Time-Domain benchtop and mobile NMR for liquid & solid material science, pore-size measurement and process monitoring

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Abstract:

We discuss Time-Domain NMR, as a method of measuring the physical properties of liquid and solid materials. Time-Domain NMR also is a good technique for measuring pore-size distributions from the nano-meter to microns.

Time-Domain NMR is excellent for quantified monitoring of physical change, particularly as a function of some changing parameter such as time or sample temperature. Thus it is a superb tool for process control on both liquids and solids.

NMR time-domain relaxation is most useful for quantitative material science measurements of both the mass and what is described in various fields as the mobility / dynamics / stiffness / viscosity / rigidity of the sample, particularly of solid hydrocarbons, rubbers and other polymers. These properties may be measured both in the bulk and in nano-meter and upward sized pores.

There are various methods for studying porous materials by time-domain NMR;

NMR is an excellent method for studying pore structure, as it can 'see inside' the pores :

NMR Diffusion and Percolation

NMR Relaxometry

NMR Cryoporometry (NMRC)

Lab-Tools Ltd. have now extended NMRC for measuring distributions of pore sizes, to cover measurements over 3 orders of magnitude in pore dimensions. Examples will be given of some of the measurements that have been performed.

As part of the evolution of NMRC, Lab-Tools have developed a highly compact precision NMR time-domain relaxation spectrometer. The R.F. is processed digitally, on a Field Programmable Gate array (FPGA) module, which gives it long- term stability necessary for process control, There is an associated Peltier thermo-electrically cooled variable temperature probe, which together make a high-performance NMR Cryoporometry instrument.

A range of international companies, universities and research institutes are now using NMRC as part of their arsenal of research tools to study their samples.