BK Instruments Inc.

FEEL THE WORLD IN A QUANTUM WAY

CIQTEK

Electron Paramagnetic Resonance
Spectrometer

Electron Paramagnetic Resonance Spectrometer

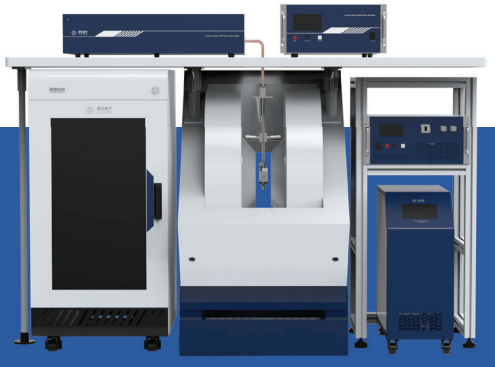
EPR100/EPR200-Plus/EPR200M

Product Introduction

Electron Paramagnetic Resonance (EPR) spectrometer is a method for studying the structure, dynamics, and spatial distribution of substances containing unpaired electrons. It can provide in-situ and non-destructive information such as electron spins, orbits and nuclei at the micro-scale.

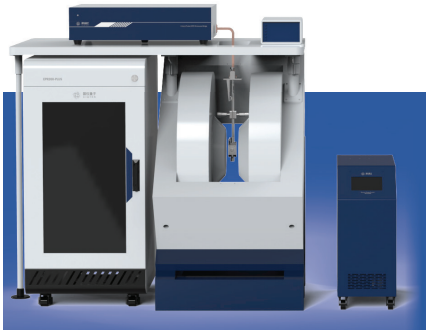
When a substance containing unpaired electrons is placed in a static magnetic field, if a certain frequency electromagnetic wave signal is applied to the sample, the emission or absorption of electron magnetic wave energy by the substance will be observed. By analyzing of change to the electromagnetic wave signal, the characteristics of the electron and its surrounding environment can be analyzed, so that the analysis of the material structure and other applications can be performed.

Substances containing unpaired electrons are widely distributed, such as isolated single atoms, conductors, magnetic molecules, transition metal ions, rare earth ions, ion clusters, doped materials, defective materials, biological free radicals, metal proteins, etc.; many substances do not contain unpaired electrons, but will generate unpaired electrons when excited by light. Therefore, electron paramagnetic resonance technology is widely used in physics, chemistry, biology, materials, industry and other fields.



X-Band Pulsed / Continuous Wave Electron Paramagnetic Resonance Spectrometer

EPR100



X-Band Continuous Wave Electron Paramagnetic Resonance Spectrometer

EPR200- Plus

X-Band Continuous Wave Desktop Electron Paramagnetic Resonance Spectrometer

EPR200M

Product Features

1. Comprehensive functions, suitable for general continuous wave and pulsed EPR measurement
2. Diverse sample environment to satisfy experimental needs such as light, low temperature, and goniometer
3. Magnetic field uniformity is better than 10 ppm, stability better than 10 mG/h
4. Time resolution of microwave pulse up to 50 ps, improving spectral resolution in pulse mode
5. High-performance solid-state power amplifier: 450 W output power
6. Unlimited number of pulses sequencer, suitable for dynamic multi-pulse decoupling technology
7. High-performance pulsed EPR probe with π / 2 pulses down to 8 ns
8. Support upgrading to high frequency EPR

EPR200-Plus/EPR200M	EPR100
1D Magnetic Field Scanning	Equipped with all CW Mode Functions of EPR200-Plus
2D Magnetic Field-Microwave Power Scanning	Echo / FID Measurement
2D Magnetic Field-Modulation Amplitude Sweep	Relaxation Time Measurement
2D Magnetic Field-Time Scanning	Sweep Echo Detection
	Electron-Electron Double Resonance Experiment
	Electron-Nuclear Double Resonance Experiment
Variable Temperature Experiment	
Light Experiment	

Product Specifications

Parameters	EPR200-Plus	EPR200M
Frequency Range	9.2 ~ 9.9 GHz	
CW Microwave Power	200 mW Max	1 μW ~ 100 mW
Absolute Spin Number Sensitivity	1×10^9 spins/(G$\sqrt{Hz}$)	5×10^9 spins/(G$\sqrt{Hz}$)
Modulation Field Amplitude	20 Gauss Max	10 Gauss Max
Maximum Magnetic Field	-0.1 ~ 1.5 T	-0.1 ~ 0.65 T
Variable Temperature System	3.8 K ~ 300 K or 100 K ~ 600 K or 300 K ~ 800 K	100 K ~ 600 K
Light System	Support	Support

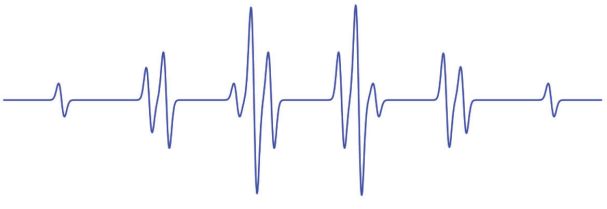
EPR100

Parameters	Values
Continuous Wave Function Parameters	Same with EPR200-Plus
Pulse Channel	Channel No.： 12
	Channel 1: 0 ° Phase pulse (+X)
	Channel 2: 90 ° Phase pulse (+Y)
	Channel 3: 180 ° Phase pulse (-X)
	Channel 4: 270 ° Phase pulse (-Y)
	Channel 5: Solid state power amplifier gate signal
	Channel 6: Receiver low-noise protection switch control signal
	Channel 7: ELDOR pulse
	Channel 8: ENDOR pulse
	Channel 9~12: For extension
Microwave Pulse Time Resolution	50 ps
Solid-state Power Amplifier Output Power	450 W Max
Microwave Pulse Phase Stability	Less than 3 ° in 1 ms
Maximum Microwave Pulse Length	3 ms
Minimum π / 2 Pulse Length	7.5 ns
Arbitrary Waveform Pulse Modulation	Sampling Rate 1.2 G SPS

Product Applications

Free Radical Research

Free radicals refer to atoms or groups with unpaired electrons formed by the homogeneous splitting of covalent bonds, when molecules of a compound under external conditions such as light and heat. Free radicals are very active and closely related to the aging of the human body and diseases. Electron paramagnetic resonance technology is currently the only method available for the direct detection of free radicals.

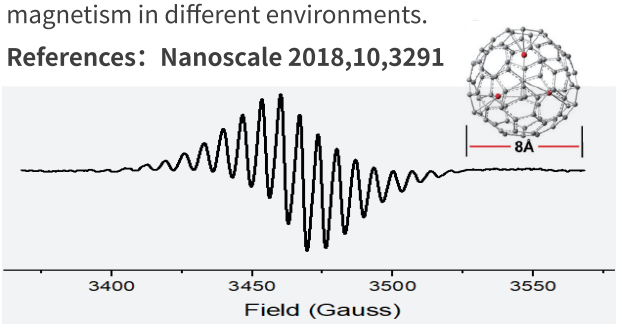


Ethyl radical spectrum

Material Science

Paramagnetic metal fullerene has important applications in magnetic resonance imaging, single molecule magnets, spin quantum information. As a new nano magnetic material,we can obtain electron spin distribution in the metal fullerene by electron paramagnetic resonance technology. It can figure out interaction between the metal spin and magnetic core, and detect the changes of the metal fullerene spins and magnetism in different environments.

References：Nanoscale 2018,10,3291

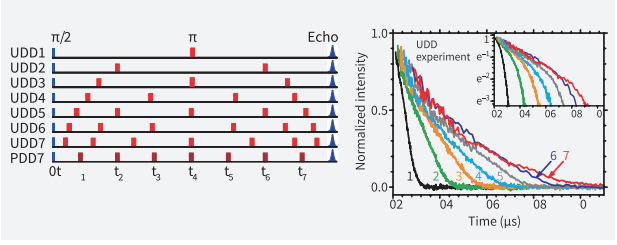


$Sc_3C_2@C_{80}$ molecular structure and its EPR spectrum

Quantum Computing

Electron spins in solid-state systems are one of the important carriers of qubits for quantum computing research. Pulsed paramagnetic resonance technology can realize the preparation, manipulation, and readout of the electronic spin quantum states, thereby performing quantum computing research on important issues. Scientists use optimal dynamic decoupling technology to increase the decoherence time of electron spins in solid-state systems. The decoherence time of malonate single crystals irradiated with gamma rays is increased from 0.04 us to 30 us. It shows the significance of the dynamical decoupling technique.

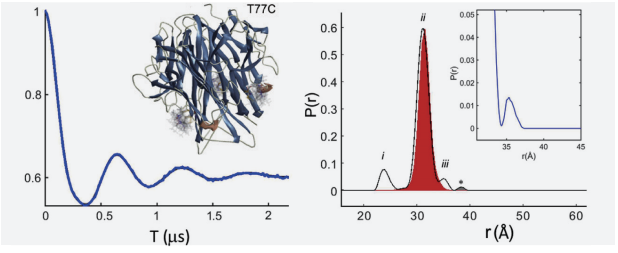
References：Nature 461, 1265- 1268 (29 October 2009)



Biological Structure Analysis

Double electron-electron resonance technology is one of the important tools for biological structure analysis. Biomolecules such as proteins and RNA can be labeled specifically by electronic spin labeling technology.The electron-electron interaction strength is measured by electron paramagnetic resonance technology. It can provide distance information between labeled sites to help the structural analysis of biomolecules. The technology can be used to measure distances between 1.7 and 8 nm with a non-destructive detection method.

Referance：Biophysical Journal 113, 371–380, July 25, 2017



Irradiated Monitoring Food

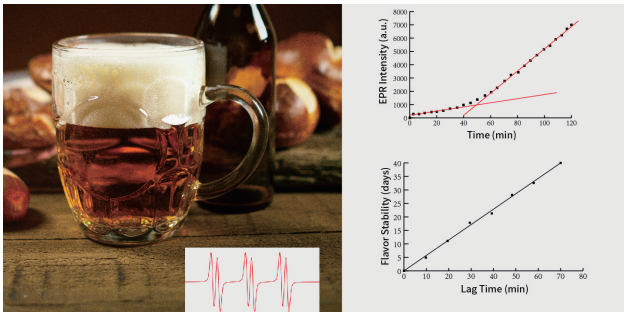
Food irradiation technology plays an irreplaceable role in ensuring food hygiene, safety, reducing pollution and chemical residues. Under the action of ionizing radiation in food, the covalent bonds of internal compounds are homogeneously split to generate a large number of free radicals. Electron paramagnetic resonance technology relies on the detection of long-lived free radicals generated by irradiation to identify irradiated foods, such as cellulose Irradiated food containing bone, bone and crystalline sugar.

Standard Name	Standard Number
Foodstuffs -Detection of irradiated foodstuff containing crystalline suger by ESR spectroscopy	BS EN 13708:2022
Foodstuff - Detection of irradiated foodstuff containing cellulose by ESR spectroscopy	EN 1787:2022
Foodstuffs - Detection of irradiated food containing bone - Method by ESR spectroscopy	SIST EN 1786:1998

Beer

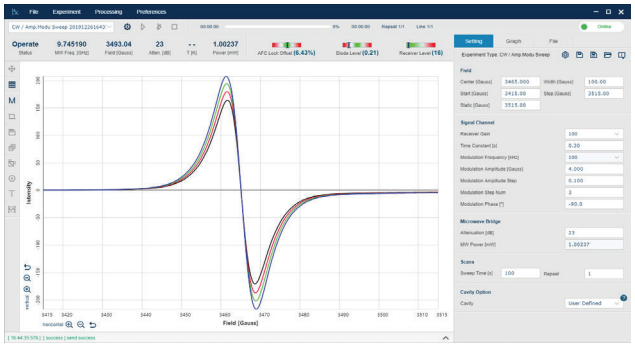
Free radicals are produced as part of the beer brewing process. These free radicals lead to deterioration of the product, reducing shelf life. The effect is accelerated by higher temperatures.

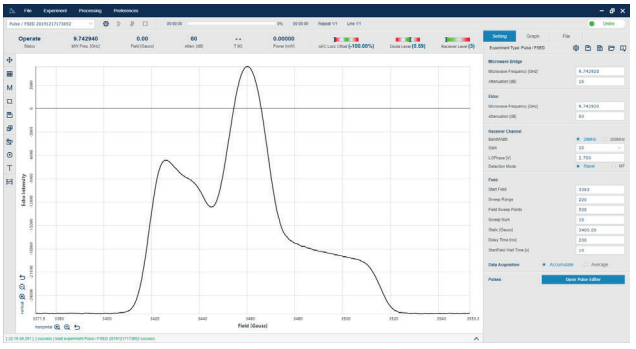
Electron paramagnetic resonance can be used to monitor changes in the free radical content of beer in the brewing process and to predict the end product.



Software & Affiliated

◆ Software : EPR-Pro





Software Features

01 Modern design style, simple and elegant interface

02 Scientific data analysis function

03 Compatible with continuous wave and pulsed modes

04 Automatic experiment report generation

05 Automatic parameter adjustment and optimization

06 Separate data analysis software for offline use

◆ Accessories

Variable temperature system

Dewar

Light system

Standard Sample

4 mm outer diameter sample tube, flat cell

Automated goniometer

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