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Microwave frequency modulation for improving polarization transfer in DNP experiments[1] M. GUY, C. RAMANATHAN, Department of Physics and Astronomy, Dartmouth College, Hanover, NH — Dynamic nuclear polarization (DNP) is a driven process that transfers the inherently high electron polarization to surrounding nuclear spins via microwave irradiation at or near the electron Larmor frequency. In a typical DNP experiment, the amplitude and frequency of the applied microwaves are constant; however, by adding time dependence in the form of frequency modulation, polarization transfer between the electron and nuclear spins occurs more efficiently. In particular, triangular and sinusoidal frequency modulation of the applied microwaves during a DNP experiment enhances the final nuclear polarization by as much as a factor 3 over monochromatic irradiation. These modulation schemes increase the electron excitation bandwidth, thereby increasing the number of electrons active in the polarization transfer process and improving overall efficiency. In the present study, we compare the nuclear spin polarization after DNP experiments with (1) no modulation of the applied microwaves, (2) triangular and sinusoidal modulation, and (3) modulation schemes derived from the sample's ESR spectrum. We characterize the polarization as a function of the modulation amplitude and frequency for triangular and sinusoidal modulation and compare the optimal results with our ESR-adapted modulation scheme. We show that by using a modulation scheme tailored to the electronic environment of the sample, polarization transfer is improved.

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