

HYP18 HYPERPOLARIZED MAGNETIC RESONANCE

2-5 September 2018
Grand Harbour Hotel
Southampton, UK
hyp18.com

CONFERENCE
PROGRAM
AND ABSTRACTS

BOOSTING ^{129}Xe DNP EFFICIENCY USING ULTRASONIC SAMPLE MIXING AND MICROWAVE FREQUENCY MODULATION

C. Zanella^a, A. Capozzi^b, T.P. Lê^{a,c}, R. Gruetter^a and J-N. Hyacinthe^{c,d}

^a EPFL, LIFMET, Lausanne, Switzerland .

^b DTU, Hypermag, Electrical Engineering, Denmark .

^c School of Health Sciences - Geneva, HES-SO, Switzerland

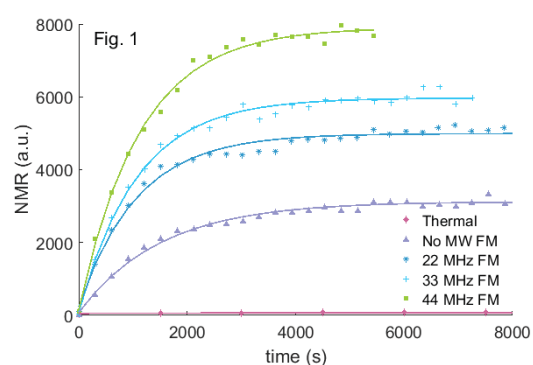
^d Image Guided Intervention Laboratory, UNIGE, Geneva, Switzerland

E-mail: c.zanella@epfl.ch

The unique properties of Hyperpolarized (HP) ^{129}Xe provide a highly sensitive tool for probing the local environment. HP ^{129}Xe has been extensively used to study materials or for biomedical MRI including functional imaging of the human lung or brain [1][2]. Alternatively to the well-established hyperpolarization method Spin Exchange Optical Pumping (SEOP), sublimation-DNP offers the advantage of employing non-dedicated hardware and perspectives of potentially higher throughput [3,4]. Nevertheless, the challenges of homogeneously embedding solid ^{129}Xe into a radical-doped glassing matrix [5] and the consequently lower nuclear polarization levels achieved prevented sublimation-DNP from spreading across the hyperpolarization community. In the present work we propose an improved sample preparation and the use of microwave modulation to enhance DNP performances in a system characterized by poor electron spin spectral diffusion [6].

Sample homogeneity was improved by using ultra-sonication instead of magnetic stirring. All measurements were performed at 5 T and 1.5 K on a sample containing 5M Xe dissolved in 50 mM TEMPO-doped isobutanol. The microwave irradiation frequency was set to 139.9 GHz, which corresponds to the maximum positive DNP enhancement.

Modulating the output frequency of the microwave source (ELVA-1 VCOM-06/140/1/50-DD) by means of a sinusoidal function showed a strong dependence of the DNP performances on the sinusoid's amplitude (see Fig. 1, modulation frequency fixed at 10 kHz). In optimal conditions (44 MHz modulation amplitude) the enhancement was improved by a factor 2.5. Furthermore, the build-up time was reduced by 25% independent of the modulation amplitude. Moreover, the new sample preparation procedure employing ultrasonic waves guaranteed more reproducible results and further increased the polarization levels achieved.



- [1] K. Bartik, P. Choquet, A. Constantinesco et al., *Actualite Chimique*, 16-34 (2005).
- [2] M.R. Rao, N.J. Stewart, P.D. Griffiths, G. Norquay et al., *Radiology*, 286(2) (2018).
- [3] A. Capozzi, C. Roussel, A. Comment, J.N. Hyacinthe, *JPCC*, 119 (2015).
- [4] A. Comment, S. Jannin, J.N. Hyacinthe et al., *Phys. Rev. Lett*, 105.1 (2010).
- [5] M. Pourfathi, N.N. Kuzma, H. Kara et al., *J. Magn. Reson*, 235 (2013).
- [6] Y.F. Kiselev, T.O. Niinikoski, *12th Int. Sym. High-Energy Spin Phys*, 389-91 (1996).