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Optimizing Frequency-Modulated CW EDMR in silicon LIHUANG ZHU, KIPP VAN SCHOOTEN, CHANDRASEKHAR RAMANATHAN, Dartmouth College — Electrically detected magnetic resonance (EDMR) is a powerful method of probing dopant and defect spin states in semiconductor devices. Moreover, at the single dopant level, these spin states are heavily investigated as potential qubit systems, though facile electronic access to single dopants is exceedingly difficult. We therefore characterize detection sensitivities of frequency-modulated CW-EDMR of phosphorus donors in silicon Si:P using a home-built 2.5 GHz system (~80 mT) at 5 K. An arbitrary waveform generator controls the frequency modulation, allowing us to optimize the signal to noise ratio (SNR) of both the dangling bond and phosphorus donor signals against multiple experimental parameters, such as modulation amplitude and modulation frequency. The optimal range of frequency modulation parameters is constrained by the relaxation time of the phosphorous electron at 5 K, resulting in the same sensitivity limit as field modulated CW-EDMR, but offers some technical advantages; e.g. reducing the relative contribution of magnetic field induced currents and eliminating the need for field modulation coils. We further characterize the EDMR SNR in Si:P as a function of optical excitation energy by using a narrow line laser, tunable across donor exciton and band gap states.

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