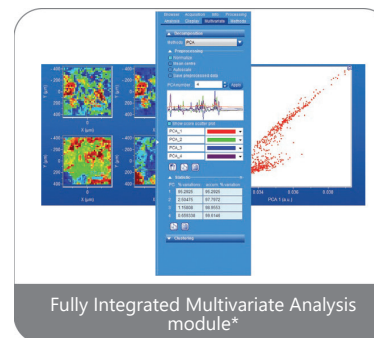
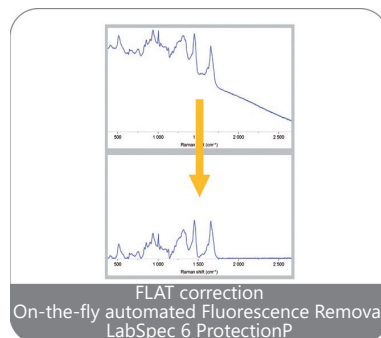
## Simply Powerful Software

### LabSpec 6 Spectroscopy Suite

HORIBA Scientific's LabSpec 6 software delivers a unique environment for complete instrument control and data processing. It combines simplicity with powerful analytical functionality, and opens up the full range of experiment protocols, ranging from basic spectrum acquisition to hyperspectral confocal imaging.

All data, whether a single spectrum or a hyperspectral map comprising hundreds of thousands of spectra, can be processed with standard spectroscopic functions. Comprehensive analysis routines are available, including integrated multivariate analysis\*. Spectrum identification is possible using the advanced capabilities of Bio-Rad's KnowItAll® Informatics Suite\*.

LabSpec 6 offers advanced automation, recordable methods for custom automation and full Visual Basic Scripting (VBS) and ActiveX for insoftware programming and remote control. Connect device is a new functionality offering the possibility to connect temperature control stages and photocurrent mapping units.



LabSpec 6 ProtectionPlus\* offers a fully configurable security and data integrity module compliant with the requirements of FDA 21CFR Part 11. In addition, LabSpec 6 comes with an advanced MultiWell\* module for high

throughput screening and the updated ParticleFinder-TM\* module for automated particle location, statistical analysis, and Raman analysis, making it the ideal spectroscopy software for self-running operation.



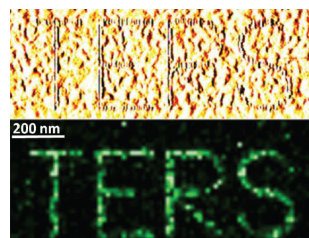
## Flexibility with Multiple Configurations

### Push the Frontiers from MicroRaman to NanoRaman™

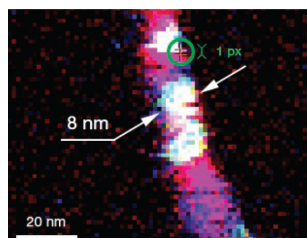
Compact, fully automated and easy-to-use, the NanoRaman™ platform concentrates the power of AFM (Atomic Force Microscopy) and Raman spectroscopy into a full-featured package, making high speed TERS (Tip Enhanced Raman Spectroscopy) imaging a reality for real world applications.

Reliable and efficient AFM-TERS tips are available for our NanoRaman™ platforms.

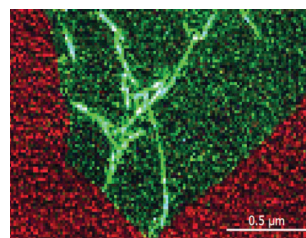
Allowing all modes of TERS operation (illumination/collection from the top, side and bottom), HORIBA TERS tips are guaranteed to provide TERS imaging and spatial resolution down to 10 nm.



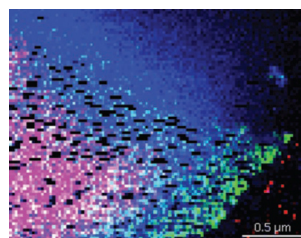
AFM and TERS images of patterned graphene oxide flake by pulsed-force lithography



TERS imaging of a carbon nanotube with 8 nm resolution



TERS imaging of MoS2



TERS imaging of graphene oxide

### From UV to NIR without Compromise

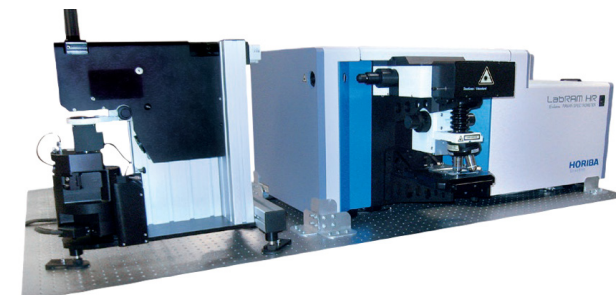
The LabRAM HR Evolution is a fully achromatic spectrometer covering a very wide spectral range from 200 nm to 2100 nm due to its multilaser and multidetector capabilities.

The optional InGaAs detector pushes the detection range to the NIR up to 2100 nm, making infra-red photoluminescence spectroscopy a possibility on the spectrometer.

Typical applications include band gap determination, recombination mechanisms observation and control of material quality.



Wide spectral range Raman/PL configuration.



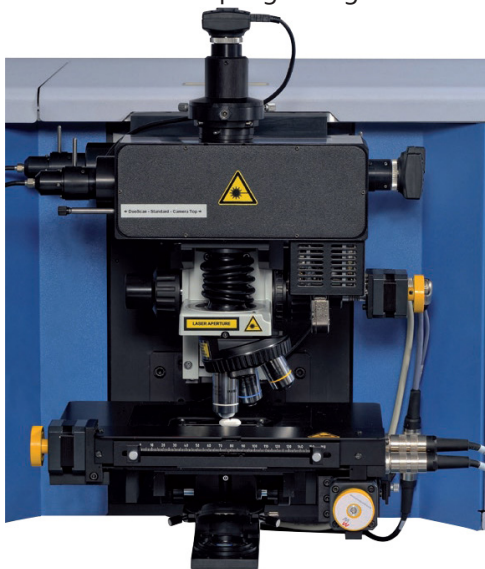
HR Evo Nano, the TERS Proven System

## Flexibility with Multiple Configurations

### Whatever your Sample and Analytical Conditions

HORIBA Scientific offers you a full range of research grade optical microscopes.

The LabRAM HR Evolution comes standardly equipped with the open-space microscope giving you free space under the objective to adapt numerous accessories like large cryostats, broad travel range stages... or even customized sampling configurations.



Open-space microscope configuration with DuoScanTM

The optional inverted microscope enables the possibility of illuminating the sample from below, and gives you free space on top of the sample, which is particularly appropriate for life science applications. Configurations with dual microscopes are proposed upon request as well.

A transmission Raman accessory opens up further analytical possibilities, and is ideally suited to bulk analysis of opaque/turbid materials, to study content uniformity or polymorphism in pharmaceutical tablets. Finally, remote measurements are also possible with the use of the SuperHead fiber optic probes enabling in-situ monitoring of reactions or on-site analysis.



Multi-wavelength transmission accessory

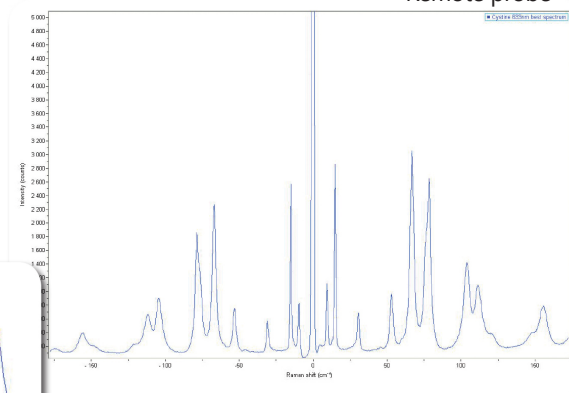
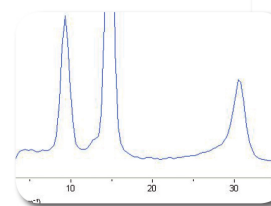
### Ultra-Low Frequency Module

HORIBA Scientific now gives you access to frequencies down to 3.5 cm<sup>-1</sup>\* on the LabRAM HR Evolution. The latest generation of notch and bandpass filters with very narrow bandwidth offer the possibility to obtain ultra-low frequency spectral data. With this solution, the LabRAM HR Evolution combines simple access to very low frequencies with a high throughput single stage spectrometer.



Remote probe

wavelength, specification <10 cm<sup>-1</sup> at 532 nm, 633 nm and 785 nm



ULF Raman measurements of L-Cysteine at 633 nm wavelength. Stokes and Anti-Stokes bands at 9 cm<sup>-1</sup> are clearly resolved.



Products Information

# Dynamic Light Scattering

## SZ-100V2 Series

**AFV**

Aria Fan Varzan

"To Make a Better Life by Applied Science"

## SZ-100V2 Series

Nanotechnology research and development is a continuously evolving effort to control substances at the atomic and molecular level in order to achieve new and better materials and products.

The miniaturization of components-that is, control at the nanolevel- is necessary to achieve faster, higher-performance devices and functions and to reduce energy consumption. Nanotechnology has come to play a key role in wide-ranging fields that affect our daily lives, including food, cosmetics, and the life sciences.

- > Clear and simple multi-parameter analysis of nanoparticles!
- > Three analyzers in a single compact body deliver high-sensitivity.
- > high-accuracy analysis of each measurement parameter.

### Particle Size Measurement Range 0.3 nm to 10 $\mu\text{m}$

The SZ-100V2 Series measures particle size and particle distribution width by dynamic light scattering (DLS). Analysis across a wide range of sample concentrations: Measurement of samples ranging from low ppm-order concentrations to high-concentration samples in double-digit percent-ages is possible.

Accepts commercially available sampling cells. Analysis of small-volume samples is also possible.

### Zeta Potential Measurement -500 to + 500 mV

Analysis of sample volumes as small as 100  $\mu\text{L}$  using HORIBA-developed microelectrophoresis cells. Use the value of zeta potential to predict and control dispersion stability. High zeta potential magnitudes indicate a stable dispersion, useful for formulation work.

### Molecular weight $1 \times 10^3$ to $2 \times 10^7$ Da

Absolute molecular weight (Mw) and the second virial coefficient (A2) are obtained by performing static light scattering measurement as a function of sample concentration and preparing Debye plots.

### The SZ-100V2 Series applies sophisticated intelligence and learning capability to rapidly determine nanoparticle properties!

> Since the SZ-100V2 Series analyzer covers a wide sample concentration measurement range, sample dilution and other preprocessing is nearly eliminated. The use of a dual optical system enables measurement of high-concentration samples such as slurry



and ink pigments as well as low-concentration proteins and polymers.

- > A single device analyzes the three parameters that characterize nanoparticles: particle size, zeta potential, and molecular weight.
- > HORIBA-developed disposable cells for zeta potential measurement prevent sample contamination. Simple analysis by means of ultra micro-volume dedicated cells (volume as low as 100  $\mu\text{L}$ ). Suitable for analysis of dilute samples.
- > HORIBA-developed electrode for zeta potential cell made from carbon material, the material is not corroded by high salt samples such as saline.

## SZ-100V2 Series

### Nanoparticle Analyzer



- Simple and Convenient Operation
- Simply fill the sample cell and place the cell in the analyzer.
- A space-saving body design makes the analyzer suitable for installation in any laboratory environment.

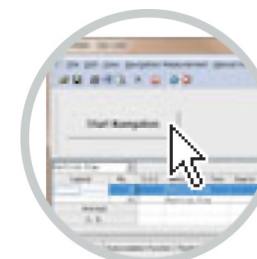
#### Operation Procedure



**Sampling**  
Fill the sample cell.



**Cell Set-Up**  
Place the cell in the analyzer.



**Start Measurement**  
Click the Start button.



**Results Display**  
Click The measurement results are displayed.

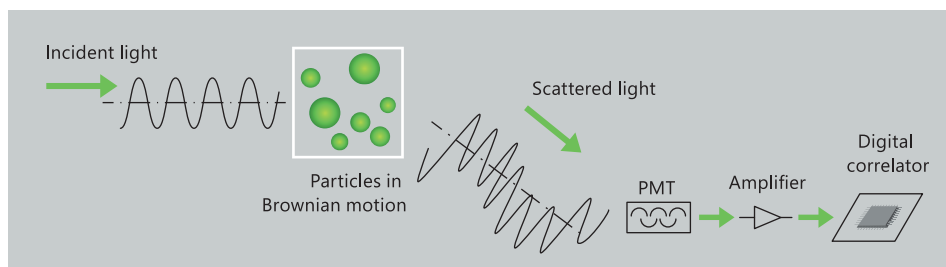
#### Maintenance Free

No maintenance or cleaning of the analyzer is required.  
After measurement, simply clean or dispose of the cell.

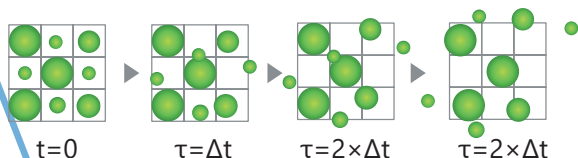


## Particle Size Measurement Principle

The SZ-100V2 uses the technique of dynamic light scattering to determine particle size. Dynamic light scattering is the measurement of fluctuations in scattered light intensity with time. These fluctuations in intensity arise due to the random Brownian motion of the nanoparticles. Therefore, the statistical behavior of these fluctuations in scattered intensity can be related to the diffusion of the particles. Since larger particles diffuse more slowly than small particles one can readily relate particle size to measured fluctuations in light scattering intensity. With modern instruments such as the SZ-100V2 the technique is rapid and reliable.

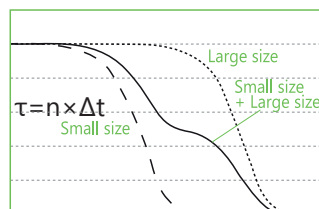


### Graphic Rendering of Diffusing Nanoparticles



### Autocorrelation Function $G_2()$

### The Relationship Between the Autocorrelation Function and Particle Size



Measurement of the autocorrelation function is done by comparing the scattered light intensity at some reference time  $t$  and after some delay time  $\tau$ . For a very short delay time, the particles have not had a chance to move and therefore the scattered light intensity is unlikely to change much. So, the autocorrelation function has a high value. For a very long delay time, the particles have had a chance to move significantly, and the autocorrelation function has a low value. This low value is related to the time average scattered intensity. The rapidity of this decay from high values to low values corresponds to the speed of particle motion and therefore to the particle size. The measured autocorrelation function typically has an exponential decay and the diffusion coefficient can be calculated with the following (simplified) relationship

$$G^{(2)}(\tau) = B + Bf \exp(-2Dm\tau)$$

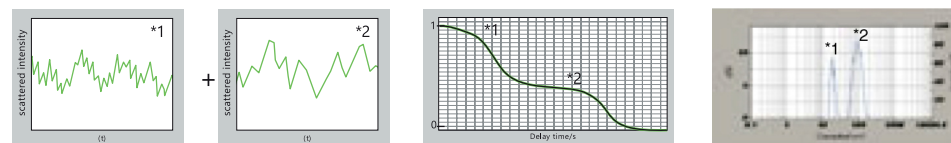
$G^{(2)}(\tau)$ : Measured amplitude autocorrelation function  $B$ : So-called baseline  $f$ : Instrument constant  $Dm$ : Particle diffusion coefficient

$q$ : Scattering vector given by  $(4\pi n/\lambda)\sin(\theta/2)$   $\tau$ : Delay time

**Particle size is calculated from the diffusion coefficient using the Stokes-Einstein equation:**

$$D_h = kT/(3\pi\eta Dm)$$

$D_h$ : Particle hydrodynamic size  $k$ : Boltzman constant  $T$ : Thermodynamic temperature and  $\eta$ : Viscosity





## Features of HORIBA's Optical System

### 1- High Sensitivity Optical Components

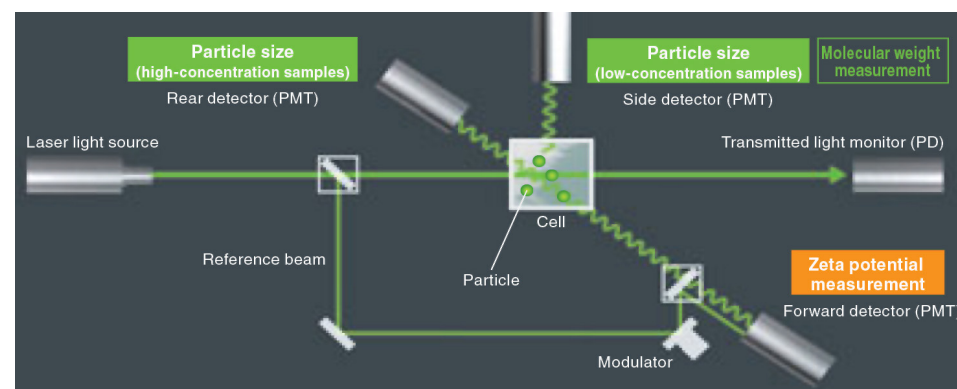
The key to accurately and rapidly evaluating size with dynamic light scattering is to use a high-energy laser light source and a sensitive detector. HORIBA uses a green laser. Scattering intensity is inversely proportional to the fourth power of wavelength. Therefore, the green laser gives more scattering intensity per milliwatt than the more commonly used red laser. Since avalanche photodiodes, APD's, are less sensitive to green light and photomultiplier tubes PMT's, are more sensitive to green light, HORIBA has included the most sensitive PMT detector available. In addition, the dead time of a PMT is shorter than that of an APD and therefore the PMT detector dynamic range is superior.

### 2- Conformance with Standards

The SZ-100V2 series conforms to ISO 13321:1996 and JIS Z8826:2005.

### 3- Automatic Measurement Optimization

The analyzer features the ability to measure particle size under a number of condi-



tions. In order to eliminate guesswork, measurement conditions can be automatically selected for each sample by using data obtained from that sample.

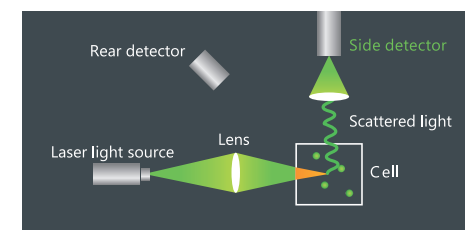
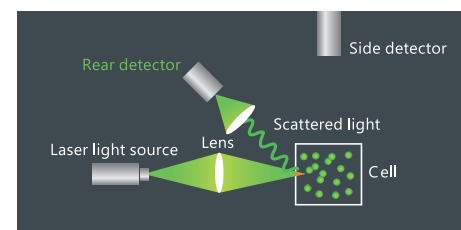
**The three angle system of the SZ-100V2 enables analysis of a wide range of high concentration and dilute samples**

### High Concentration Samples

> In order to minimize the effect of multiple scattering the analyzer detects back-scattered light from a scattering volume close to the cell wall.

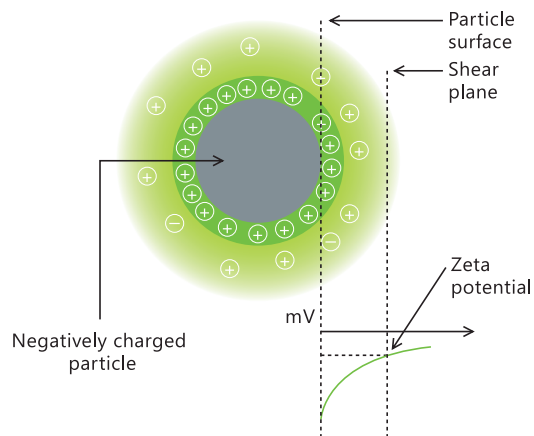
### Dilute Samples

> In order to minimize the effect of stray light and maximize signal to noise ratio the analyzer detects scattered light at a right angle.



## Zeta Potential Measurement Principle (Laser Doppler Electrophoresis)

Many nanoparticles or colloidal particles have a surface charge when they are in suspension. When an electric field is applied, the particles move due to the interaction between the charged particle and the applied field. The direction and velocity of the motion is a function of particle charge, the suspending medium, and the electric field strength. Particle velocity is then measured by observing the Doppler shift in the scattered light. The particle velocity is proportional to the electrical potential of the particle at the shear plane which is the zeta potential. Thus, this optical measurement of particle motion under an applied field can be used to determine zeta potential.



### Features

- > Extremely low sample volume makes it possible to measure precious or rare samples.
- > Modern signal processing electronics efficiently convert optical signals to mobility and zeta potential information. There is no need to manually calculate particle velocity or match speeds.

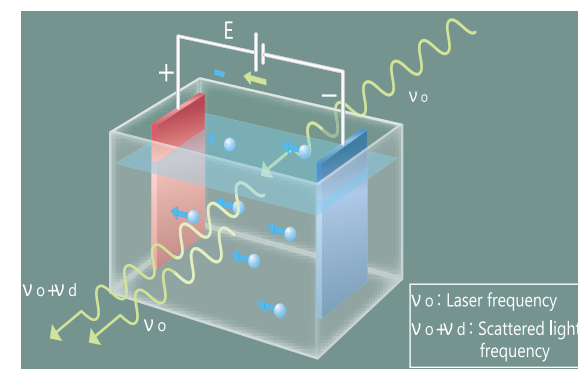
### Electrophoresis

Particle motion under an applied electric field is known as electrophoresis. The method used by the SZ-100V2 is known as laser Doppler electrophoresis. Sample particles are suspended in a solvent of known refractive index,  $n$ , viscosity,  $\eta$ , and dielectric constant,  $\epsilon$ . The sample is irradiated with laser light of wavelength  $\lambda$ . An electric field with strength  $E$  is applied. Due to the electric field, the particles are moving. Since the particles are moving, the scattered light has a frequency (Doppler) shift proportional to the particle charge. The frequency shift of the scattered light at angle  $\theta$  is measured and the particle velocity  $V$  is determined from the frequency shift. Mobility is then readily obtained as the ratio of velocity to electric field strength  $V/E$ . Zeta potential is then found from mobility using a model, the most common of which is the Smulo-chowski model.

$$U = \frac{\lambda v_d}{2E n \sin(\theta/2)}$$

The following equation is used for the relationship between the calculated electrical mobility and zeta potential.

$$\zeta = \frac{U \eta}{\epsilon f(\kappa a)}$$

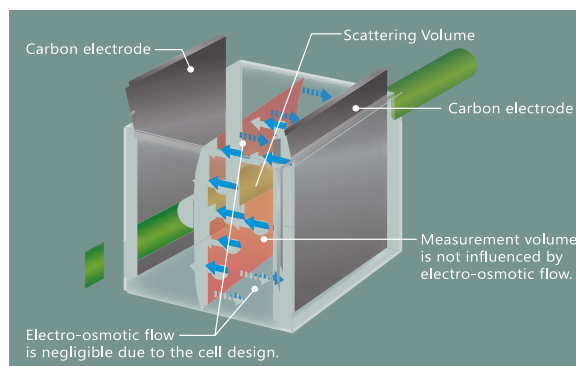


**$\zeta$** : Zeta potential  **$U$** : Electrical mobility  **$E$** : Electric field strength  **$n$** : Solvent refraction index  **$\epsilon$** : Solvent dielectric constant  **$\eta$** : Solvent viscosity  **$F(\kappa a)$** : Henry coefficient

## Molecular Weight Measurement Principle

### Cell design minimizes electro-osmotic flow to enhance sensitivity.

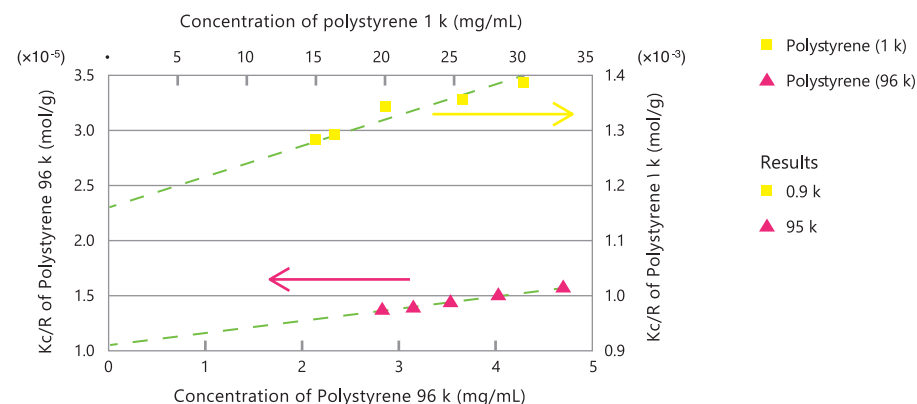
Particles are not the only objects that acquire a surface charge when in contact with a liquid. Macroscopic objects such as cell or capillary walls do as well. Due to electrostatic attraction, ions with a charge opposite to that of the wall will accumulate close to the wall. And, when an electric field is applied during zeta potential measurement these ions will move in response to the applied field. The moving ions drag the fluid along, creating bulk flow called electroosmotic flow. This flow will disturb particle motion and distort zeta potential measurements. By eliminating the capillary between the electrodes, the HORIBA zeta potential cell minimizes this effect and maximizes instrument sensitivity. Molecular weight of macromolecules such as polymers, proteins, or starches is determined in two ways with the SZ-100V2. The first method is the use of the dy-



dynamic light scattering size information and the empirical Mark Houwink Sakurada equation. The second method is analysis with a Debye plot. Both of these methods are described below.

The Mark Houwink Sakurada equation relates the diffusion coefficient determined by dynamic light scattering to the molecular weight. All that is required are two empirical constants for the selected polymer-solvent system, an exponent and a prefactor. If the constants are not in the SZ-100V2 software database, the user can add new constants for rapid analysis. This technique has the advantage that sample concentration need not be well known.

The Debye plot is obtained by first measuring the excess static light scattering intensity of a series of solutions with well known concentration. Here, the excess intensity refers to the increase of the scattered intensity of the solution compared to the pure solvent. Plotting a quantity proportional to the concentration over the excess scattering as a function of concentration yields a straight line. Extrapolating



to zero concentration yields the reciprocal of molecular weight. The graph below shows a typical result.

## Software

### Simple and Convenient Operation/Software Functions

The operator selects a measurement mode (particle size, zeta potential, or molecular weight),

loads the sample when the measurement screen appears, and begins measurement.

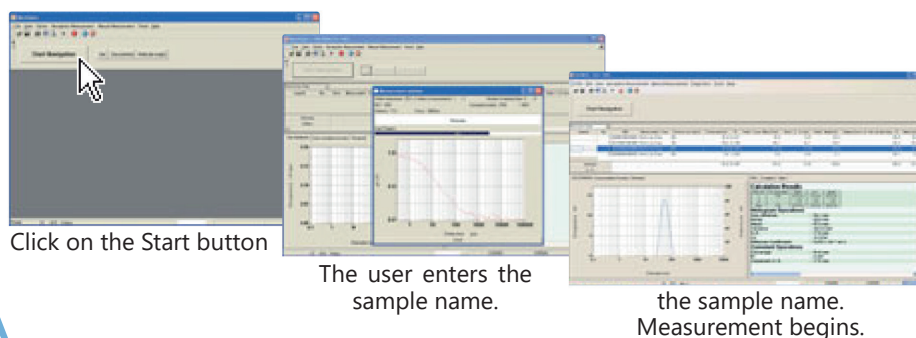
The SZ-100V2 Series offers the ultimate in clear, simple operability.

21 CFR Part 11 software is available.

### Quick and Simple Operation

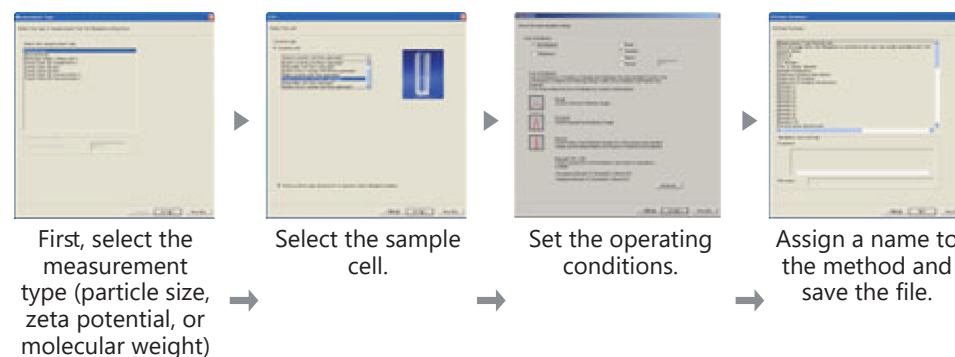
Measurement conditions are readily set manually or with user programmable methods that can be tied to custom buttons.

Operators need merely click a button to begin.



### Navigation Creation Is Simple

Use the software wizard to select analysis conditions. If desired, assign a button for fast analysis in the future.



## Performance

### Measurement Accuracy

HORIBA confirms measurement performance prior to product shipment using HORIBA-approved standard samples to confirm accuracy and reproducibility as per the tables below. To ensure high-level, stable performance, HORIBA delivers products manufactured in accordance with rigorous quality control systems worldwide.

### Particle size

Particle size measurement accuracy using NIST-traceable polystyrene latex standards particles is as shown below.

Particle Size Standard Value (nm)	Concentration	Standard
100 nm	100	Measured Values for Cumulant Average Size are Within $\pm 2\%$ . (This Does not Include Variation in the Standard Particles Themselves)

### Particle size measurement reproducibility is as shown below.

Particle Size Standard Value (nm)	Concentration	Standard
100 nm	100	The CV Value for Repeated Measurements is Less Than 2%.
100 nm	10wt%	The CV Value for Repeated Measurements is Less Than 5% or Less

\*Conforms to ISO 13321: 1996, ISO 22412 : 2008 and JIS Z 8826: 2005.

### Zeta Potential

Using a HORIBA-designated colloidal silica sample, HORIBA confirms that the measured value is higher than -75 mV and lower than -40 mV. Reproducibility for 6 repeated measurements is within 10 % or less in CV value.

### Molecular Weight

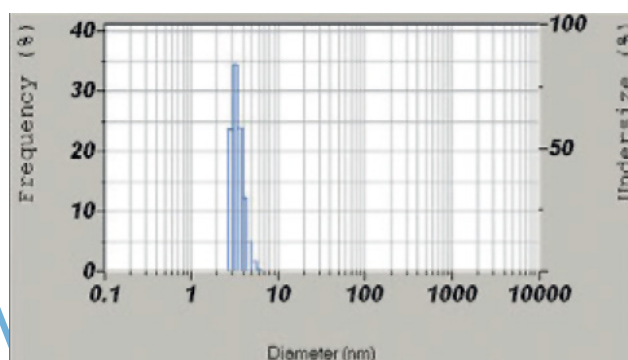
The measured value is within  $\pm 10\%$  of the standard value using a polystyrene standard sample (Nominal molecular weight: 96,000).

## Accessories

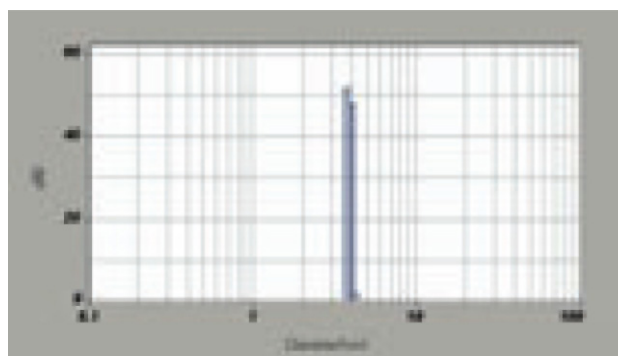
### Biomaterials: Gold colloid particle size measurement results

Au Colloids (NIST)	RM8011	RM8012	RM8013
Nominal Size (nm)	10	30	60
NIST Reference Size By Dynamic Light Scattering (nm)	13.5	26.5	55.3
Size Measured With SZ-100V2 (nm)	11.0	26.6	55.4

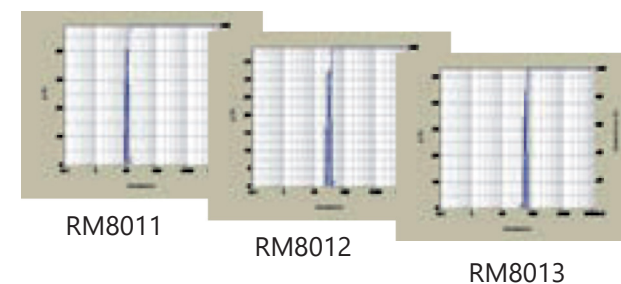
> Sample concentration: 0.05 mg/mL  
 Acetic acid buffer: pH = 4.3  
 Average diameter: 4.0 nm



> Lysozyme (from egg white) particle size measurement result (with high power laser 532 nm 100 mW)

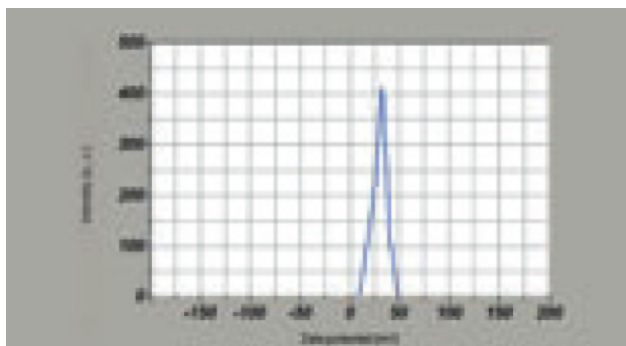


> Gold colloid particle (2 nm) size measurement results (with high power laser 532 nm 100 mW)



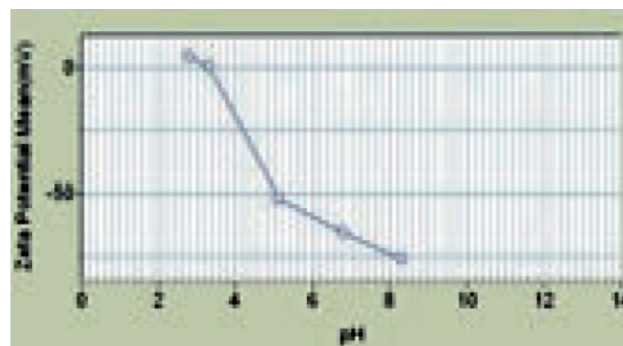


## Applications



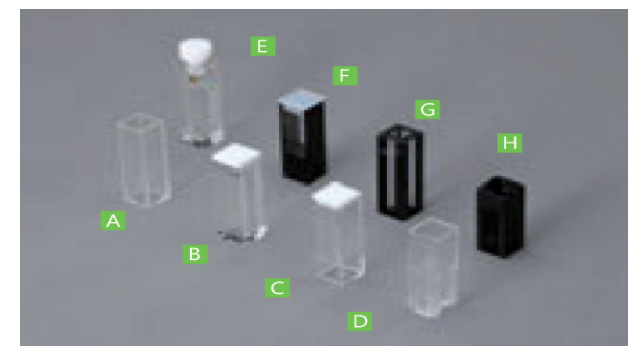
### NIST SRM 1980 -FeOOH zeta potential measurement result

Sample concentration: 50 ppm, pH = 2.5  
Mobility (rated):  $2.53 \pm 0.12 \mu\text{m.cm/Vs}$   
Measurement results: Mobility =  $2.53 \mu\text{m.cm/Vs}$   
Zeta potential = 32.9 mV



### Isoelectric point of silica measurement result

Sample concentration: 0.01 mol/L  
(Adjusted to 10 w% with KCl)  
Zeta potential = -38.3 mV



### Sample Cell Types and Specifications

We can guide you in selecting the right cell for your application.

## Accessories



Zeta potential measurement disposable cells (for zeta potential and particle size measurements, 100  $\mu$ L, Aque

### Autotitrator

This device can be used to automatically prepare plots of zeta potential or particle size as a function of pH.

It is an excellent choice for iso-electric point determination.

### pH Controller Accessory Specifications

- > Number of titrant bottles: 1 or 2
- > pH adjustment range: 1-13
- > Burette volume: 5ml
- > Power supply: AC 100-240 V, 50/60 Hz. 45 VA

### > Dimensions and weight:

Body: 141 (w) 296 (D) 367 (H) mm, approx. 4kg  
Circulation Pump: 124 (W) 202 (D) 122 (H) mm, approx. 1.7 kg

- > Option: Magnetic Stirrer
- pH electrode parts number 3200525428
- pH calibration unit parts number 3200043642



Cell Name	Measurement Application	Remarks
Disposable Cell	Particle size/Molecular weight	Plastic, 4 surfaces clear, 100 pieces, Full volume 4000 $\mu$ L (Minimum sample volume 1000 $\mu$ L)
Semi-Micro Cell	Particle size	Quartz, 4 surfaces clear, Full volume 1600 $\mu$ L (Minimum sample volume 400 $\mu$ L)
Glass Cell	Particle size/Molecular weight	Glass, 4 surfaces clear, Full volume 4000 $\mu$ L (Minimum sample volume 1000 $\mu$ L)
Semi-micro Disposable Cell	Particle size	Plastic, 2 surfaces clear, 100 pieces, Full volume 800 $\mu$ L (Minimum sample volume 400 $\mu$ L)
Cell With Lid	Particle size/Molecular weight	Quartz, 4 surfaces clear, Full volume 4000 $\mu$ L (Minimum sample volume 1000 $\mu$ L)
Micro_Cell (Slide Detector Only)	Particle size/Molecular weight	Quartz, 3 surfaces clear, Side detector only, Full volume 30 $\mu$ L (Minimum sampling volume 12 $\mu$ L)
Sub-Micro Cell	Particle size/Molecular weight	Quartz, 4 surfaces clear, Full volume 750 $\mu$ L (Minimum sampling volume 250 $\mu$ L)
Flow Cell	Particle size/Molecular weight	Quartz, 3 surfaces clear, Full volume 100 $\mu$ L (Minimum sampling volume 100 $\mu$ L), 2 connectors with pH controller
Zeta Potential Plastic Cell	Zeta Potential	For aqueous sample, 20 pieces
Zeta Potential Glass Cell	Zeta Potential	For organic solvent, 50 replacement gold electrodes, PTFE lid, and 2 caps.

## Accessories

### SZ-100-S2 measurement Specifications

Model	SZ -100-S2 (particle size and molecular weight measurement only)
Measurement principles	Particle size measurement: Dynamic Light Scattering Molecular weight measurement: Debye plot method (static scattered light intensity)
Measurement range	Particle size: 0.3 nm to 10 $\mu$ m Molecular weight: 1000 to 2 x 10 <sup>7</sup> Oa (Debye plot) 540 to 2 x 10 <sup>7</sup> Oa (MHS Equation) *1
Maximum sample concentration	40 wt%*2
Particle size measurement accuracy	Measurement accuracy of $\pm 2\%$ for NIST traceable polystyrene latex 100 nm spheres (not including variation in the standard particles themselves)
Measurement angles	90° and 173° (automatic or manual selection)
Cells	Cuvettes
Measurement time	Approx. 2 min. under ordinary conditions (from the start of measurement to the display of results for particle size measurement)
Required sample volume	Minimum volume of 12 $\mu$ L*3 to 1000 $\mu$ L (differs depending on cell material)
Usable liquids	Water, ethanol, organic solvents

### SZ-100-Z2 measurement Specifications

(particle size and molecular weight measurement specifications are the same as for the SZ-100-Z2)

Model	SZ-100-Z2 (with zeta potential measurement until)
Measurement principles	Zeta potential measurement: Laser doppler electrophoresis
Measurement range	-500 to +500 mV
Size range suitable for measurement	Minimum 2.0 nm. Maximum 100 $\mu$ m *4
Measurement conductivity range	0 to 20 S/m*5
Maximum sample concentration	40 wt%*2
Cells	Dedicated cell with electrodes
Measurement time	Approx. 2 min. under ordinary conditions
Required sample volume	100 $\mu$ L
Carrier fluids	Water

### Data Processing

Navigation files turn complex parameter input into simple to use operating procedures.  
/ Store 100 data items on a data list. / Display individual data items with a single mouse click. / Perform pH, temperature, and sample concentration trend measurement.

### Particle Size Measurement

Real-time display of the autocorrelation function / Display of median size, specific surface area, mode size, average size, standard deviation, coefficient of variation, span value, percentage size (max. of 10 items), Z average, polydispersity index, size percentage (max. of 10 items displayed) / Particle distribution graph, autocorrelation function, residual error / Refractive index, viscosity, computing range, and data recalculation after measurement

## Accessories

### Analyzer Specifications (SZ-100-S2 and SZ-100-Z2)

Model	SZ-100-Z2 (with zeta potential measurement until)
Measuring unit optical system	Light source: Diode pumped frequency doubled laser (532 nm. S2 / Z2 10 mW, HS2 / HZ2 100 mW) Detectors: Photomultiplier tubes (PMT)
Laser classification	Class I
Operating temperature and humidity	15 -35 °C. RH 85 %A. or less (no ncondensing)
Holder temperature control	0-90 °C (up to 70n °C for cells with electrodes and plastic cells)
Purging	Dry gas purge port tube connection is possible.
Power supply	AC 100-240 V. 50/60 Hz, 150 VA
Dimensions	528(W)x385 (D)x273(H)mm (excluding protrusions)
Weight	25kg
Personal computer	Windows computer with one available USB port
Interface	USB 2.0 (between measuring unit and PC)
OS	Windows 10 32/64 bit

The HORIBA Group adopts IMS (Integrated Management System) which integrates Quality Management System ISO9001, Environmental Management System ISO14001, and Occupational Health and Safety Management System OHSAS18001. We have now integrated Business Continuity Management System ISO22301 in order to provide our products and services in a stable manner, even in emergencies.

**Please read the operation manual before using this product to assure safe and proper handling of the product.**

### Molecular Weight Measurement

Molecular Weight Measurement

Real-time display of Debye plots / Display of molecular weight and the second virial coefficient / Recalculation of Debye plot graph display data

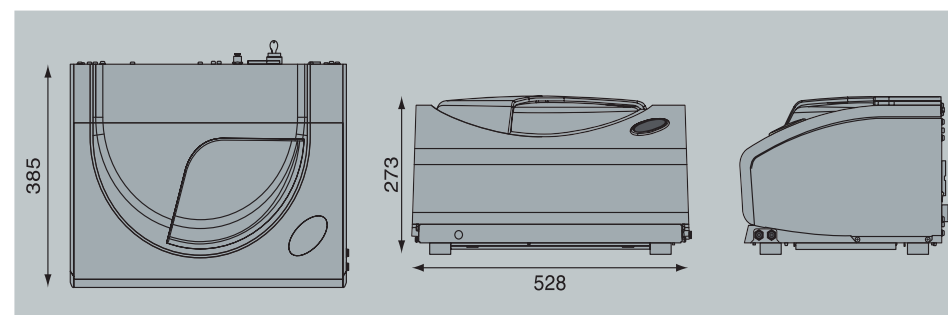
### Zeta Potential Measurement

Zeta potential, standard deviation, electrophoretic mobility, and average zeta potential at each peak / Display of zeta potential graphs, mobility graphs, recalculation of data

### Options

21CFR Part 11 software / Zeta potential measurement organic solvent cells / pH control unit / IQ/OQ/PQ support / High power laser 532 nm 100 mW

Dimensions (mm)





Products Information

# XRD (X-Ray Diffraction)

Dispersive General Purpose Spectrometer

**AFV**

Aria Fan Varzan

"To Make a Better Life by Applied Science"

## History

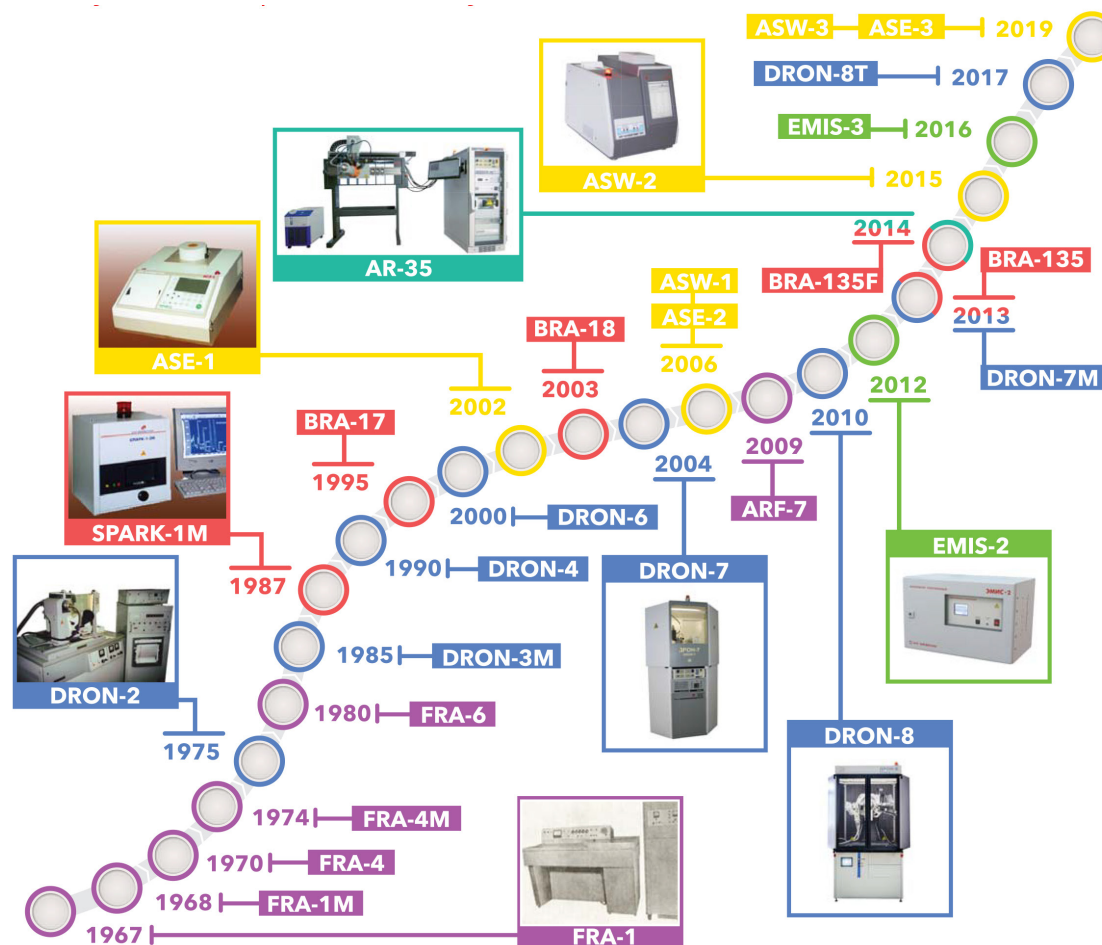
"Bourevestnik" JSC – is the CIS's largest enterprise for research, development and manufacture of X-ray equipment for industrial and scientific purpose. The enterprise dates back to the year 1959, when the special design office of X-ray equipment (SKB RA) has been established and joined together with the Boure-vestnik factory, which had been produced the first domestic X-ray equipment in 1928. For more than half a century "Bourevestnik" JSC has been creating devices for the needs of different industries and areas of scientific and technical activities such as mining and ore dressing industry, atomic power energetics, oil refining, metallurgy and machine industry, electronic industry, nanoindustry and environmental monitoring, at every turn improving the technologies with regard to progressive market requirements. High technical level and quality of the output products still remain the guiding lines of our activities, along with custom-tailored approach of solving specific tasks, rendering of comprehensive support including personnel training, after-sales service, technical and software maintenance. The enterprise's Quality Management System is certified for compliance with ISO 9001:2011 requirements. In addition, Bourevestnik, Inc. is certified as per the Environmental Management System ISO 14001:2007 and Occupational Health and Safety Assessment System OHSAS 18001:2007.





## History

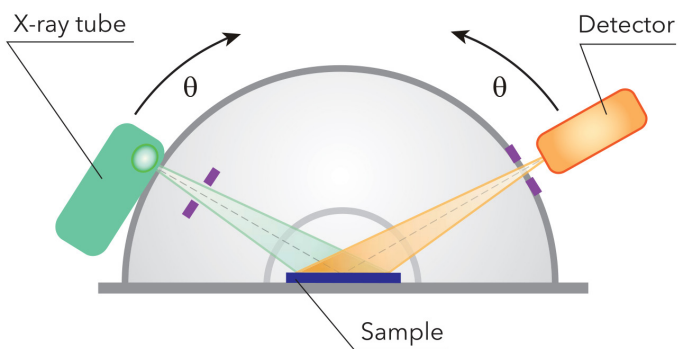
### History of development of analytical instruments



## DRON-8/8T X-ray

### Multifunctional Diffractometer

- > High-precision wide-angle vertical goniometer with
- > changeable radius
- > Automated alignment of sample plane
- > Implementation of various X-ray diffraction techniques
- > Flexible design and wide range of options
- > Variety of X-ray optical schemes
- > Remote control of all devices and systems



DRON-8/8T X-ray general purpose diffractometer with vertical  $\Theta$ - $\Theta$ , goniometer and horizontal sample plane enables to perform X-ray diffraction analysis of phase composition, structural state and orientation of wide range of crystalline objects with different shape and size.



## DRON-8/8T X-ray

### Multifunctional Diffractometer

Technical parameter		DRON-8/8T	Horizontal 2 $\Theta$ - $\Theta$
Goniometer type		Vertical $\Theta$ - $\Theta$	Horizontal 2 $\Theta$ - $\Theta$
X-ray optical scheme		Bragg-Brentano/Debye-Sherrer/parallel-beam	
Radius R, mm		180 – 250	200
Angular range, deg	2 $\Theta$	from -10 to 165	from -100 to 165
	$\Theta$		from -180 to 180
	$\Theta_F$	from -5 to 165	
	$\Theta_D$	from -5 to 95	
Scanning modes		discrete/ continuous	
Scanning methods		$\Theta$ - $\Theta$ , $\Theta_F$ , $\Theta_D$ , $\Omega$ , 2 $\Theta$ - $\Omega$ , $\Psi$ , $\sin^2\Psi$	$\Theta$ -2 $\Theta$ , 2 $\Theta$ , $\Theta$ , 2 $\Theta$ - $\Omega$
Smallest addressable increment, deg		0.0005/0.0001	0.001
Scanning rate, deg/min		0.1 - 50	
Reproducibility, deg		$\pm 0.001 \pm 0.0001$	$\pm 0.0025$
Maximum angular speed, deg/min		600/2000	720
Radiation dose rate, mSv/h		Not more than 1	

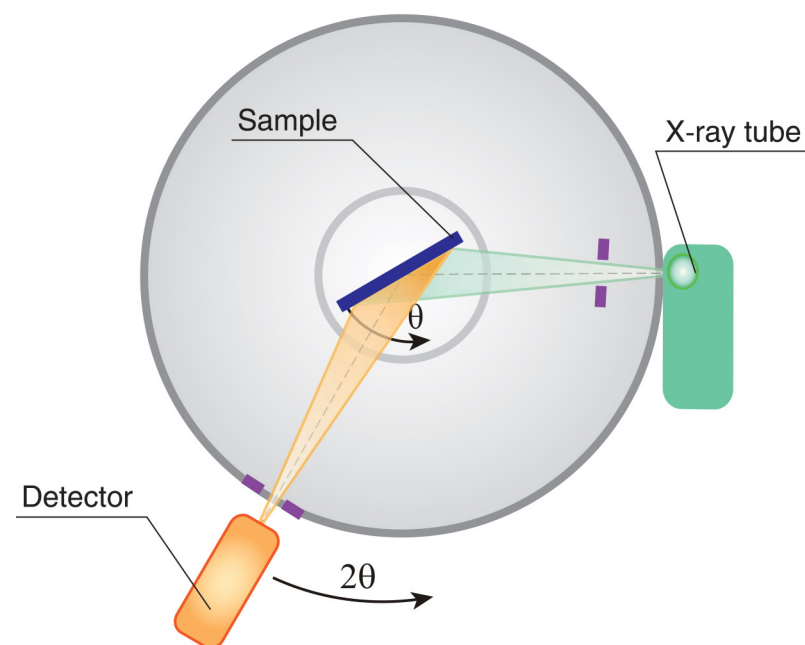
## DRON-7M X-ray

### General Purpose Diff ractometer

- > Horizontal two-circle  $2\theta$ - $\theta$  goniometer
- > High reliability and user-friendly operation
- > Flexible design and wide range of options
- > High automation for setting and measurements

DRON-7M X-ray diff ractometer is capable to solve a wide variety of tasks for powder diff raction analysis.

Independent control of  $2\theta$  and  $\theta$  movements allows research of single crystals.



## DRON-7M X-ray

### General Purpose Diffractometer

#### Basic configuration includes:

- > Protective cabinet with interlock system of doors
- > Two-circle goniometer
- > High-voltage power supply for X-ray tube
- > X-ray tube with Cu anode
- > Scintillation NaI detector
- > Rotating sample holder for powders
- > X-ray collimation system with a set of changeable slits
- > Beta-filter : Ni (for copper radiation)
- > Reference sample of polycrystalline quartz
- > Data Collection software package for control and data collection
- > Set of spare tools, accessories and replacement parts
- > Personal computer





## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

### Application

- > Mining industry
- > Mineralogy
- > Construction
- > Machinery
- > Energetics
- > Oil and gas industry
- > Chemistry
- > Electronics
- > Criminalistics
- > Forensics
- > Pharmaceuticals
- > Crystallography
- > Nanotechnology
- > Examination of cultural
- > Valuables
- > Ecology

### Problems

- > Qualitative and quantitative phase analysis of polycrystalline materials and objects including coatings and thin films.
- > Determination of crystallinity, crystallite sizes and microstrains of lattice.
- > Determination of lattice type and dimensions, crystal structure refinement.
- > Tracing of phase transitions, chemical reactions and thermal deformations of lattice in variable environment (temperature, pressure, humidity, gaseous medium or vacuum).



Powder diffraction analysis in Bragg-Brentano,

## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

### Application

Metallurgy  
Machinery  
Electronics  
Technical crystals

### Problems

- > Analysis of preferred orientation of particles in metals and in other polycrystalline materials.
- > Determination of linear, planar and volumetric stresses in welded seams, parts and frameworks.
- > Determination of orientation of single crystals and different articles made of them.

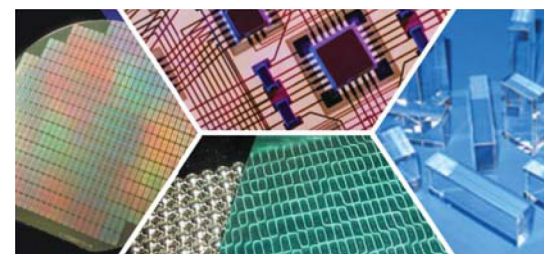
Micro- and nano-electronics

- > Determination of composition, thickness, mismatch and defects of layers in thin films, epitaxial and nanoheterostructures.
- > Quality control of materials for micro- and nanoelectronics.

Sample



**Analysis of residual stresses, textures**



**Analysis of thin films structure and**

## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

### Application

- > Catalysis
- > Colloid chemistry
- > Electronics
- > Molecular biology
- > Automotive- and aircraft
- > Industry (plastics and polymers)
- > Protection of main pipelines and cable industry
- > Packaging industry (nanocomposites and films)

### Problems

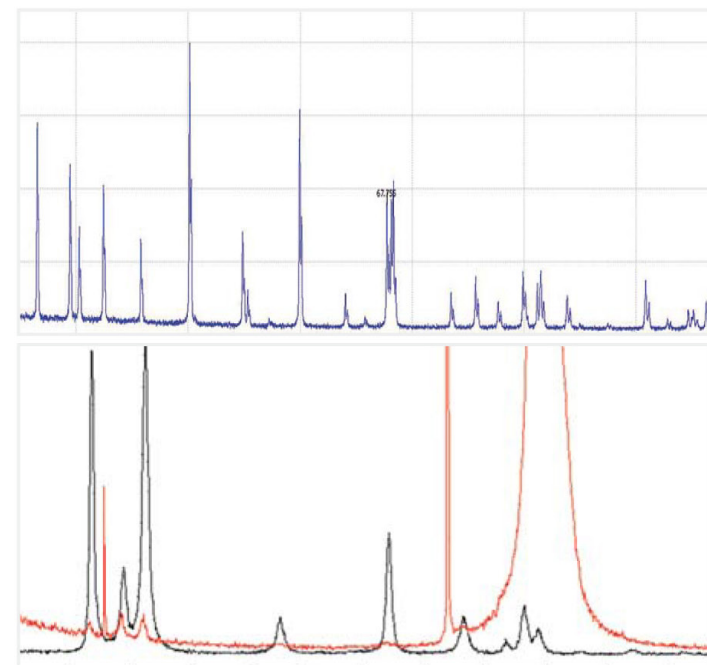
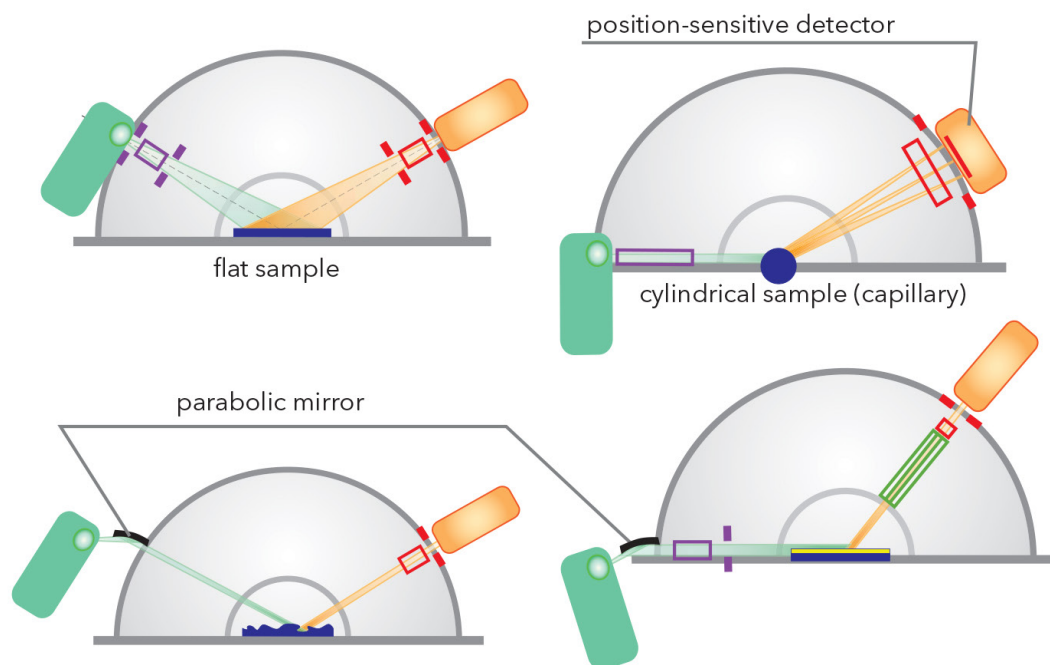
- > Determination of shape, size, phase composition, internal structure, orientation and distribution of nanoparticles in surface-active material, emulsions (including in biological mediums), fibers, catalysts, polymers, nanocomposites, liquid crystals and other disperse systems.



Analysis of residual stresses, textures

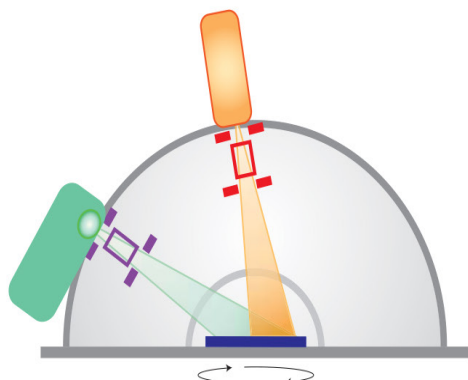
## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

Debye-Sherrer, grazing incidence and parallel-beam geometries.

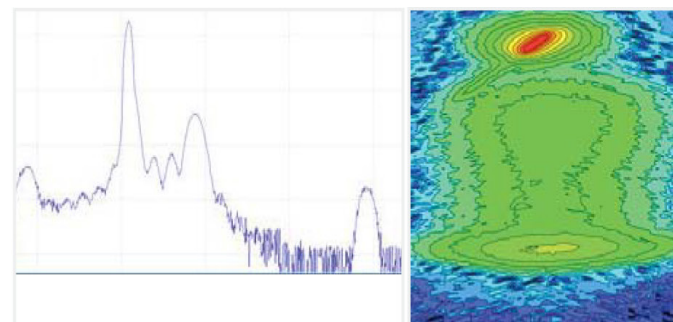
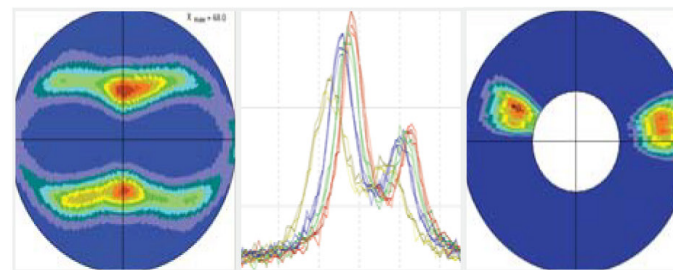


## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

Debye-Sherrer, grazing incidence and parallel-beam geometries.



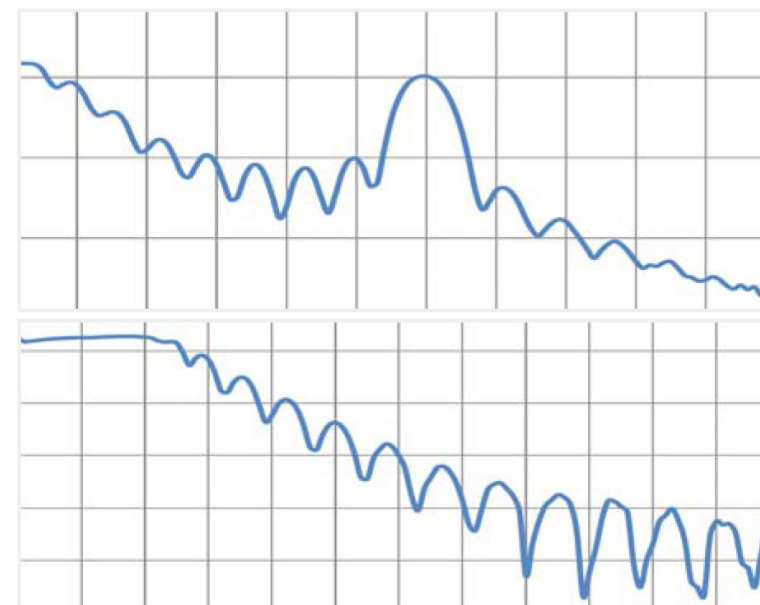
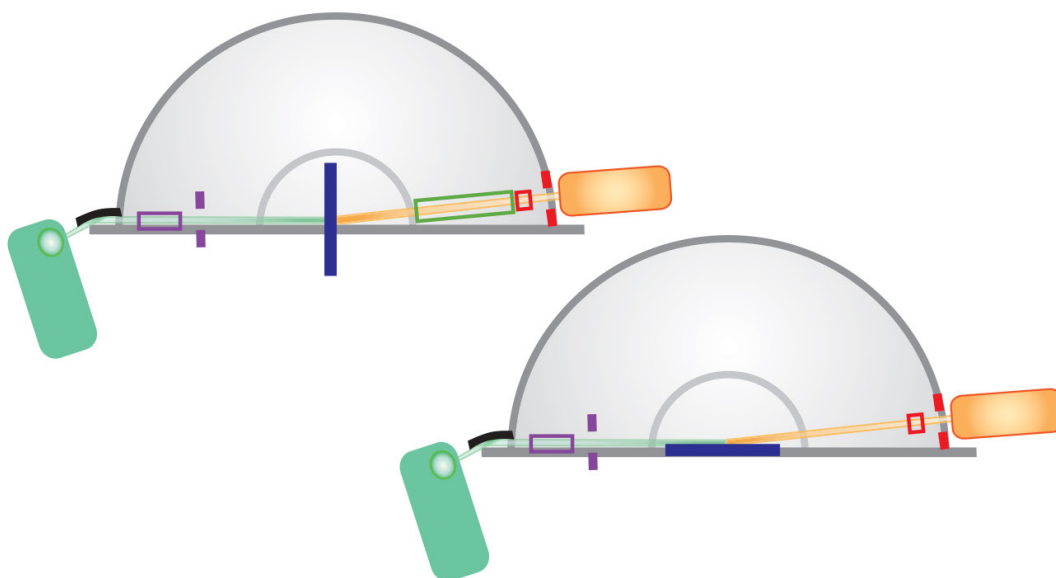
determination of crystal orientation





## Applications of DRON-7M and DRON-8/8T X-ray Diffractometers

by small-angle X-ray scattering and reflectometry



## Software for DRON-7M and DRON-8/8T X-ray Diffractometers

### Data processing - DrWin

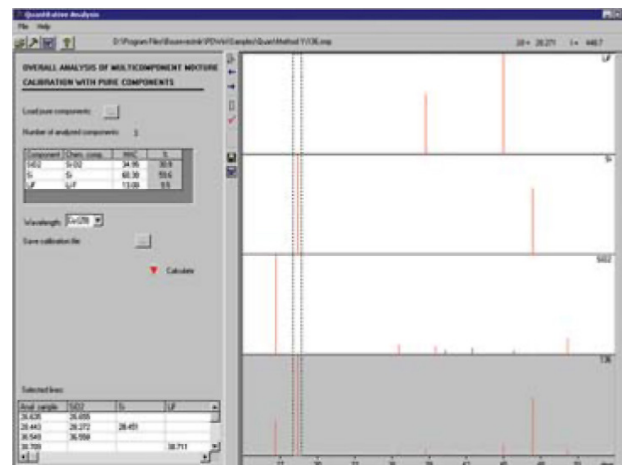
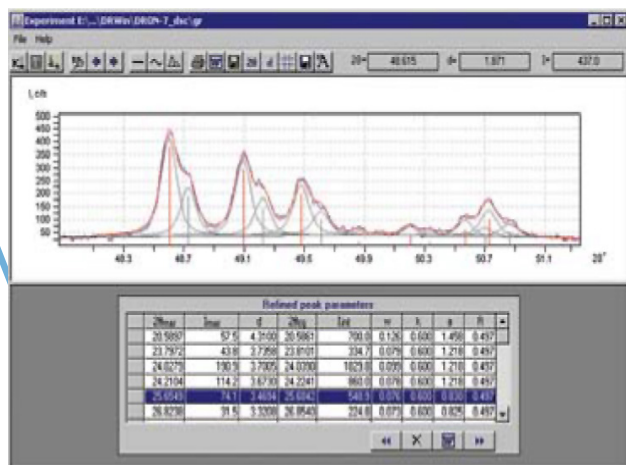
- Processing of diffraction pattern or selection
- Background approximation (by polynomial or user curve)
- Separation of K-doublets
- Peak search and determination of their angular positions
- Approximation of reflection profiles by pseudo-Voigt function (for the entire array or independently for each peak)
- Calculation of peak heights and their integral intensities
- Calculation of FWHM of reflections

### Quantitative phase analysis - Quan

- Overall analysis of multicomponent mixture
- Analysis of n-component system
- Analysis of sample with known mass absorption coefficient
- Method of internal standard
- Method of Reference Intensity Ratios (RIR's)
- Method of additives
- Method of reduction

### Calculation of average size of coherent domains and of microstrains - Size & Strain

- Calculation of size of coherent domains and microstrains by the method of second central moments
- Calculation of instrumental line broadening
- Application of absorption correction to the samples with another composition



## Software for DRON-7M and DRON-8/8T X-ray Diffractometers

### Calculation of theoretical diffraction pattern - TheorPattern

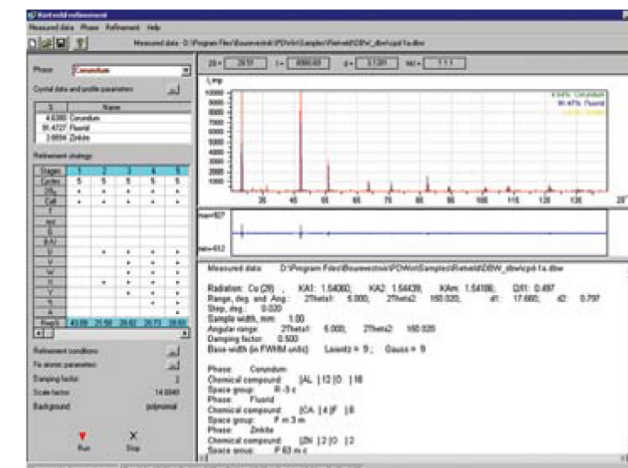
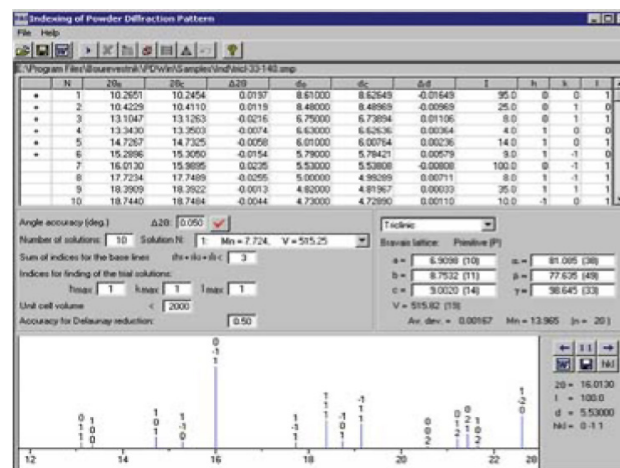
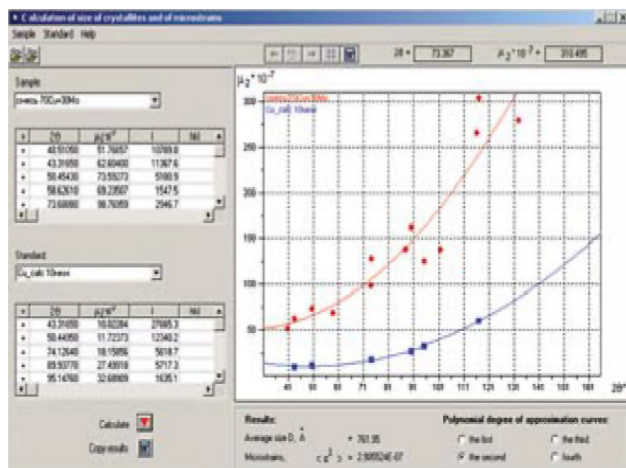
- Simulation of diffraction patterns of multicomponent mixtures from structural data
- Account for of instrumental factor
- Account for texture and crystalline size for each component
- Comparison of simulated and measured diffraction patterns
- Integrated package of geometrical crystallography

### Auto indexing of Powder Diffraction Pattern - Ind

- Determination of Bravais lattice type
- Choice of unit cell
- Computation of Miller indices for selected lines
- Bar graph of input diffraction pattern

### Full profile analysis by Rietveld method - Rietveld

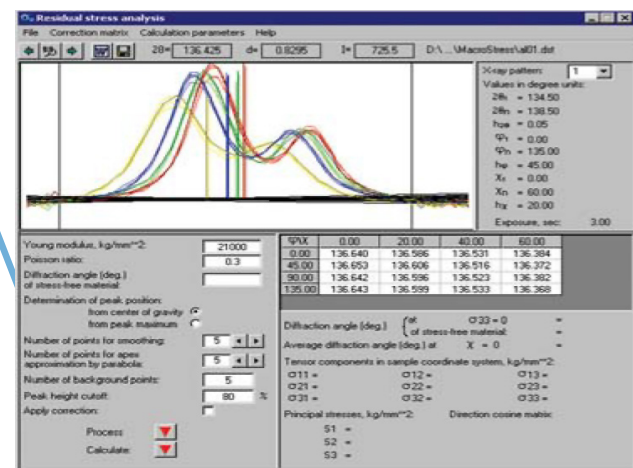
- Refinement of crystal structures from X-ray powder diffraction data of single crystalline phases and mixtures
- Calculation of polynomial and physical background
- Independent refinement of U, V, W, X, Y profile for different phases and for different groups of reflections
- Refinement of unit cell parameters, atomic & thermal parameters, occupations of atomic positions for each phase
- Choice of refinement strategy
- Control of Refinement conditions
- Calculation of five R-factors



## Software for DRON-7M and DRON-8/8T X-ray Diffractometers

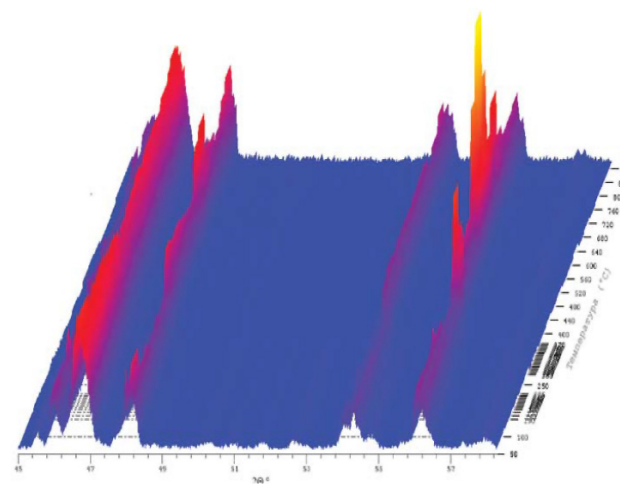
### Residual stress analysis - MacroStress

- Calculation of peak angular position from center of gravity or from peak topapex
- Application of correction matrix
- Calculation of linear, planar and volumetric stresses
- Calculation of stress deviations



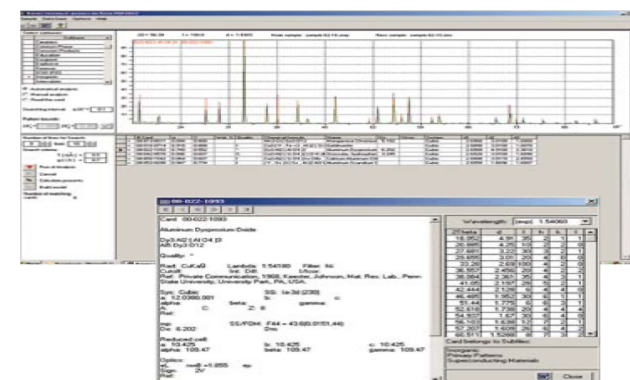
### High temperature-X-ray diffraction - Thermo

- 3D-imaging of measured data in "diffraction angle - intensity - temperature" co-ordinates
- Calibration of the measured data set by internal or external standard
- Refinement of unit cell parameters of the calibrated data set
- Determination of phase transition points
- Determination of thermal expansion coefficients (TEC) in different directions and thermal deformation tensors
- Building of TEC figures



### Qualitative phase analysis & access to the Powder Diffraction File database-Retrieve and Search-Match

- Use of PDF-2/PDF-4 database of International Center of Diffraction Data (ICDD) for qualitative analysis
- Automatic or manual search algorithm
- Creation of user subbases for search facilitation
- Addition of user standards into subbases
- Qualitative phase analysis by different criteria, bases (subbases)
- Analysis of lines matched by angular position & intensity
- Quantitative phase analysis by Reference Intensity Ratios (RIR's) method
- Access to the data base including search by selected criteria

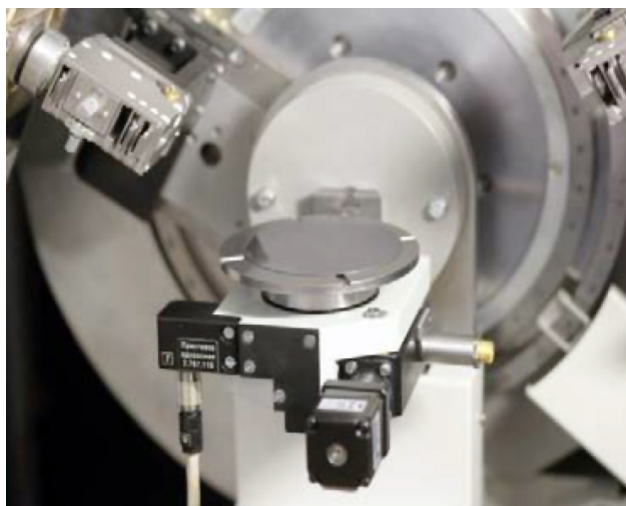




## Options for DRON-7M and DRON-8/8T Diffractometers

### Multidrive attachments and sample stages

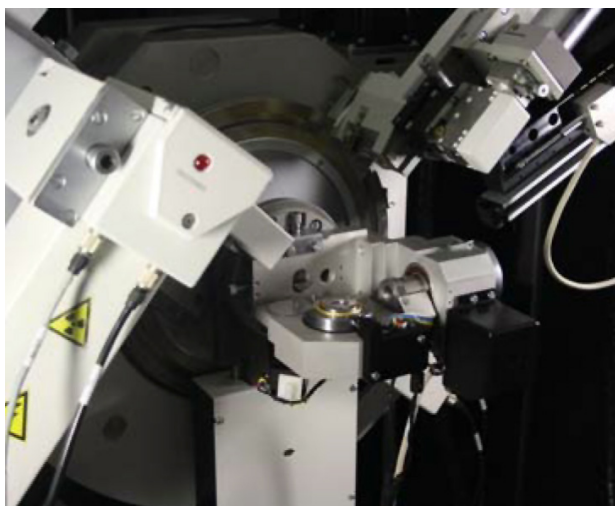
#### Single-axis $\varphi$ Y-attachment



for DRON-8/8T

Analysis of textures and residual stresses in polycrystalline materials, determination of single crystal orientation, study of phase composition and structural characteristics of powder and bulk objects.

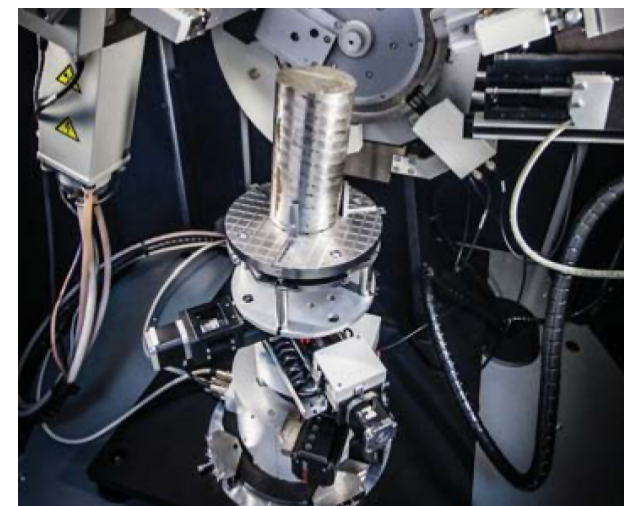
#### Two-axis $\varphi\chi$ -attachment



for DRON-7M, DRON-8/8T

Analysis of lattice dimensions and quality of single crystals in different crystallographic directions.

#### Four-axis xyz $\varphi$ holder for large



for DRON-8/8T

Mapping of phase composition and structural characteristics across sample surface, analysis of layer composition and structure in thin films.  
Maximal sample weight 1 kg 0.3 kg 50 kg Maximal sample

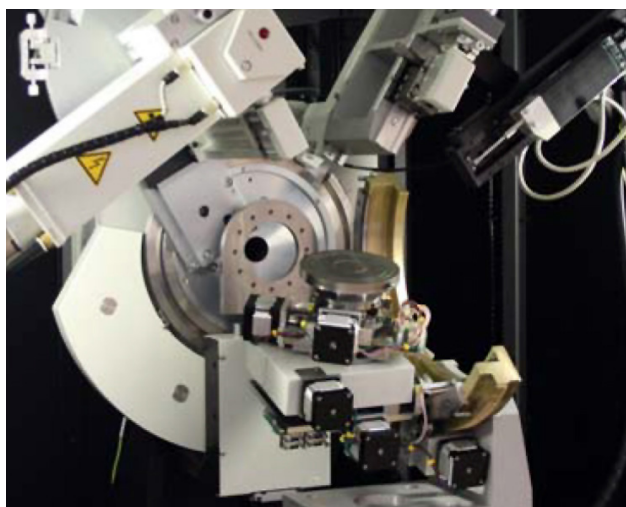


## Options for DRON-7M and DRON-8/8T Diffractometers

Maximal sample weight		
1 kg	0.3 kg	50 kg
Maximal sample weight		
100x20 mm	28x10, 15x100 mm	300x250 mm
Maximal sample dimensions (Ø x h)		
5 µm	-	5 µm
Automatic alignment of sample plane, accuracy		
0.001 deg.	0.01 deg	0.001 deg.
Smallest selectable step of X-rotation		
-	0.001 deg	-
Range of X-inclination		
-	from -5 to +95 deg.	-
Range of xy-movement		
-	-	±100 mm
Smallest selectable step of xy-movement		
-	-	0.1 mm
Scanning modes		
$\Omega, \Omega-\Phi, 2\Theta-\Omega, \sin^2 \Psi$	$\Omega, \Omega-\Phi, X-\Phi, 2\Theta-\Omega, \Psi, \sin^2 \Psi$	$\Omega, \Omega-\Phi, 2\Theta-\Omega, \Psi, \sin^2 \Psi$

## Options for DRON-7M and DRON-8/8T Diffractometers

**Multi-purpose  $\phi$ -axis  $\chi$ -attachment**



**for DRON-8/8T**

Analysis of textures and residual stresses in polycrystalline materials, determination of single crystal orientation, study of phase composition and structural characteristics of powder and bulk objects. Continuous measurement of powder and bulk sam-

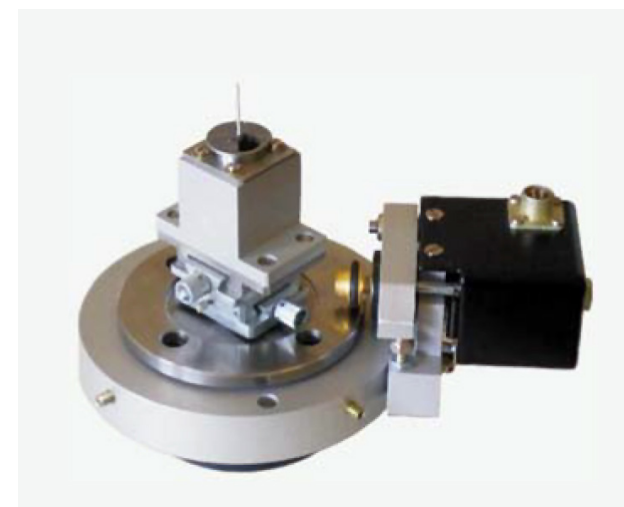
**Autosampler**



**for DRON-7M, DRON-8/8T7M, DRON-8/8T**

ples in automatic mode. Speed of sample rotation: 0.5 or 1 rps. Measurements of cylindrical samples (capillaries) of 0.1-1.0mm in diameter in Debye-Sherrer geometry (transition mode).

**Stage for cylindrical samples**



**for DRON-7M, DRON-8/8T**

Mapping of phase composition and structural characteristics across sample surface, analysis of layer composition and structure in thin films. Analysis of lattice dimensions and quality of single crystals in different crystallographic directions, mapping of reciprocal space.

## Options for DRON-7M and DRON-8/8T Diffractometers

Maximal sample weight		
1 kg	-	-
Maximal sample weight		
100x20 mm	28x10, 15x100 mm	Ø 0,1-1,0 mm; length up to 100 mm
Maximal sample dimensions (Ø x h)		
5 µm	5 µm	-
Automatic alignment of sample plane, accuracy		
0.001 deg.	-	-
Smallest selectable step of X-rotation		
0.001 deg.	-	-
Range of X-inclination		
from -5 to +95 deg.	-	-
Range of xy-movement		
±20 mm	-	-
Smallest selectable step of xy-movement		
0.1 mm	-	-
Scanning modes		
Ω, Ω-Φ, 2Θ-Ω, sin <sup>2</sup> Ψ	Θ Θ-(DRON-8/8T); 2Θ-Θ(DRON-7M)	2Θ

## Options for DRON-7M and DRON-8/8T Diffractometers

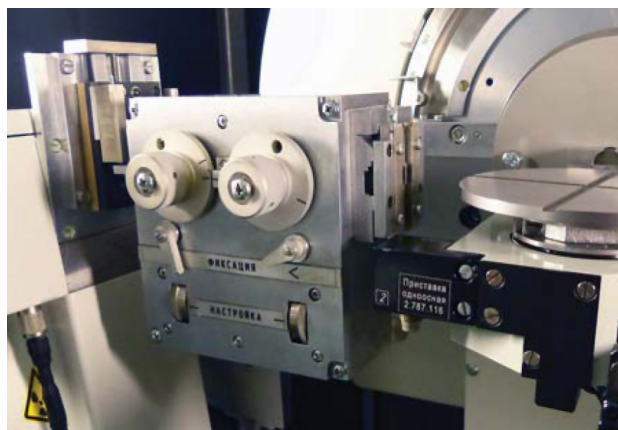
### X-ray optical elements



**One-dimensional parabolic mirror for DRON-7, DRON-8/8T. Converts a divergent primary beam to a parallel one, makes it monochromatic and enhances intensity.**

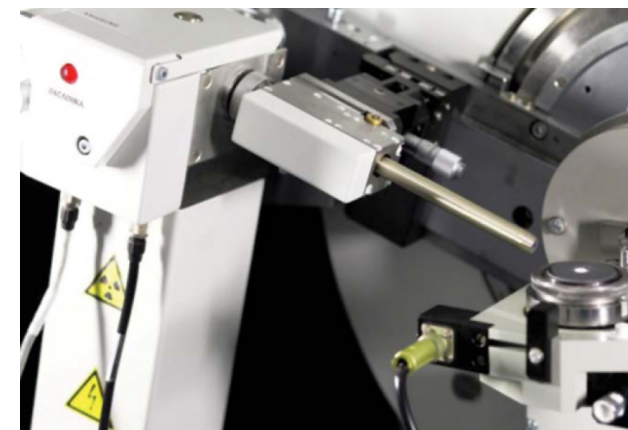
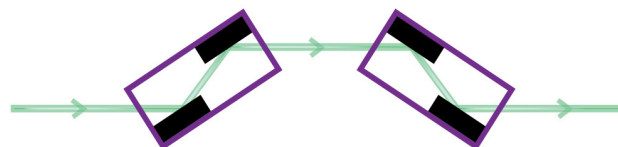
Application:

- > Measurements of samples with uneven surface.
- > Small-angle X-ray scattering (SAXS).
- > Grazing-incidence X-Ray diffraction (GIXRD).
- > X-Ray reflectivity (XRR).



**4-bounce channel-cut Ge 220 x 4 monochromator of Bartels type for DRON-8/8T**

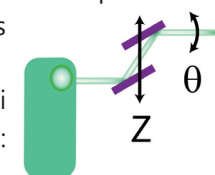
- > Converts to high-resolution geometry.
- > Singles out pure monochromatic K-1 line with the angular resolution of 12 arc. sec.



**Polycapillary lenses for DRON-8/8T**

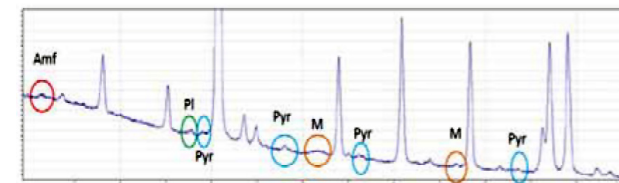
Focusing lens provides:

- > Intensity gain of primary beam 50-100 times.
  - > beam spot on sample surface is 50-100  $\mu\text{m}$ .
  - > Microanalysis in different points of sample surface.
- Collimating semi-lens forms quasi-parallel beam of  $\varnothing 10 \text{ mm}$  to perform:
- > Measurement of uneven surfaces in parallel-beam geometry
  - > Analysis of texture and residual stress.



## Options for DRON-7M and DRON-8/8T Diffractometers

### Fast registration system



Fast registration system with linear stripped PSD Mythen2 R 1D и Mythen2 R 1K (Dectris, Switzerland) for DRON-7M, DRON-8/8T.

- > Strip width,  $\mu\text{m}$ :  $50 \pm 3$ .
- > Number of channels: 1280 (2 R 1K) and 640 (2 R 1D).
- > Active area,  $\text{mm}^2$ :  $8 \times 64$  (2R 1K) and  $8 \times 32$ ,  $4 \times 32$  (2R 1D).
- > Measurement time is 100 times less.
- > Angular resolution is the same as for scintillation counter.

- > Increase of signal/noise ratio, especially for the weak reflections.
- > Increase of sensitivity limit.
- > Suppression of X-ray fluorescence background.
- > Automatic calculation of strip aperture, goniometer radius and zero angle during alignment and calibration of PSD.

#### Application:

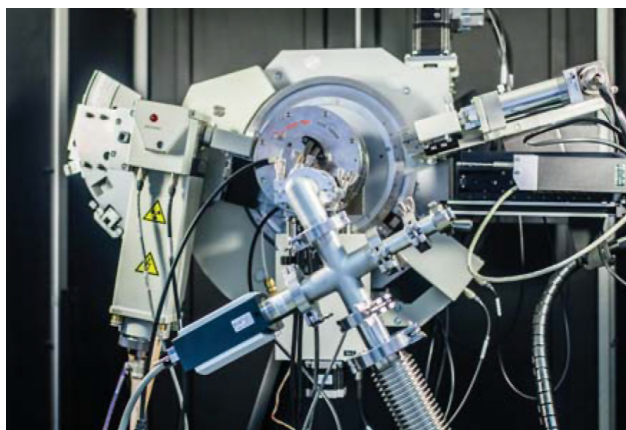
- > Measurements of large number of samples in a limited

period of time.

- > Analysis of residual stress.
- > Study of poorly crystallized and quickly decomposed materials.
- > Real-time studies of phase transformations and chemical reactions.
- > Identification of minor impurities.
- > Measurements of small quantities of material.



## Options for DRON-7M and DRON-8/8T Diffractometers



### **TTK-600 Low-temperature chamber for DRON-8/8T**

Operation temperatures: from -190 to +600 oC

Atmospheres: vacuum (10-2 mbar), air, inert gases

### **CHC+ cryo & humidity chamber for DRON-8/8T**

Operation temperatures (in vacuum): from -5 to +400 oC

Humidity range: 5 – 95% at temperatures from +10 to +60 oC

### **Vacuum equipment for DRON-8/8T**

Application: tracing of phase transitions and chemical reactions, polymorph screening, analysis of thermal deformations of lattice in variable environment (temperature, pressure, humidity, gaseous medium or vacuum).

### **HTK-1200N oven-chamber for DRON-7M, DRON-8/8T**

Operation temperatures: from +25 to +1200 oC

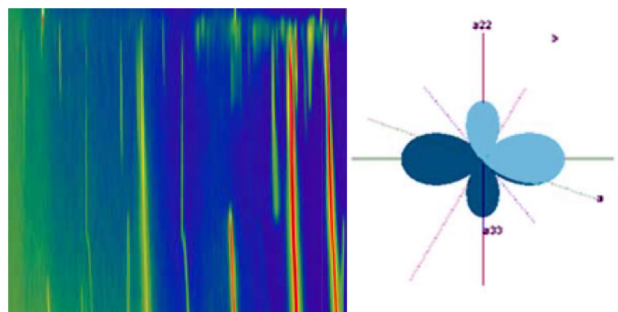
Atmospheres: vacuum (10-4 mbar), air, inert gases

### **HTK-16N/2000N strip-heater chambers for DRON-8/8T**

Tungsten (W) heater (in vacuum): from +25 to +2300 oC

Platinum (Pt) heater (in vacuum, on air, or in atmosphere of inert

gas): from +25 to +1600 oC







Products Information

# XRF (X-Ray Fluorescence)

Dispersive General Purpose Spectrometer

**AFV**

Aria Fan Varzan

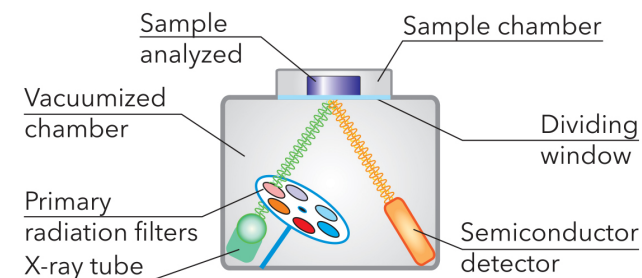
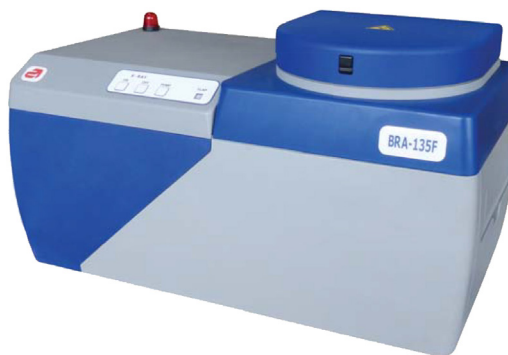
"To Make a Better Life by Applied Science"

## BRA-135F XRF Energy Dispersive General Purpose Spectrometer

- Wide range of detected chemical elements – 9F-92U
- High sensitivity due to optimal X-ray optical path
- High resolution of ultra-modern SDD detector
- Fundamental parameter (FP) Method for steel and alloy quantitative analysis
- Built-in control PC
- Patent for X-ray transparent dividing window



X-ray fluorescence energy dispersive general purpose spectrometer BRA-135F allows simultaneous determination of chemical elements by characteristic energies in the 1 to 30 keV range (where elements from F till U are fitted) over a wide scope of concentrations from hundreds ppb. BRA-135F analyzes solid, powder and liquid samples, thin layer on the surface or precipitated on filters.



Completely satisfies the requirements of radiation safety.

## BRA-135F XRF Energy Dispersive General Purpose Spectrometer

### Operating principle

The spectrometer operating principle is based on excitation of fluorescence radiation of atoms in the substance being analyzed by radiation coming from the low-power X-ray tube.

The fluorescence radiation from the sample gets into the SDD semiconductor detector where quanta of different energies are converted into electrical pulses, which amplitudes are proportional to the energy of absorbed quanta. Pulse-frequency rate with the certain amplitude is proportional to the chemical element concentration in the sample.

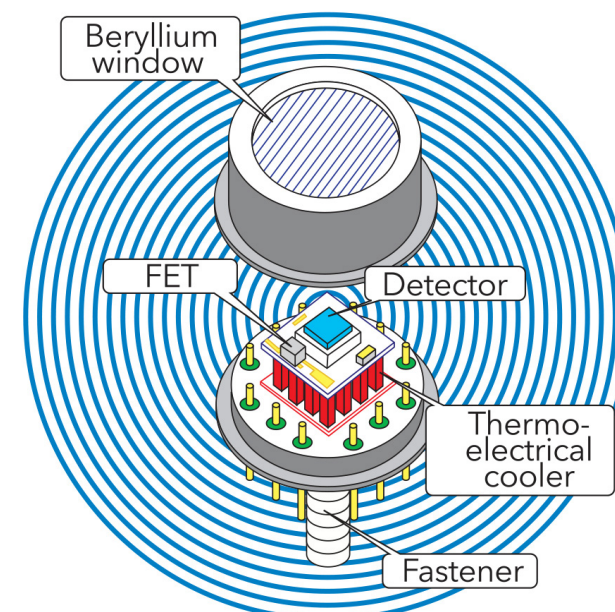
### Method advantages

X-ray fluorescence analysis (XRF) occupies a leading

position among the other methods for determination of the quantitative elemental composition of substances. XRF advantages are as follows: nondestructive measurements, multielement determination, express method, high accuracy of analysis, wide range of measured concentrations, development level of quantitative analysis theory, possibility for quantitative analysis with absence of standard samples.

### High efficiency SDD detector

The silicon drift detector (SDD) with ultra-thin entrance window allows to register x-ray radiation in wide energy range on retention of energy resolution and response.



Detector scheme

## BRA-135F XRF Energy Dispersive General Purpose Spectrometer

### Low detection limit

Owing to optimally selected materials and thickness of primary radiation filters, high transparent X-ray optical scheme, a low detection limit can be achieved for all elements to be analyzed.

In the range of light elements from 9F to 17Cl low-energy radiation registration becomes possible using vacuum where the optical path of radiation passes.

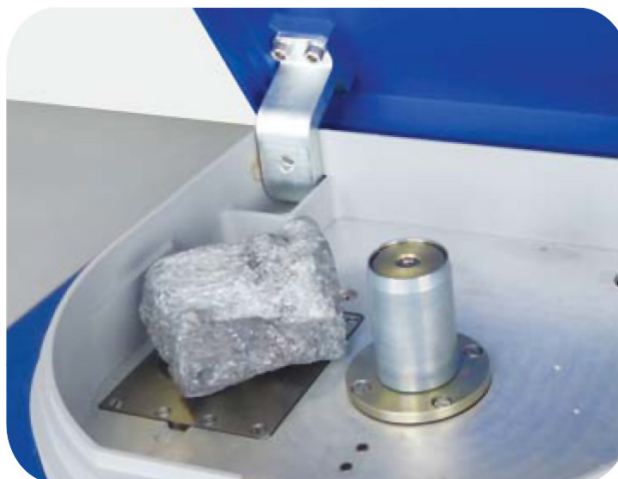
### Large or irregular shape samples

It is possible to measure large-size or odd-shaped samples:

- Large-size minerals and nuggets
- Industrial articles for analysis for ROHS requirements
- Metals and alloys incoming control
- Analysis of liquids in the special cells or on the special filters.

### Compact body and functionality

- The housing spectrometer ensure fully radiation -protection
- Handles for carrying
- Built-in operational computer (PC)
- LAN port for remote control and archiving of measurement results
- LIMS integration is available
- Easy report creation
- Password protection and separation of access rights.

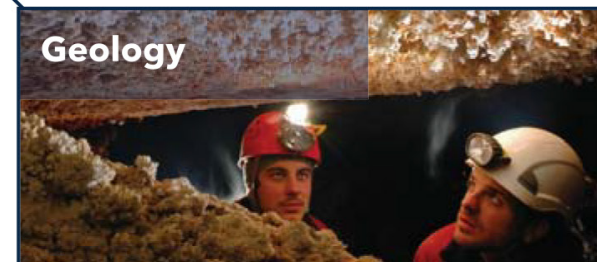
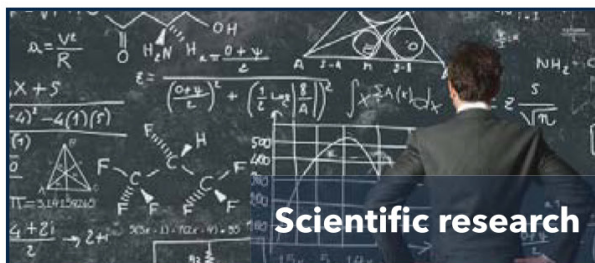
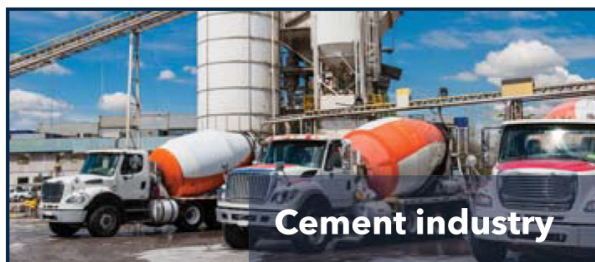




## Technical Data

Range of detected elements	<sup>9</sup> F - <sup>92</sup> U
Limits of detection without preliminary enrichment, %	
- for elements from Na to Mg	$n \cdot 10^{-2}$
- for elements from Al to Cl	0,002
- for elements from K to U	0,0005
Limit of determination at sample preconcentration (depending on chemical element), %	$1.5 \cdot 10^{-5}$
Limit of determination in mid group element (liquid), g/dm <sup>3</sup>	$n \cdot 10^{-3}$
Average time of one sample analysis, s	100
Energy resolution on MnKa line at pulses counting rate up to $10^4 \text{ s}^{-1}$ , not more than, eV	145
Max. voltage of X-ray tube, kv	50
X-ray power, W	10
X-ray tube cooling	by air
Primary X-ray radiation filters, pcs	5
Number of samples installed into sample changer, up to	
changer #1 (Ø34 mm samples)	15
changer #2 (34,36,40,44 mm samples)	11
Maximum sample size, mm	Ø 200x60
Ethernet connection	Yes
Possibility for remote control	Yes
Overall dimensions (LxWxH), mm	700x410x400
Instrument Weight, max, kg	65
Power	220 V, 50 Hz
Power Consumption, W	500

## Fields of application



## Filed of application

### Methodology description

#### Oil analysis

For measuring purposes of trace elements Al, Ba, Ca, Cu, Fe, Mn, V, Ni, Pb, Zn, P into oil and petrochemicals appropriate methodology was developed.

Analytic complex consisting of BRA-135F and measuring methodology is capable of carrying out quantitative element analysis of petrochemicals in order to define metal trace elements and can be used to analyse exhausted motor oils of aircraft, machines, special motor vehicle in order to identify deterioration rate of engines and define applicability of technical service for it. Methodology is purchased additionally.

Besides BRA-135F could be used for testing as per ASTM D4294 and ASTM D6481. These test methods cover the measurement of sulfur, Barium, Calcium, Magnesium, Phosphorus, Zinc & Chlorine in hydrocarbons, such as lubricating used oil, diesel, naphtha, kerosene, residuals, lubricating base oils, hydraulic oils, grease, jet fuels, crude oils, gasoline (all unleaded), and other distillates. Additionally, sulfur in other products, such as M-85 and M-100, may be analyzed using this technique.

#### Cement materials analysis

For measuring purposes of mass fraction of Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Zn, Rb, Sr into cements and cement production materials (clinkers, raw mixes) suitable methodology was developed.

Analysis methodology includes algorithms of principal components determination using X-ray energy-dispersive fluorescent spectrometers BRA-135F and is based on recommendations from GOST 5382-91, GOST R 55410-2013 (ISO 12677:2011).

There is provided remelting method into platinum crucibles (according to GOST R 55410-2013) for samples preparation in the methodology.

#### Detection limits of BRA-135F according to certified methodology (ppm):

P	Al	Mn	Ba	Pb	V	Cu	Ni	Fe	Zn	Ca
100	100	5	50	5	5	5	5	5	5	50

## Fields of application

### Advanced software

BRA-135F software is the optimal combination of high performance and functionality with an intuitive interface and tooltips.

Owing to this, performance of routine measurements requires no special trained staff.

Only few simple steps are enough to make a measurement: select the sample position, enter its code, choose the research method and run the analysis.

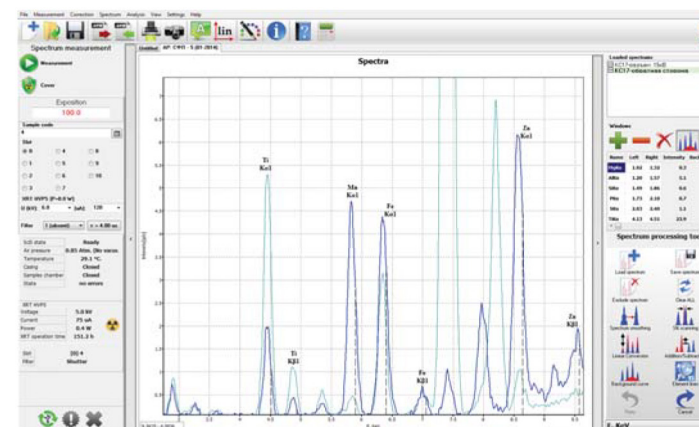
Excellent methodical support

Bourevestnik JSC has a methodological support of spectrometers, including the development and validation of methods for determining the elemental composition of various materials: oil products, ores, rock, slag, refining products, cement and raw mixes, soil and sediment, water, air.

Qualitative and quantitative analysis

BRA-135F software unveils wide opportunities for on-line receiving of information on the chemical composition of the material to be analyzed. The user chooses the method of substance analysis: qualitative or quantitative.

For operator convenience in operation, the auxiliary utilities were implemented to minimize errors during the analysis. For example, semi-automatic marker of lines allows correct identification of spectral lines of different elements.



Spectrum measuring and its processing conditions



## Fields of application

### Fundamental parameters method

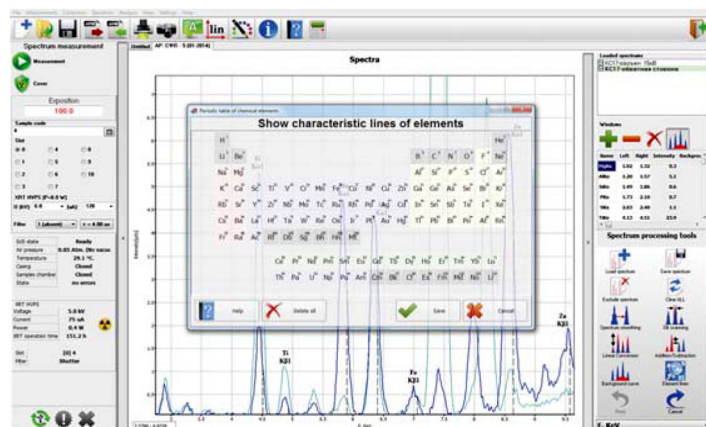
The software implementing fundamental parameters method allows semi-quantitative and quantitative determination of elements within the range from Mg (12) to Pb (82) in solid samples of steels and alloys with composition of 0.1% to 100%.

If there are no standard composition samples, to calibrate the spectrometer and with large list of materials under analysis, the standardless semi-quantitative analysis is implemented, which represents the following dependences:

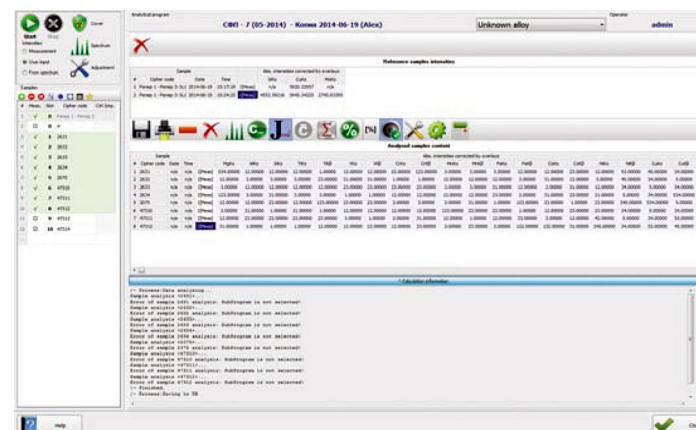
on sample composition (this dependence was implemented through absorption parameter

### Registered spectra can be:

- > saved in suitably structured archive
- > got out for repeat analysis based on a new calibration characteristics
- > processed as per user's request: added, deducted, KLM-marked
- > scaled



Spectrum measuring and its processing conditions



Fundamental parameters method







Products Information

# Diamond Quantum Computer

**AFV**

Aria Fan Varzan

"To Make a Better Life by Applied Science"

## About CIQTEK

CIQTEK is a high-tech enterprise with quantum precision measurements as the core technology. It is devoted to providing products and services to enterprises, governments, and research institutions worldwide, including core devices represented by enhanced quantum sensors, advanced instruments, equipment for analysis and test, technical solutions for enabling industry applications, etc. The business units include Magnetic Resonance, Quantum Precision Microscope, Quantum Computing, Scanning Electron Microscope, Electronic Test & Measurement, Specific Surface Area, etc. The company has more than 500 employees, of which the R&D team accounts for 70%. CIQTEK is headquartered in Hefei, China, with branch offices in Beijing, Shanghai, Guangzhou, Shenzhen, and Chongqing, China. CIQTEK originated from the Key Laboratory of Microscale Magnetic Resonance of the Chinese Academy of Sciences, University of Science and Technology of China. The laboratory has been deeply engaged in researching and developing high-end scientific instruments and critical core devices for more than ten years.



## Diamond I

### Product Introduction

Diamond Quantum Computer for Education is based on the principle of NV color center and spin magnetic resonance in diamond. By controlling laser, microwave, magnetic field, etc, to perform quantum manipulation and readout of the spin of the NV color center to realize the quantum computing functions. The instrument operates at room temperature conditions, and without low-temperature vacuum environment, which makes the equipment have almost zero operating costs. The desktop design allows it to adapt to a variety of teaching environments, whether in the classroom or laboratory, it's easy to carry out the experimental teaching of quantum mechanics and quantum computing.

Besides, it allows students to build and debug the experiment equipment by hand, and write custom pulse sequence with the multi-functional software. Also it can provide complete teaching and experimental content of quantum computing based on the diamond NV system. From basic quantum mechanics experiments to quantum computing algorithm experiments, it helps and universities and research institutions to open and optimize university physics experiment courses

and modern physics experiments courses in quantum information science, promotes the construction of the discipline of quantum mechanics, innovates the teaching content of the discipline, and improves related disciplines and teaching quality.

Qubit: NV color center in diamond  
Laser power: 10~20mW  
Magnetic field:  $30 \pm 20$  Gauss  
Microwave channel: 2  
Time accuracy: 2 ns  
Pulse control module channel: 8

### Product Features



## Diamond I

### Product Parameters

- > Qubit: NV color center in diamond
- > Laser power: 10~20mW
- > Magnetic field:  $30 \pm 20$  Gauss
- > Microwave channel: 2
- > Time accuracy: 2 ns
- > Pulse control module channel: 8

### Quantum computing

- > qubit
- > quantum logic gate
- > quantum decoherence
- > quantum algorithm

### Quantum mechanics

- > quantum state
- > quantum state evolution
- > Zeeman effect
- > electron spin

### More functions

- > magnetic resonance
- > optically detected magnetic resonance
- > quantum control technology
- > quantum precision measurement

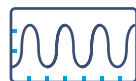
### Experiments

Diamond quantum computer for education is composed of microwave module, light module, control acquisition module and power module. The hardware supports a variety of basic experiments related to quantum computing, as well as quantum precision measurement, light detection magnetic resonance and more expand development.



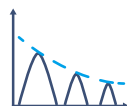
#### Instrument Calibration

Set up and adjust the instrument, get familiar with the principle of optically detected magnetic resonance, NV center, microwave generation and pulse control.



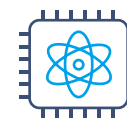
#### Rabi Oscillation

The Rabi oscillation of NV center is measured, and get the microwave pulse length corresponding to the quantum logic gate.



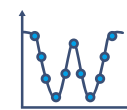
#### T2 Measurement

T2 experiment shows the evolution of quantum superposition state and measures the decoherence time of NV center spin.



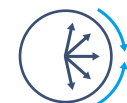
### D.J. Algorithm

A two-qubit Deutsch-Jozsa quantum algorithm is realized on the NV center quantum processor.



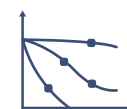
### Continuous Wave

Understand NV center qubit by measuring the optically detected magnetic resonance spectrum and get the resonance frequency for spin control.



### Spin Echo

Spin echo is an effective technique used to suppress the coupling between the qubit and the environment, so as to prolong the coherence time.



### Dynamic Decoupling

The decoherence time is extended by designing the dynamic decoupling sequence to average out the coupling between the qubit and the environment.



## Development status of quantum computing

### Experiment Interface

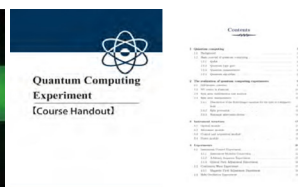


### Curriculum Solutions

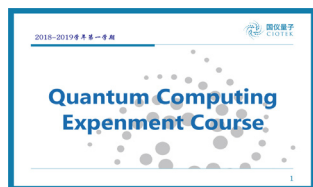
Based on the diamond quantum computer for education, we can provide a complete set of solutions related to quantum computing curriculum, including laboratory construction, course handout, lecture video, courseware, demonstration and training, etc.



Lecture Video



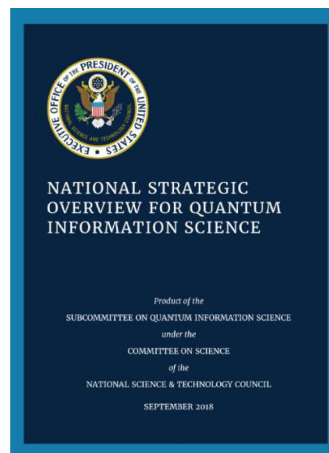
Course Handout



Lecture Slides



Demonstration and Training



**USA July 2016**  
National Strategic  
Overview for Quantum  
Information Science

**Urgent need for a large number of relevant professionals**



**Germany Nov 2018**  
Quantum Technology  
-From Basics to Market

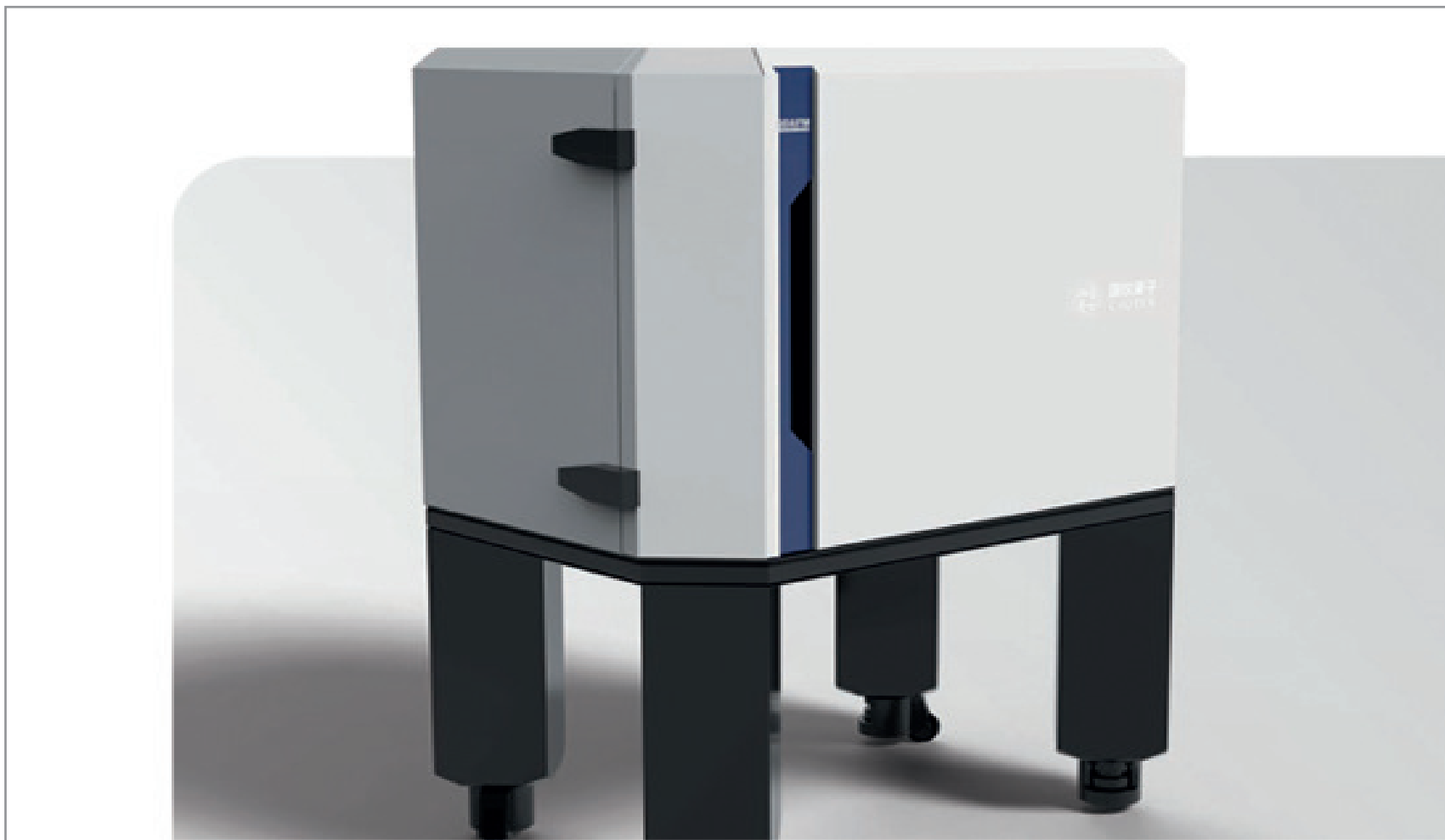
**Urgent need for a large number of relevant professionals**







Products Information



# Quantum Diamond

Atomic Force Microscope

**AFV**

Aria Fan Varzan

"To Make a Better Life by Applied Science"

## Introduction

### Quantum Diamond Atomic Force Microscope (QDAFM)

Quantum Diamond Atomic Force Microscope (QDAFM) is a magnetic imaging instrument based on both NV center in diamond and AFM scanning imaging technology. By quantum control and readout of the spin state in the diamond probe, the magnetic property of samples is acquired quantitatively and non-invasively. With nanoscale spatial resolution and ultra-high detection sensitivity, QDAFM is an innovative technology to develop and study magnetic textures, high-density magnetic storage, and spintronics.

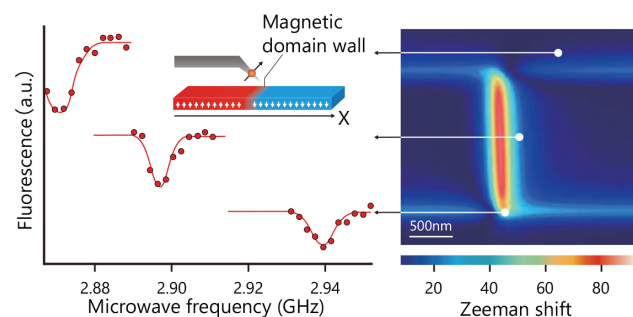
## Features



## Introduction

QDAFM has extensive applications in material science, biology, physics and so on.

### Nanoscale magnetic imaging



Magnetic imaging of Bloch domain wall

In condensed matter physics, it is significant to determine the static spin distribution of magnetic materials, which is also the key to study new magnetic devices.

QDAFM enables high-quality imaging of domain walls with ultra-high sensitivity at the nanoscale.

Reference:

Tetienne, J. P. et al. The Nature of domain walls in ultrathin ferromagnets revealed by scanning nanomagnetometry. *Nature Communications* 6, 6733(2015).

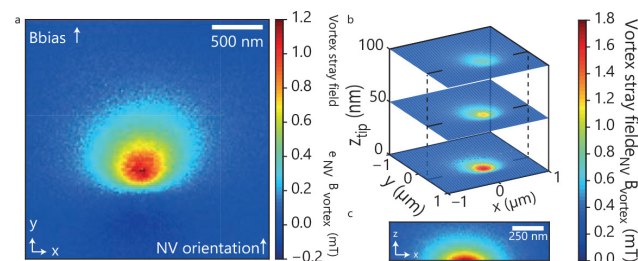
### Superconductor vortex imaging

Microscopic studies of superconductors and their vortices play a vital role in understanding the mechanisms underlying superconductivity.

QDAFM working at cryogenic conditions demonstrated its quantitative measuring and imaging ability for superconductor vortices, and this technique can be easily applied to other cryogenic condensed matter systems.

Reference:

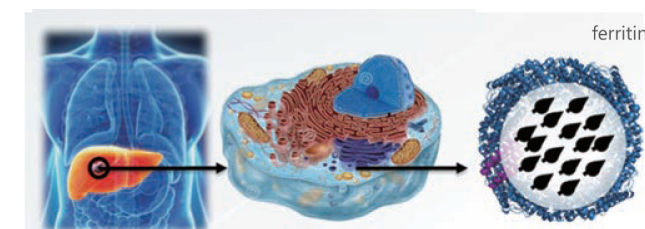
Thiel, L. et al. Quantitative nanoscale vortex imaging using a cryogenic quantum magnetometer. *Nature Nanotechnology* 11,677-681 (2016).



Quantitative mapping of single-vortex stray magnetic fields

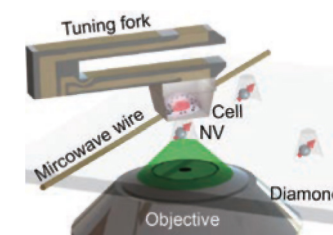
### Single cell magnetic imaging

The in situ measurement of biomolecules inside a single cell is an important goal in life science. Among various imaging techniques, the magnetic resonance imaging (MRI) technique can quickly and non-destructively acquire spin distribution images in vivo.



In situ nanoscale magnetic imaging of ferritins in a single cell

As MRI has almost no damage to organisms, it plays an important role in pathological research, di-



Schematic view of the experimental setup for nanoscale magnetic imaging

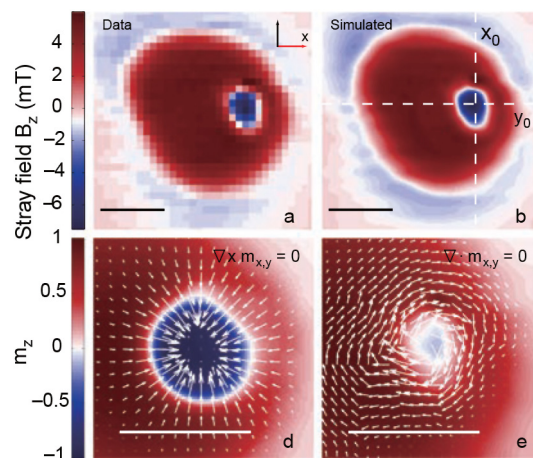
## Introduction

agnosis, and treatment of diseases. However, the spatial resolution limit of traditional MRI is above micrometers, thus it is impossible to perform molecular-scale MRI in a cell. The researchers break the limit with QDAFM, which enables a 10 nm spatial resolution magnetic imaging of ferritins in a single cell. Refrence.

Topological magnetic structure characterization 6 y Wang, P. et al. Nanoscale magnetic imaging of ferritins in a single cell. Science advances 5, 8038 (2019).

### Topological magnetic structure characterization

Magnetic skyrmions are small swirling topological defects in the magnetization texture. It exhibits rich novel physical properties and provides a new platform for studying topological spintronics. The potential applications include high-density, low-power cost and nonvolatile storage devices. However, the detection of a single skyrmion at room temperature is still challenging. Owing to the high sensitivity and high spatial resolution features, QDAFM demonstrated its ability to solve this long-standing prob-lem by reconstructing the full set of spin textures from a measured stray field.



Refrence:

Dovzhenko, Y. et al. Magnetostatic twists in room-temperature skyrmions explored by nitrogen-vacancy center spin texture reconstruction. Nature Communications 9, 2712 (2018).

### Specifications

Scanning probe frequency	32 kHz
Compatible probe type	Akiyama probe, diamond probe
AFM scan range	80×80 μm <sup>2</sup>
Confocal scan range	80×80 μm <sup>2</sup>
Lens numerical aperture	0.7
Spatial resolution of magnetic imaging	10 nm
Magnetic detection sensitivity	1 μT/ Hz
Microwave frequency	0.7 - 4.0 GHz
Time accuracy of pulse control	50 ps
Magnetic field	10 - 500 Gauss





Products Information

## Desktop EPR

Electron Paramagnetic Resonance Spectrometer EPR200M

**AFV**

Aria Fan Varzan







"To Make a Better Life by Applied Science"

## Desktop Electron Paramagnetic Resonance Spectrometer EPR200M

### Product Introduction

EPR200M is a newly designed and ergonomically compact desktop electronic paramagnetic resonance spectrometer. On the basis of dedication to high sensitivity and high stability, provide a super cost-effective, simple and friendly experience for every scientific research or industrial user who needs EPR testing.

### Product Features

-  High sensitivity, accuracy, stability
-  Integrated instrument control software, data processing software and spectrum fitting software
-  Standard sample for accurate g measurement & quantitative EPR measurement
-  Support manual and automatic tuning
-  Customized software package: application for radiation dosimetry
-  Multifunctional accessories: low temperature measurement, angle device, light



## Product Application

Unpaired electrons are widely distributed, such as isolated single atoms, conductors, magnetic molecules, transition metal ions, rare Earth ions, ion clusters, doping materials, defective materials, biological free radicals, metal proteins, etc.; many substances do not contain themselves unpaired electrons will produce unpaired electrons after being excited by light. Therefore, electron paramagnetic resonance technology is widely used in physics, chemistry, biology, materials, industry and other fields.

Environment Science: Environmental monitoring such as air pollution, sewage treatment, transition metal heavy metals, EPRFs.

Chemistry: Coordination compound structure research, catalytic reaction, free radical detection, reactive oxygen species detection, chemical reaction kinetics, etc.

Physics & Material: Single crystal defects, magnetic material properties, semiconductor conductive electrons, solar cell materials, polymer properties, fiber defects, etc.

Biomedical: Antioxidant characterization, nitrogen oxide detection, reactive oxygen species ROS, occupational disease protection research, nuclear radiation emergency medical rescue diagnostic classification,

cancer chemotherapy and radiation related research. Food Science: Agricultural product irradiation dose, beer flavor preservation period, edible oil rancidity test, alanine dosimeter, food and beverage antioxidant.

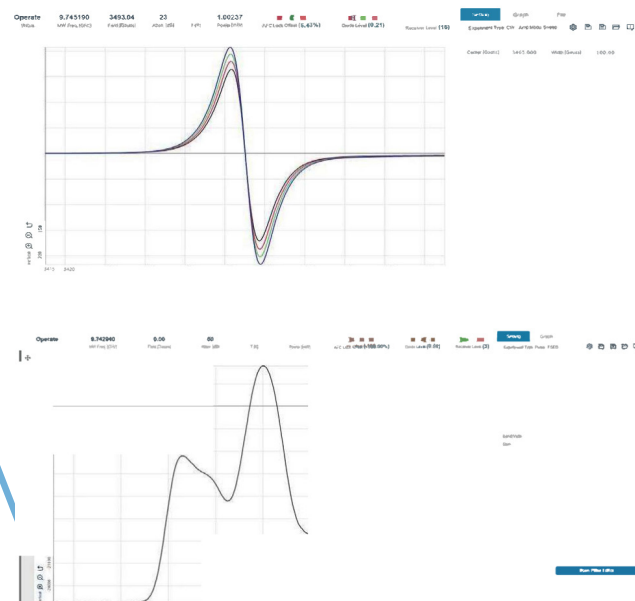
Industry: Coating aging research, cosmetic free radical protection coefficient, diamond defect identification, tobacco filter efficiency, free matrix controlling petrochemical industry.

### Product Parameter

Parameter	Value
Frequency Range	9.2-9.9GHz
Modulation Field Amplitude	10 Gauss
Magnetic Field Range	6500 Gauss (Max)
Uniformity of magnetic field in sample area Detection	Better than 50mG
SN ratio in continuous wave mode	Better than 600:1
Absolute spin number sensitivity	$5 \times 10^9$ spins/(G√Hz)
Light Window	Support
Low Temperature Test	100-475 K or optional
Auto Tuning	Support
Scan Speed	10ms/P~5s/P
g-value Standard Sample	Internal
Quantitative EPR test Microwave	Internal standard sample Mn
Power Range	1 uW-100mW
Modulation Field Frequency	10 kHz / 100 kHz
Weight	50 kg
Size	530 mm*420 mm*354 mm

## Product Software: EPR-PRO

EPR-PRO is the operating software of EPR Spectrometer, which provides fast experimental operation procedures and scientific data analysis functions.



### Software Features

- 1- Modern design style, simple and elegant interface
- 2- Separate data analysis software for offline use
- 3- scientific
- 4- Automatic experiment report generation

### Product Affiliated



Liquid nitrogen variable temperature



Liquid nitrogen dewar



Liquid nitrogen dewar



Light system



4 mm outer diameter sample tube, flat cell



Automatic corner device

## About FANDA

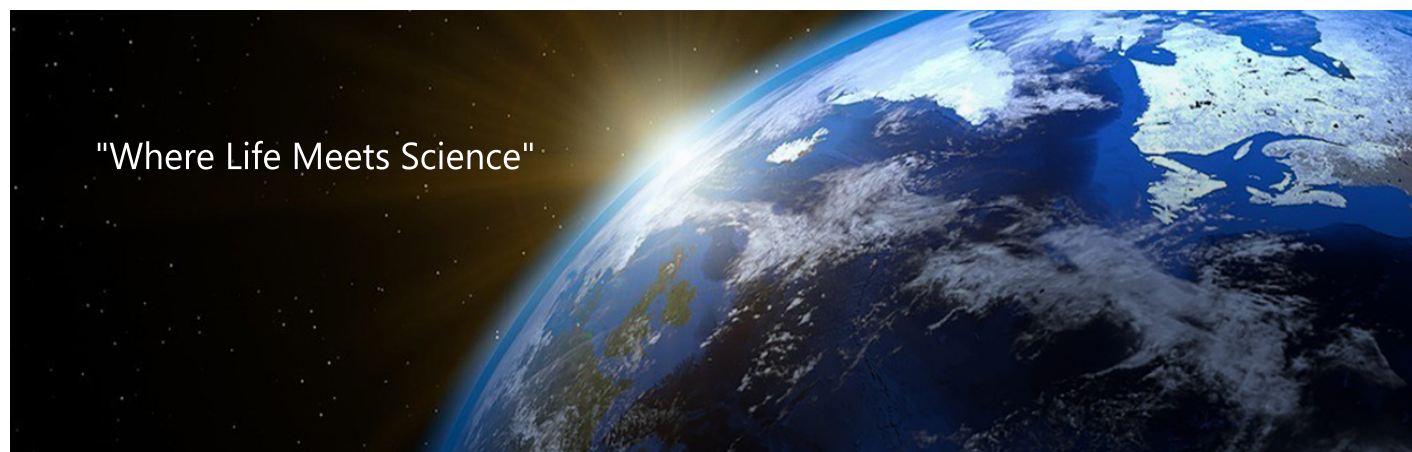
**Aria Fan Varzan** is a part of FANDA, which is an international group in the field of distributing applied science's high-tech products, we are focused on bringing useful technologies and sciences based on the vision of "making better life by applied science", this is our group's vision that we are committed to achieve this vision in our daily works.

**NanoScience:** introducing hybrid, microscopic, macroscopic and spectroscopic techniques to bring technologies and knowledge of using high tech analytical instrument and their cutting edge applications in the field of pure science research, Photovoltaic and solar cell, Petroleum, Environment, Pharmaceutical, food,.... By holding different professional academy to push these fields's knowledge one step forward to have better life by NanoScience (analytical instrument).

**BioScience:** making cell therapy easy and feasible field for researcher and help to develop clinical progress in this field in middle east by preparing necessary infrastructure about; knowledge, Facilities, materials and... by importing, training and manufacturing requirement, we hope our daily works ended to have many cell therapy clinics that can help people to have better life by BioScience (advanced medicine therapy) by 2021.

**NeuroScience:** introducing Hybrid science and innovations with bringing latest knowledge to make this science feasible and usable for scientist and specialist in this field and help people using new scientific methods for their old problems, we hope Neuroscience get well known field in this territory by our daily works and people feel it in their daily life by 2021.

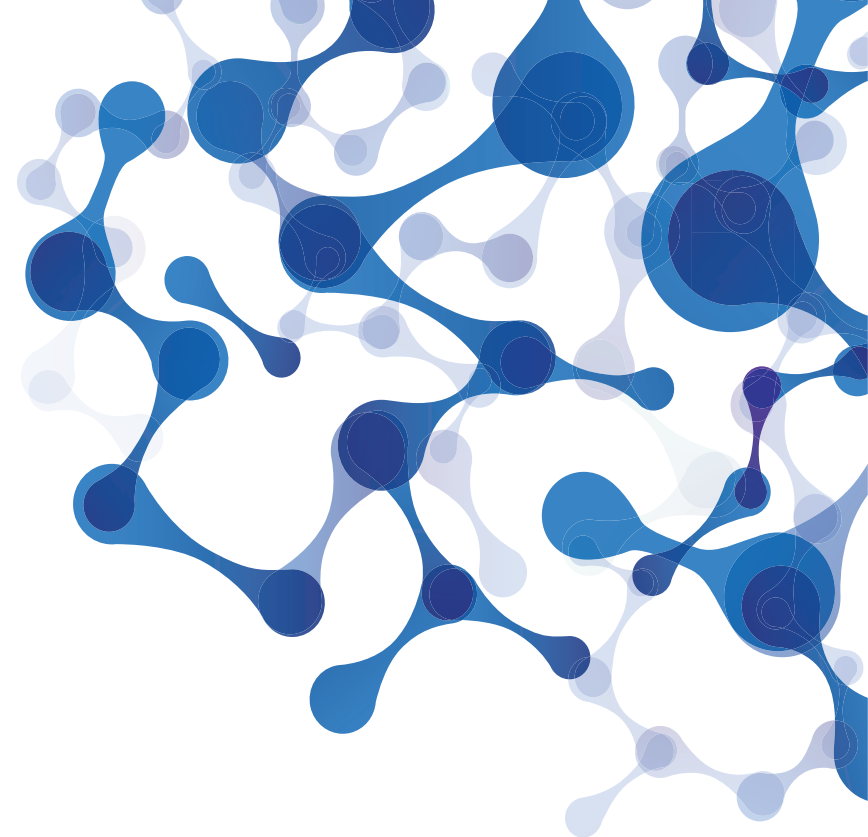
**PlasmaScience:** we have a team of motivated and talent scientists who are committed to find new solutions for daily problems of middle east people by magic of PlasmaScience, we have interesting solutions to make better life for middle east people by PlasmaScience. Aria Fan Varzan is a part of FANDA, which is an international group in the field of distributing applied science's high-tech products, we are focused on bringing useful technologies and sciences based on the vision of "making better life by applied science", this is our group's vision that we are committed to achieve this vision in our daily works.





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"Where Life Meets Science"



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AFV

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ARIA FAN VARZAN is a part of FANDA Group