PULSED ELECTRON PARAMAGNETIC RESONANCE SPECTROMETER OPERATING AT 110-336 GHz

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Introduction

We have upgraded our multi-high-frequency continuous-wave electron paramagnetic resonance (EPR) spectrometer[1] to run in pulsed mode also. This is the highest frequency and highest field pulsed EPR spectrometer currently operating in the world. We present multi-frequency measurements with two different samples.

Experimental

We built a Fabry-Perot resonator that can be tuned while it is in the cryostat. The solid-state microwave source was purchased from Virginia Diodes Inc. and consists of a 13 GHz synthesizer with multipliers, to which we added a switch. This provides around 3 mW (30 mW, 100 mW) at 334 GHz (221 GHz, 112 GHz); the $\pi/2$-pulse always lasts less than 750 ns.

Two organic radicals were prepared in polystyrene films at a concentration of 0.1% by mass. These were α, γ-bisdiphenylene-β-phenyl allyl (BDPA) and TEMPOL ($C_9H_{18}NO_2$).

Results and Discussion

Figure 1 shows that the T_2 relaxation time of BDPA increases as the magnetic field is increased and as the temperature is lowered. We conclude that this is due to the higher polarization of neighboring spins reducing the opportunities for 'flip-flop relaxation' in which two electron spins flip in opposite directions simultaneously.

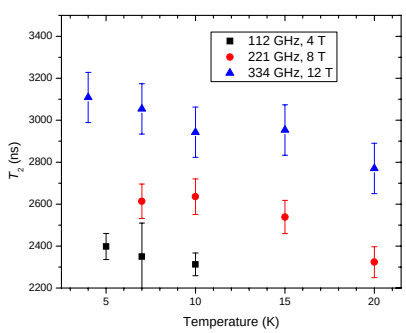

Figure 1. T_2 relaxation times of BDPA.

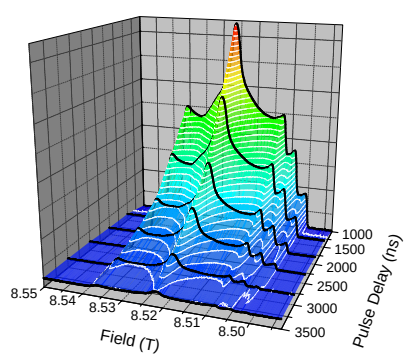

Figure 2. 2D echo-detected field-sweep of TEMPOL at 15K, 239.04 GHz

Conclusions

We have demonstrated a pulsed EPR spectrometer operating between 110 and 334 GHz. The high electronic polarization achieved in this spectrometer will be useful in experiments such as dynamic nuclear polarization [2] and quantum information processing. Also, the high field makes it possible to study the electron-nuclear double resonance of low γ nuclei.

Acknowledgements

This research was supported by an IHRP grant from the NHMFL.

References

[1] J. van Tol *et al.*, Rev. Sci. Inst. **76**, 074101 (2005).
[2] G. W. Morley *et al.*, http://arxiv.org/abs/quant-ph/0611276