



## Measurement of Surface Area, Particle Sizes and Concentrations in Dispersions

### GENERAL NOTES

Capacitors, resistors, semiconductors, inks and dyes as well as pills, cosmetics, environmental adsorbents and many other things in industry and in daily life represent heterogeneous colloidal substances. To characterize them there are several very important values like Surface Area, Particles Dimensions, Colloid Concentration (solid particles mass or volume fraction in liquid solution). Surely there exists a number of classical methods to measure these values like light scattering, diffraction, electron microscopy, viscosimetry, centrifuging etc. Time Domain NMR (TD-NMR) is one of the most promising approach of all existing ones that is extremely cost effective, easy and accurate.

### BASICS OF THE METHOD AND MEASUREMENT

The spin-spin relaxation rate  $R_2$  is the reciprocal of relaxation time  $T_2$ . If particles are homogeneously dispersed in a liquid than the molecules of solvent interfacing to particles surface possess much less mobility (showing higher value of  $R_2$ ) than in a bulk volume.

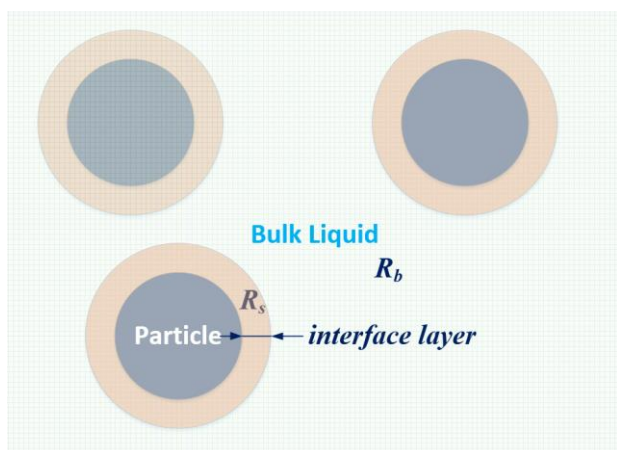


Fig. 1. Schematics of particles in a solvent

Denoting spin-spin relaxation rates as  $R_s$  (surface interacting molecules),  $R_b$  (bulk solvent) and  $v$  as relative volume of *interface layers* within a sample, we can write the weighted sum for measured relaxation rate  $R_m$ :

$$R_m \approx v \cdot R_s + (1-v)R_b$$

$v$  is proportional to overall surface of particles and their concentration  $n$  while  $R_s$  characterizes the nature of particle-solvent physical interaction.

Increasing the amount of dispersed particles one can get the *Relaxivity* value (slope of line on Fig. 2.) that is *proportional to surface area* of particles and that is used in Spin Track application “Particles and Dispersions”.

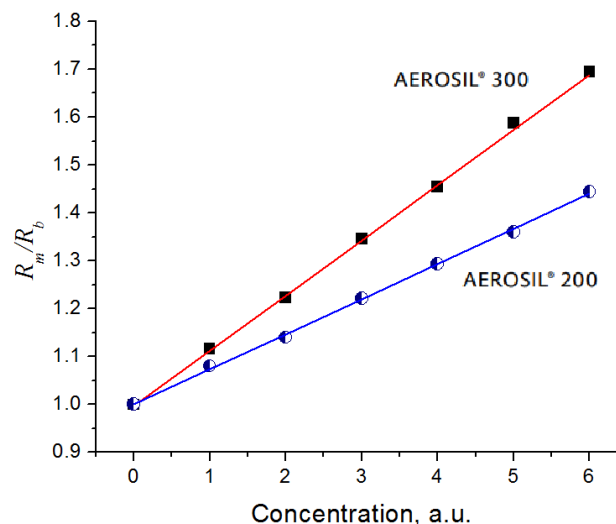


Fig. 2. Dependence of Relaxation rate for Silica powders with different Surface Area on concentration

So, for measuring **surface area**, **concentration** or mean **particles size** a user just needs to select what parameter to estimate and insert a sample into the magnet of Spin Track. All measurements, calculations and reports will be done automatically or according to the measurement script loaded into **Relax8** software.

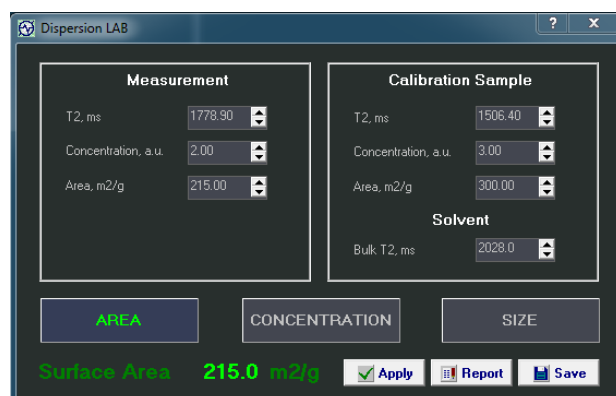


Fig. 3. Simple user interface of the “Particles and Dispersions” application

For **calibration** of the instrument it is necessary to have just one sample (of the same nature) with known surface area and concentration. Calibration data are stored in the application file and can be retrieved at any moment.



**Samples preparation** concludes in placing known amount of particles or particles suspension into a test tube with similar volume of bulk solvent as for the calibration sample. Units of concentration can be ever, e.g. g/l, g/g, g/test-tube volume etc.

For exceptional precision of results, we suggest to condition samples for a few minutes before measurement, that normally takes not more than 10 seconds.

## INSTRUMENTATION



Fig. 4. NMR analyzer **Spin Track**

NMR analyzer **Spin Track** (Fig. 2) from Resonance Systems is perfect and affordable instrument for accurate investigation of colloidal systems. High signal-to-noise ratio, very homogeneous magnetic field, extremely perfect timing and strong power of NMR pulses allow precise measurement of CPMG sequence with just one scan.

The recommended **Particles and Dispersions Analyzer** consists of:

- Spin Track NMR Analyzer with thermally stabilized magnet system;
- PC with pre-installed Microsoft OS © Windows 7, 8 or 10\* and Relax 8 software;
- Thermostat "ST-80" (Optional);
- Precision Balance (for preparation of suspensions)
- Test tubes with outer diameter 5, 10 or 18 mm\*\*;
- Plastic caps for test tubes;
- Installation Manual;
- Method Sheet;
- Autosampler (optionally).

\* Determined by the PC manufacturer

\*\* Depends on configuration of magnet

## CONTACTS

Please refer to additional information on the website of Resonance Systems

[www.nmr-design.com](http://www.nmr-design.com)

### German Headquarter

Seestrasse 28, D-73230, Kirchheim/Teck,  
Resonance Systems GmbH  
Fon: +49 (0) 7021-9822668  
Fax: +49 (0) 7021-9822667  
Mobil: +49 (0) 172-4374693  
E-mail: [info@nmr-design.com](mailto:info@nmr-design.com)

### Czech Headquarter

Veleslavinska 39/48, Praha 6, 16200, Prague, Czech Republic, Resonance Systems s.r.o.  
Tel.: +420 777 223 119  
E-mail: [info@nmr-design.com](mailto:info@nmr-design.com)

### Russian Headquarter

424000, Russian Federation, Mari El Republic, Yoshkar-Ola, Volga State University of Technology, Lenin sq., 3, Physics department, Resonance Systems.  
Phones: +7 8362 532799, +7 8362 436020  
E-mail: [info@nmr-design.com](mailto:info@nmr-design.com)