

Fast Hydrogenation by Presaturation

Efficient production of hyperpolarized contrast agents for MRI with parahydrogen induced polarization (PHIP)

Technology

MRI is a powerful tool for medical diagnostics but inherently limited to only imaging the most abundant substances and nuclei in living organisms, i.e. hydrogen in water and lipids. However, nuclear hyperpolarization (HP) intensifies the signal of selected molecules in such a way, that highly-sensitive contrast agents can be generated for real-time imaging of metabolism, pH value or functional imaging. Among current HP techniques parahydrogen-based methods (i.e. PHIP) are most promising, because of low cost and fast production of the agents even inside the MRI system with little additional hardware.

The here-described innovative process solution improves the hyperpolarization and concentration of PHIP-produced agents. Typically, PHIP consists of two important production steps: (a) the hydrogenation of a molecule with parahydrogen and (b) a transfer of spin-order to achieve detectable and longer-lived HP of a ^{13}C nucleus. Now, (a) is performed differently, i.e. the reaction solution is first saturated with parahydrogen up to the saturation limit at high pressure; next, the reaction is started by mixing presaturated solutions containing the catalyst and the agent precursor molecules. As a result, a maximum of parahydrogen is provided for the reaction from the very beginning of the HP production. In addition, gas-water surfaces, which otherwise cause inhomogeneities of the static magnetic field, are avoided.

Innovation

- Presaturation is a new method to effectively perform the hydrogenation reaction in parahydrogen induced polarization.
- Fast hydrogenation and high concentration of parahydrogen
- Undisturbed transfer of spin-order
- Undesired injection of gas into living animals, which can lead to collapse of vessels, is avoided
- Production of highly polarized and highly concentrated contrast agents at low costs
- Absence of gas bubbles simplifies the quality assurance before administration.

Application

- MRI metabolic imaging
- MRI pH-value Imaging
- MRI functional imaging.

Developmental Status

- Proof of principle
- Sophisticated setup currently being constructed and tested

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