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Abstract:Dynamic nuclear polarization (DNP) increases the sensitivity of nuclear magnetic resonance (NMR) spectroscopy by using high frequency microwaves to transfer the polarization of the electrons to the nuclear spins. The enhancement in NMR sensitivity can amount to a factor of well above 100, enabling faster data acquisition and greatly improved NMR measurements. With the increasing magnetic fields (up to 23 T) used in NMR research, the required frequency for DNP falls into the THz band (140- 600 GHz ). Gyrotrons have been developed to meet the demanding specifications for DNP NMR, including power levels of tens of watts; frequency stability of a few megahertz; and power stability of 1% over runs that last for several days to weeks. Continuous gyrotron frequency tuning of over 1 GHz has also been demonstrated. The complete DNP NMR system must include a low loss transmission line; an optimized antenna; and a holder for efficient coupling of the THz radiation to the sample. This paper describes the DNP NMR process and illustrates the THz systems needed for this demanding spectroscopic application. THz DNP NMR is a rapidly developing, exciting area of THz science and technology.
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