**High Frequency Pulsed EPR Study of Yb(trensal)**

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**Introduction**

Electron spins have attracted growing interest for use as the basis for quantum information processing. Among the proposed spin qubits, lanthanide molecular magnets have shown great promise due to their scalability and large magnetic anisotropy. However, only a few EPR studies have focused on the quantum coherence properties of 4*f* metal complexes at high fields and frequencies. We have previously studied the quantum coherence properties of Yb(trensal) (**1**), where H3trensal = 2,2’,2”-tris(salicylideneimino)trimethylamine by X-band (9.7 GHz) pulsed EPR and demonstrated that **1** doped in Lu(trensal) is a promising candidate for the realization of a 4f qubit [1,2]. Here, we have studied the temperature and field dependence of the spin lattice relaxation time (T1) and phase coherence time (Tm) of **1** at high frequencies.



**Fig.1** Field swept ESE spectra of a single crystal of **1** with ~1% Yb(III) concentration, collected at 120 GHz and 1.6 K (black trace). The blue squares show Tm values for three resonances. The standard error in Tm lies within the data points.

**Experimental**

High frequency pulsed EPR measurements were carried out on a single crystal of **1** at about 1% Yb(III) concentration using the Heterodyne Quasi-Optical EPR spectrometer at the MagLab. Using one-axis rotation, the crystal’s easy-axis is first aligned with the external magnetic field using continuous-wave EPR at frequencies of 120 and 240 GHz, at 5.5 K. Field-swept electron spin echo (ESE) detected spectra and electron spin echo decay curves were then collected at a temperature of 1.6 K for the external magnetic field parallel to the easy-axis of the molecule (**Fig.1**).

**Results and Discussion**

Naturally occurring Ytterbium (with *J*= 7/2) is composed of 7 stable isotopes, of which 171Yb (14%) and 173Yb (16%) possess nuclear spins of *I* = 1/2 and 5/2, respectively. The remaining isotopes do not bear a nuclear spin. The three prominent resonances in the Field-swept ESE spectrum of **Fig.1** correspond to the electronic transitions with *mI*= 0 (center resonance) and *mI*= ±1/2 (side resonances). The coherence times for each transition were derived using an exponential fit to the ESE decay curves. These measurements resulted in Tm values on the order of 0.5 μs. However, the resolution of the experimental data was not satisfactory which was probably due to a cracking of the crystal during the cool-down, resulting in line broadening.

**Conclusions**

Coherence times of up to 0.5 μs were obtained at 120 and 240 GHz, at 1.6 K, for **1** with 1% concentration of Yb(III). We hope to investigate the temperature and field-dependence of the Tm values in more detail in future on a new batch of single crystals of improved quality.

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**References**

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