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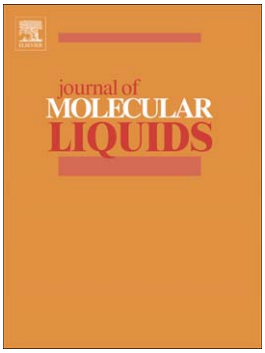

Nuclear spin catalysis: From physics of liquid matter to medical physics

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ACCEPTED MANUSCRIPT

Nuclear spin catalysis: from physics of liquid matter to medical physics

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Highlights

- Magnetic-isotope effects (MIEs) in molecular liquids are briefly discussed.
- Beneficial MIEs of magnesium, ^{25}Mg, have recently been revealed in living cells.
- Magnetic ^{25}Mg accelerates the enzymatic ATP hydrolysis driven by isolated myosin.
- Plausible physical mechanisms of the MIEs in biomolecular liquids are suggested.
- Possible applications of the nuclear spin catalysis in biomedicine are discussed.

Abstract

In molecular and chemical physics, magnetic isotope effects (MIEs) have long been known for a number of magnetic isotopes, among them ^{13}C, ^{17}O, ^{29}Si, ^{33}S, ^{73}Ge, ^{117,119}Sn, ^{199,201}Hg, and ^{235}U. Recently MIEs have been discovered in experiments with living cells enriched with magnetic or nonmagnetic isotopes of magnesium. Furthermore, the beneficial effects of the magnetic ^{25}Mg were revealed in the reaction of ATP hydrolysis driven by myosin, one of the most important molecular motors of cell bioenergetics. This paper is a brief review of recent developments in this field. Although detailed mechanisms of the ability of biomolecular nanoreactors to perceive the nuclear magnetism require further investigations, the recent developments in this new field highlight promising venues for future research of the nuclear spin catalysis in molecular liquids and biopolymer nanoreactors with possible application of the stable magnetic isotopes in medical physics.

Keywords

nuclear spin catalysis, magnetic isotopes, biomolecular liquids, reliability, robustness, medical physics.

Abbreviations

MIE(s) – magnetic isotope effect(s), ATP – adenosine 5'-triphosphate, ADP – adenosine 5'-diphosphate, P_i – inorganic phosphate.

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