ESR measurement condition ** Magnetic field sweep width **

Product used：Electron Spin Resonance (ESR)

■ Optimization of ESR measurement condition

In order to measure ESR under optimal conditions, it is important to consider the following items. For more detailed information about (1) - (3) , please refer to the application notes ((1) : ER220001、ER220005、(2) : ER220003、(3) : ER220004).

(1) Microwave power
(2) Magnetic modulation width
(3) Sweep time and Time constant
(4) Magnetic field sweep width

■ Line width and range of ESR signal in various samples

The sample condition can affect the line shape of ESR signal. Generally, the line width of the ESR signal for solid samples is wider than that for solution samples. Table 1 shows various samples and their respective ranges of ESR signals. Radicals in solution exhibit fast molecular motion, causing their anisotropy to average out to produce a symmetrical and sharp ESR signal. Organic free radicals in solution exhibit a narrow line width ranging from 5 μT to 50 μT. Typically, organic radicals in solid have a line width of 0.1 mT or more. In solid samples of polycrystalline, asymmetric signals due to anisotropy appear because ESR signals of radicals with various orientations overlap with respect to the magnetic field. The molecular motion of radicals in highly viscous solutions is suppressed, leading to an ESR signal line shape that falls intermediate between that of a solution and a solid.

Table 1. Comparison of ESR signals ranges in various samples.
(①、②：Solution、③～⑥：Solid(powder)、⑦：Gas)

Number	Sample	ESR signal area (mT)	Application note
①	Perylene	4	ER220004E
②	TEMPOL	5	ER220001E
③	Carbon	3	ER220005E
④	Ultramarine	25	ER200002E
⑤	Copper sulfate	100	ER220001E
⑥	Chromium oxide (III)	600	ER200003E
⑦	Oxygen	> 1000	ER230006E

■ Setting magnetic field sweep width

The value of the magnetic field at which the ESR signal is observed is determined by the resonance condition expression: $h\nu = g\mu_B H$. The magnetic field sweep widths for various samples are provided below. If the magnetic field sweep width becomes too wide for the observed signal, it can lead to a deterioration in the signal response.

○ Sample of organic radicals (N、O、Si etc.)
335 / 325 ± 10 mT (Resonance frequency：around 9.4 / 9.1 GHz)

○ Sample of metal complex
300 ± 250 mT

ν : Resonance frequency、H : Resonance magnetic field、h : Plank constant、μ_B : Bohr magneton、g : g -factor

* Please also note that when using attachments such as a variable temperature controller, the resonance frequency and the resonance magnetic field will change.

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