Biologically Applicable Water-Soluble Heterogeneous Catalysts For Parahydrogen-Induced Polarization

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SUMMARY

UCLA researchers in the Department of Chemistry and Biochemistry have developed a novel method of parahydrogen-induced polarization in water using heterogeneous catalysts.

BACKGROUND

Medical imaging is an important diagnostic tool for physicians and researchers, however many imaging techniques, such as x-ray and computerized axial tomography (CAT) scans, require potentially harmful ionizing radiation. In this sense, imaging techniques based on nuclear magnetic resonance (NMR), such as magnetic resonance imaging (MRI), are attractive alternatives. MRI uses magnetic fields and radio waves to scan the body. However, the images generated can be low contrast due to a weak spin polarization signal. Catalysts are used to produce contrasting agents, which artificially boost the spin signal through a process called hyperpolarization.

One process for generating hyperpolarization is parahydrogen-induced polarization (PHIP).The catalysts that utilize PHIP can be homogeneous or heterogeneous. Typically, homogeneous catalysts are rhodium based, presenting toxicity concerns. Heterogeneous catalysts often employ organic solvents, which are not biocompatible. The ideal catalyst for biocompatible contrasting agents used in vivo MRI would be both water-soluble and capable of producing strong polarization in water.

INNOVATION

Researchers in the department of Chemistry and Biochemistry at UCLA have developed a novel method of inducing hyperpolarization in water using a water-soluble, heterogeneous catalyst. This catalyst does not require organic solvents and can be removed from the polarized molecules through filtering or solid support.The catalyst also favors pairwise hydrogenation, a necessity for producing strong spin polarization using PHIP.The resulting contrasting agent is biocompatible for in vivo MRI and NMR diagnostic tools.

APPLICATIONS

- Structural biology
- Quantum computation
- Investigation of catalytic reactors
- Gas-solid reactors
- Molecular imaging
- In vivo diagnostics: Detection of cancer, Alzheimer’s disease, Parkinson’s disease, Huntington’s disease

ADVANTAGES

- Heterogeneous catalyst allows for separation of polarized molecules
- Water-soluble catalyst eliminates need for organic solvents
- Catalyst produces strong nuclear spin polarization in water via PHIP
- Resulting contrasting agent is biocompatible for in vivo MRI

RELATED MATERIALS

- S. Glögger et al. “A Nanoparticle Catalyst for Heterogeneous Phase Para-Hydrogen-Induced Polarization in Water,” Angew. Chem. Int. Ed., vol. 54, no. 8, pp. 2452 –2456, Feb. 2015.

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OTHER INFORMATION

KEYWORDS

Heterogeneous catalysis, hyperpolarization, nanoparticles, NMR spectroscopy, para-hydrogen, heterogeneous hydrogenation, hyperpolarized gases, immobilized metal complexes, nuclear magnetic resonance, parahydrogen-induced polarization, supported metal cata

CATEGORIZED AS

- **Biotechnology**
  - Other
- **Imaging**
  - Medical
- **Materials & Chemicals**
  - Chemicals
- **Medical**
  - Devices
  - Diagnostics
  - Imaging
  - Other
  - Research Tools
- **Nanotechnology**
  - Other
- **Research Tools**
  - Reagents

▶ R. Sharma & L. Bouchard, “Strongly hyperpolarized gas from parahydrogen by rational design of ligand-capped nanoparticles,” Scientific Reports, vol. 2, no. 277, pp. 1-5, Feb. 2012.

RELATED CASES

2015-959-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11273431	03/15/2022	2015-959
United States Of America	Published Application	2022-032394	10/13/2022	2015-959

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Reducing Computational Complexity of Training Algorithms for Artificial Neural Networks
- Image Filtering Algorithm for Enhanced Noise Removal and Feature Preservation

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