Hyperpolarization Researches with NV center, ^{129}Xe and Parahydrogen

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NMR (Nuclear Magnetic Resonance) has been harnessed as the key spectroscopic technology in both industry and science field. However, the high cost and effort of implementation and maintenance of NMR/MRI (Magnetic Resonance Imaging) due to the difficulty in maintaining strong magnetic field and cryogenic condition were the problematic even those great advantages. The best way to overcome these drawbacks is to take advantage of hyperpolarization effect that leads to the beyond the Boltzmann distribution, allowing lowered demand for strong magnetic field. Dynamic nuclear polarization (DNP) has been one of the most widely used method to induce hyperpolarization on target materials. However, DNP exhibits low efficiency and poor stability due to its harsh condition such as strong magnetic field and cryogenic condition. Therefore, there has been much efforts to induce hyperpolarization on targets using safe materials at room temperature. Several promising tools (NV Center in diamond, ^{129}Xe, and parahydrogen) that can induce hyperpolarization in normal condition will be introduced and discussed. Especially, parahydrogen system is currently set up in Korea Military Academy and I will share some interesting results from it.

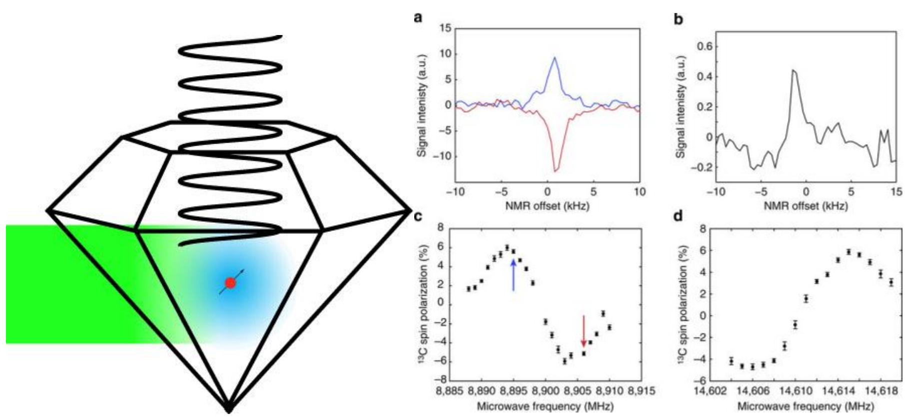

Figure 1. Schematic of induced hyperpolarization at NV center in diamond by applying laser and microwave (left). NMR signals and ^{13}C spin polarization based on hyperpolarization at NV center in diamond.

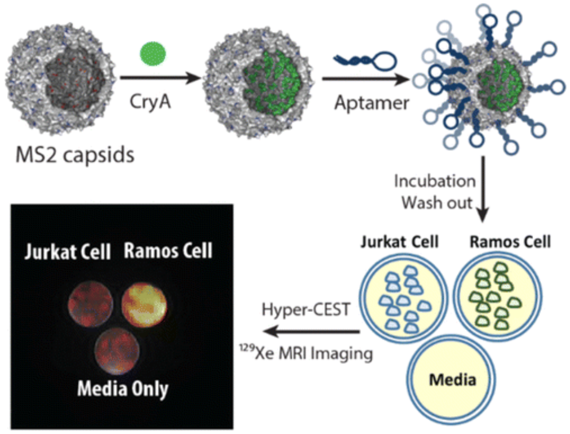

Figure 2. highly sensitive ^{129}Xe NMR nanoscale biosensors using a spherical MS2 viral capsid, Cryptophane A molecules, and DNA aptamers. The biosensors showed strong binding specificity toward targeted lymphoma cells (Ramos line)

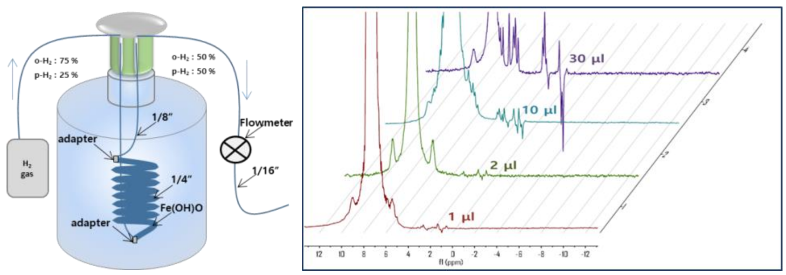

Figure 3. (Left) Parahydrogen generator. (Right) 43 MHz 1H NMR spectra of different concentrations of styrene in chloroform after exposure to parahydrogen for 5 s through bubbling. The spectra clearly reveal that 0.1% styrene in a solvent can be identified through phase difference

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