Para-Hydrogen Induced Polarization at Time Domain NMR Spectrometer

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Nuclear Magnetic Resonance (NMR) is a widely used spectroscopic method in a broad range of disciplines. Unfortunately NMR suffers from a low intrinsic sensitivity. The low sensitivity of NMR can be successfully improved by application of hyperpolarization technique called Para-Hydrogen Induced Polarization (PHIP) which was discovered in 1986 [1-3]. Till now, a substantial progress in the methodology of PHIP has been made. In particular the PHIP technique has been found to be a very useful tool in organic synthesis [4] and Magnetic Resonance Imaging (MRI) [5]. Here we present further aspects concerned with potential applications of PHIP [6]. For a series of Phenylpropionic Acid Esters we demonstrate PHIP at low resolution and low cost bench-top time domain (TD) NMR spectrometer. For the purpose of these TD-NMR PHIP experiments we employ the 45°-\textit{evolution time}-t-180°-\textit{evolution time}-t-\textit{acquisition} pulse sequence (\textit{t} is given by 1/4\textit{J}, \textit{J} is the spin-spin coupling constant between two vinyl protons stemming from para-hydrogen). Further, for both variant of TD-NMR PHIP i.e. TD-ALTADENA and TD-PASADENA, enhancement factors are discussed. Moreover, solid-state NMR calculations were presented which demonstrate that the solid echo (90\textdegree\textit{y}-\textit{t}-90\textdegree\textit{x}-\textit{t}) version of the TD-ALTADENA experiment is able to convert up to 10% of the PHIP signal into visible magnetization. Eventually, the low resolution TD-NMR PHIP technique is capable for commercial applications in many industry branches, where until now the spreading of this method has been hampered for technical and economical reasons.

References