EMXnano

The New Standard for Bench-Top EPR

Innovation with Integrity

EPR

The New Standard in Bench-Top EPR

Welcome to a new world of both research performance and ease of routine use in EPR. Giving you the power and flexibility you really need in an easy to use compact enclosure, the EMXnano brings affordable high-end EPR performance to labs for the first time, delivering a real choice of analysis options. Benefitting from decades of experience at the forefront of EPR innovation and leadership, the EMXnano exploits Bruker's newest technologies and key customer insight to deliver bench-top EPR at an unparalled price-to-performance ratio.

The EMXnano

Extending Bruker's renowned EMX spectrometer family to the bench-top class, the EMXnano is a completely new development featuring the latest digital and microwave technologies. Combined with a new generation of magnet system with field range from 0 to 6.5 kG and a highly efficient microwave resonator, this state-of-the-art bench-top instrument is superior in sensitivity and stability, making it ideal for a comprehensive range of analysis and teaching applications.

The new dedicated bench-top instrument requires minimal infrastructure with a low cost of ownership, making it suitable for a wide range of laboratory types.

Routine Ease of Use with Unmatched Performance

For the first time in this instrument category quantitative EPR is offered at your fingertip, thanks to a fully calibrated instrument and inclusion of the Bruker patented spin counting module.

Thanks to a varied and unmatched portfolio of EPR measurements and very well-defined workflows it offers broad access to EPR for non-experienced and experienced users alike.

Add to that Bruker's extensive worldwide Application Support and complete service network, and any customer can confidently add, or enhance, their lab with real world EPR:

- Integrated amplitude and g-factor reference
- Quantitative EPR by reference free spin counting
- Spectrum simulation and fitting
- Spin-trap library
- Remote system diagnostics

Bringing EPR To A Wider World

Chemistry

Reaction kinetics, free radical chemistry, catalysts, bioinorganic chemistry, molecular magnetism, redox chemistry

Biology

Membrane proteins, metallo-enzymes, IDPs, photosynthesis, RNA, DNA, spin labeling/trapping, nitric oxides, ROS & RNS

Material Science

Polymer degradation, paint properties, solar cells, fuel cells, impurities in optical glass, batteries

Physics

Defects in semi conductors, transition metals, quantum computing

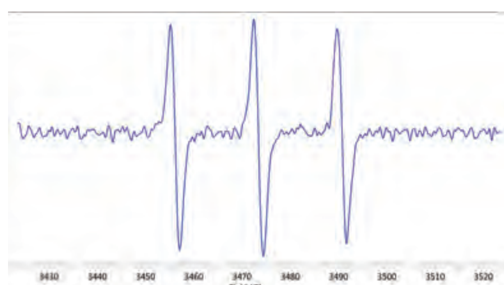
Industry

Free radicals in polymers and polymerization, food science and beverages, oxidative stability, antioxidant capacity, photo/oxidative degredation of APIs

Sensitivity and stability

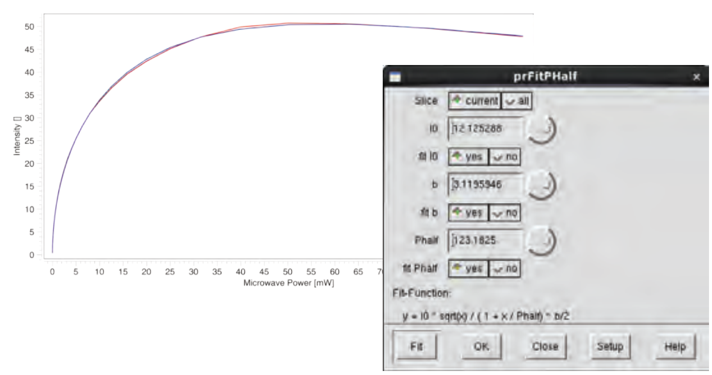
No matter what the focus of your application is, the critical requirements of an EPR spectrometer are the sensitivity and stability. The latest generation magnet and microwave technology delivers class leading performance, enabling the EMXnano to combine both ease of use with highest quality EPR data.

100 nM TEMPOL in water



Power saturation

Power saturation is a valuable tool in the analysis of relaxation properties of paramagnetic centers in various environments, e.g. oxygen accessibility of proteins. The EMXnano features a highly efficient resonator for fully automated 2D saturation measurement (magnetic field vs. power). The P1/2 analysis tool, which allows the numerical quantification of the saturation level at any spectrum position, completes the tool-box.

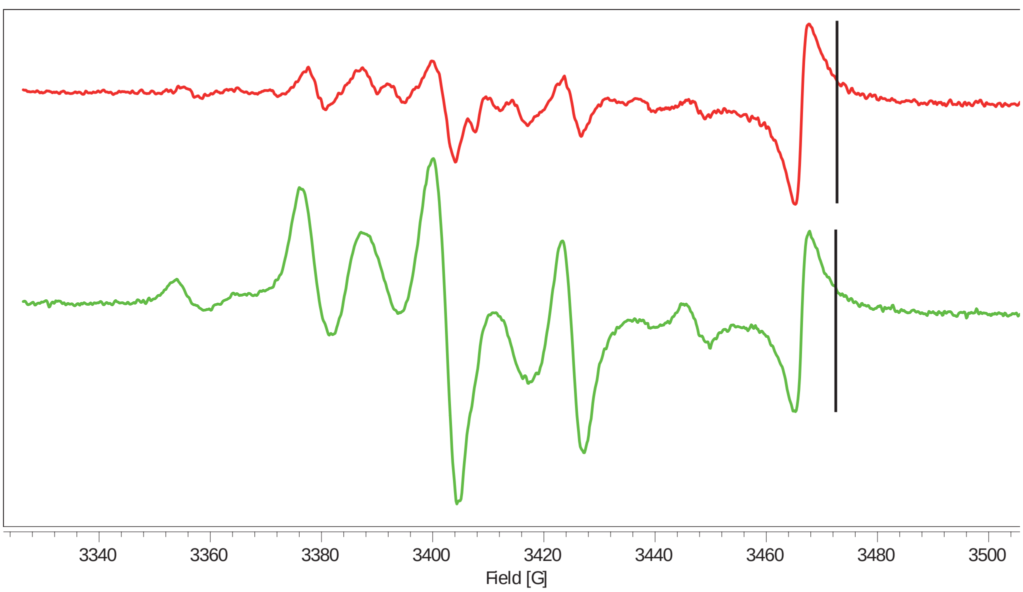


Integrated intensity/field reference

EPR is used not only for static investigations such as detection of the presence and structure of radicals in solids and liquids, but also for investigating dynamic processes such as radical formation and degradation, chemical reactions and light responses. EPR methods are ideal for dynamic measurements compared with other spectroscopic methods because an EPR spectrum can be measured while applying a temperature change, light irradiation, etc.

In polymers, radical reactions are involved in various processes such as polymerization, cross-linking and degradation. It is possible to investigate these phenomena by using EPR spectroscopy. These methods are used in both academic and industrial research for quality control and research.

The figure (below) shows the observed EPR spectra during UV irradiation for MMA with AIBN at 50 C. The top spectrum shows the spectrum after 4 min. and lower, after 8 min. of UV irradiation. Both spectra use the reference standard to quantify the intensity changes. Soon after UV irradiation, the EPR spectrum with 13 lines is observed but later, the line width broadens and finally the spectrum changes to a 9 line pattern (lower). This shows the evolution in time of the polymerization process.



Sample:

Initiator: AIBN(2,2'-Azobis(isobutyronitrile)
Cross-linking agent: DCP(dicumyl peroxide)
Monomer: MMA(Methyl-Methacrylate), styrene
Polymer: PE(polyethylene), PP(polypropylene), PS(polystyrene)
Hindered amine light stabilizer (HALS): TINUVIN® 123
Solvent: toluene

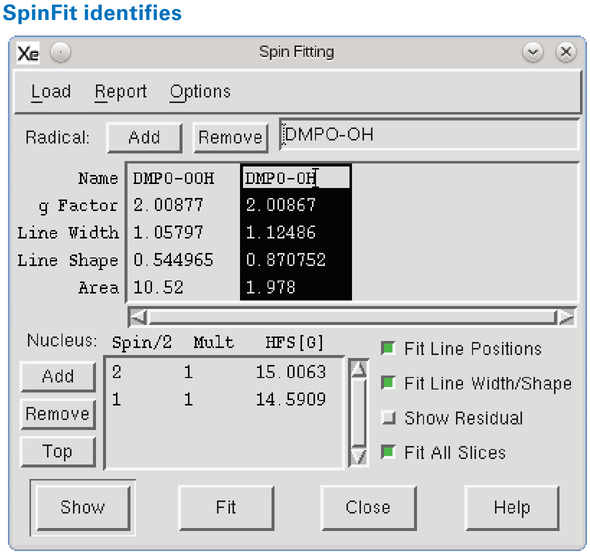
Quantitative spin trapping tools

EMXnano can be used effectively for mechanistic studies and kinetic analysis of mixtures of radicals (ROS and RNS) generated in enzyme reactions. Properly controlled spin trapping experiments can verify that the formation of radical adducts is due to free radical production in the reaction system being studied.

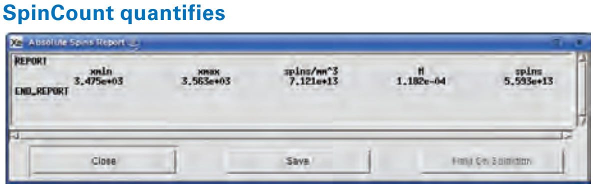
With the EMXnano even a non-experienced user can do successful spin trapping experiments. A full workflow for measuring, analyzing and quantifying spin trap experiments guides one through the entire procedure.

- Sample: Xanthine Oxidase/Xanthine
- 2D EPR spin trapping experiments using DMPO show the formation of the radical adducts
- Each EPR spectrum containing multiple species can be simulated by the SpinFit module to identify the radical adducts
- The SpinCount module is then used to quantify the radical adducts and determine their concentration

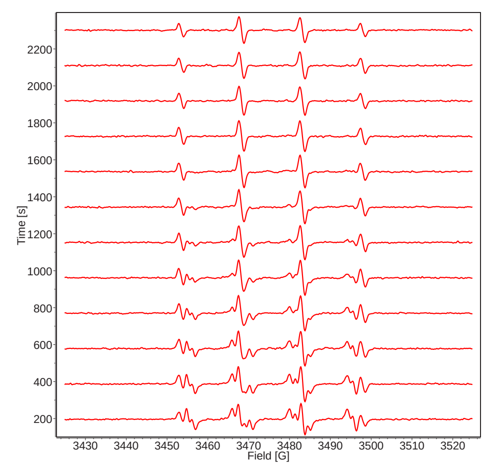
SpinFit identifies



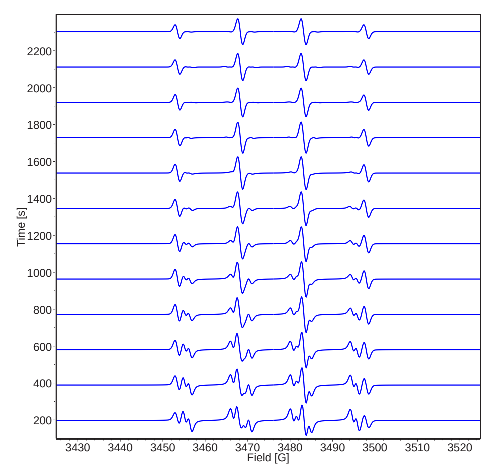
SpinCount quantifies

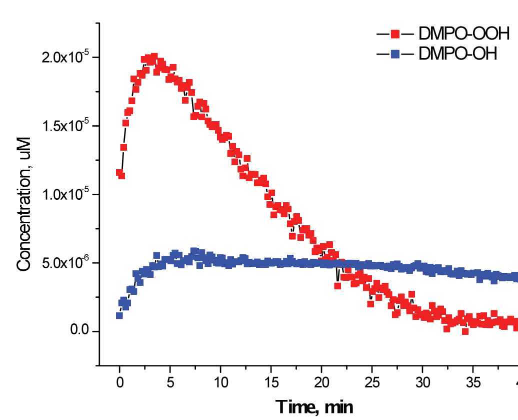


Experimental data



Simulation and fit

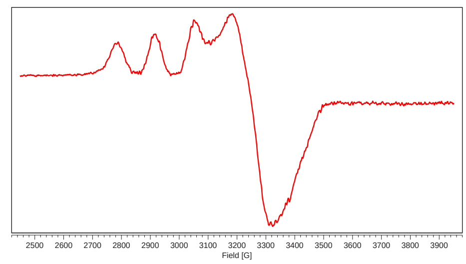




Temperature and light applications

Superoxide Dismutase (77 K with finger dewar)

Using the liquid nitrogen finger dewar is a helpful technique for examining the naturally occurring transition metal ions and radicals in metalloproteins, and learning about their function and environment. The EMXnano is capable of detecting metalloproteins such as Cu,Zn-superoxide dismutase (SOD1) using the finger dewar at 77 K. Figure at right shows: 50 µM SOD in 100 mM phosphate buffer (pH 7.4)

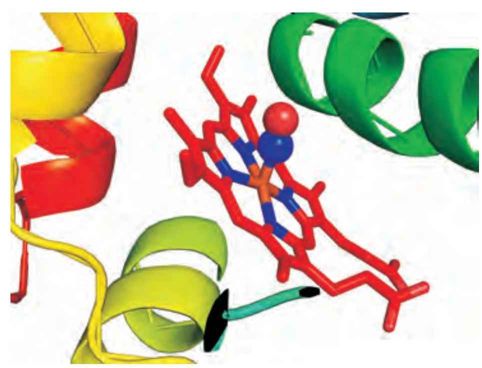


Nitric Oxide (NO) detection (100 K with VT unit)

Nitric Oxide (NO) is a highly reactive regulatory molecule which has many important physiological roles, such as a neurotransmitter in the central nervous system, a regulator of vasomotor tone in the cardiovascular system, and a cytotoxic mediator of the immune system. The oxidation of nitric oxide (NO) to nitrate by oxyhemoglobin (oxyHb) is a fundamental reaction in NO biology. This reaction is considered to be the major pathway for NO elimination from the human body.

EPR spectrum of NO-Hb complex using the variable temperature system at 100 K

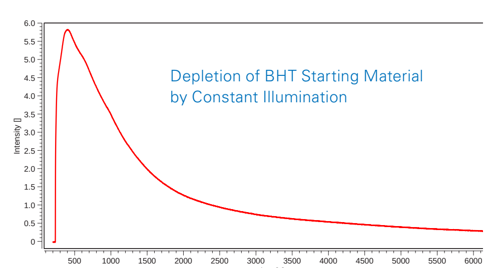
Crystal structure of NO-Hb (4G51)



BHT and vegetable oil (UV unit)

BHT (Butylated Hydroxy Toluene) is a common stabilizer and antioxidant used in many consumer goods. It readily forms phenoxy radicals upon exposure to light via first order kinetics. The radicals decay away quickly via dimerization to form diamagnetic products via higher order kinetics. The EMXnano enables you to collect EPR spectra at time intervals and then extract the kinetic profile.

- First BHT radicals are produced
- Then signal decays owing to depletion of BHT



Accessories

Liquid nitrogen finger dewar (77 K)

For particular applications, such as the detection of nitroxide (NO), the nitrogen finger dewar is the method of choice. The finger dewar minimizes sample preparation time and experimental set-up. The sample temperature is at 77 K.

Nitrogen variable temperature unit (100–425 K)

The Digital Temperature Control System makes use of liquid or gaseous nitrogen as coolant. The accessible temperature range is 100 K to 425 K. With the dewar insert holder, the dewar is mounted to the cavity. The sample is inserted into the quartz dewar. Sample exchange at any temperature is a standard feature of this system.

UV irradiation unit

The UV Irradiation System provides the possibility for in-situ irradiation of the sample of interest in the microwave cavity. The main aim is to produce paramagnetic compounds via continuous light irradiation. The EMXnano UV system features a light pipe to sample cavity interface that assures high light transmission efficiency and compliance with international safety standards.

Flat cell for aqueous solution

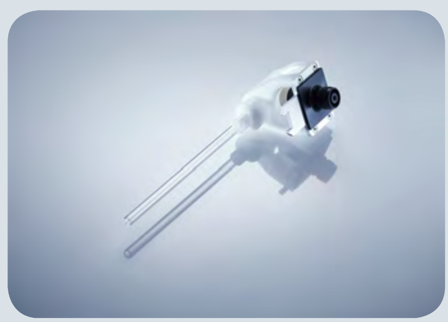
Flat cells are used for liquids with dielectric loss to increase sample volume for optimum sensitivity. A dedicated holder assures quick and reproducible sample exchange.

Flow through cell

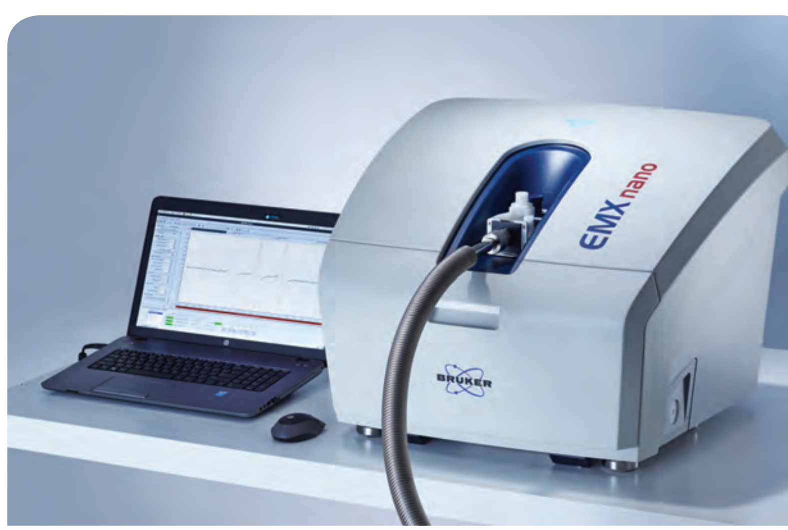
The flow through cell is designed for lossy and non-lossy samples and can be used with an autosampler.

Sample tubes and holders

Flatcell



VT dewar



EMXnano Key specifications	
Operating frequency	X-Band
Microwave power	100 mW
Concentration sensitivity	50 pM
Field sweep range	7000 G
Field homogeneity	50 mG over sample volume
Field stability	10 mG/h
Sweep resolution (field and time)	250.000 points
Reference standard	Integrated and motorized
SpinCount	Concentration determination
SpinFit	Spectrum simulation and fitting

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