Development of a high-frequency rapid scan electron spin resonance spectrometer

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We report on the recent development of a high-frequency rapid scan electron spin resonance (FRASCAN) spectrometer at the Brno University of Technology. The basic principle of frequency rapid scan will be explained and compared to conventional methods. The FRASCAN operates in induction mode using quasi-optics with a superheterodyne detection scheme. Fast frequency sweeps of the order of 1000 THz/s allow to access spin relaxation of the order of 1 ns [1,2], in a frequency range of 80 GHz to 1100 GHz [3], at temperatures from 1.8 K to 300 K, and at magnetic fields up to 16 T. We developed several sample holders for performing measurements on liquids, oriented single crystals, and air-sensitive samples, including the possibility of photo-excitation [3]. In addition, we developed a carousel sample holder for pressed powders that accommodates up to 6 samples, avoiding the time-consuming event of loading the probe into the cryostat and cooling down process. The carousel holder can be used for quantitative ESR. The FRASCAN is controlled by a home-written software in LabView, allowing to run experiments in an automatic mode controlled by scripts. Frequency rapid scan experiments on an oriented single crystal of LiPc will be presented along with simulation for calculation of the relaxation times. Furthermore, additional capabilities of FRASCAN are demonstrated using frequency-detected magnetic resonance spectra as a function of the orientation for a single-crystal of copper acetate and frequency-field ESR maps for Mn_{12} and TEMPO.

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