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Understanding electron and nuclear spin dynamics in Cr^{5+} doped K_3NbO_8[1]

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Chromium(V) doped in the diamagnetic host potassium niobate, a simple spin $S = 1/2$, $I = 0$ system, has been proposed as an alternative standard for field calibration and g-standard for high-field EPR [1]. This system constitutes a dilute two-level model relevant for use as a electron spin qubit [2] and as such coherent electron spin manipulation at X-band (~9.5 GHz) was observed over a wide range temperature. Rabi oscillations are observed for the first time in a spin system based on transition metal oxides up to room temperature. At 4 K, a Rabi frequency Ω_R of 20 MHz together with the phase coherence relaxation (spin-spin relaxation) time, T_2 of ~ 10 μs results in the single qubit figure of merit Q_M ($=\Omega_R T_2/\pi$) as about 500, showing that a diluted ensemble of Cr(V)(S = 1/2) doped K_3NbO_8 is a potential candidate for solid-state quantum information processing. Also, the field and temperature dependence of the T_1 (spin-lattice relaxation) and T_2 times was investigated [3] for a further understanding of the relaxation mechanisms governing the phase decoherence in this system. These studies show that the coupling of the electron spin with the neighboring ^{39}K nuclei ($I = 3/2$) is one of the prominent T_2 mechanisms. The hyperfine and quadrupole interactions with ^{39}K nuclei was resolved by using the high-frequency (240 GHz) pulsed electron nuclear double resonance (ENDOR).

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[3]. S. Nellutla, G. W. Morley, M. Pati, N. S. Dalal and J. van Tol, *Phys. Rev. B.* **78**, 054426 (2008).

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