Research paper

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Arvydas Tamulis[1], Kristina Majauskaite[2], Visvaldas Kairys[3], Krzysztof Zborowski[4], Kapil Adhikari[5], Sarunas Krisciukaitis[6]

[1]Independent expert of European Commission; *tamulis9@gmail.com*
[2]Independent researcher, Master of Science in Neurobiology, Vilnius, Lithuania; *kristina.majauskaite@gmail.com*
[3]Department of Bioinformatics, Institute of Biotechnology, Vilnius University, Saulėtekio al. 7, LT-10222 Vilnius, Lithuania
[4]Faculty of Chemistry, Jagiellonian University, 3 Ingardena Str., 30-060 Kraków, Poland
[5]Texas A&M University at Qatar, P.O. Box 23874, Doha, Qatar
[6]Barclays Global Operations Lithuania, Vilnius, Lithuania

Abstract:

Implementation of liquid state quantum information processing based on spatially localized electronic spin in the neurotransmitter stable acetylcholine (ACh) neutral molecular radical is discussed. Using unrestricted DFT quantum chemical calculations we proved that this molecule possesses stable localized electron spin, which may represent a qubit in quantum information processing. The necessary operating conditions for ACh molecule are formulated in self-assembled dimer and more complex systems.

The main quantum mechanical research result of this paper is that the neurotransmitter ACh systems, which were proposed, include the use of quantum molecular spintronics arrays to control the neurotransmission in neural networks.

KEYWORDS: acetylcholine molecule; neutral radical; dimer; tetramer; self-assembled complexes; electron spin density; quantum information processing.

1. Introduction

The Los Alamos National Laboratory (LANL) research project has been supported by the USA Department of Energy under Contract No. W-7405-ENG-36 and used neutral radical molecules for quantum information processing [1-3].

It was suggested [1,4-6,14-22] that self-assembled monolayer systems [15-18] could be used to create a macroscopic ensemble of quantum entangled 3-spin groups as a first step in quantum information processing (QIP) [19-24]. The spins of such a group could be connected by dipole–dipole interaction. Application of a non-uniform external magnetic field would allow selective excitation of every spin inside the group. The proper sequence of resonant electromagnetic pulses would then drive all spin groups into the 3-spin entangled state. In the suggested proposal [14] the spins were associated with a single unpaired electron spin of a neutral radical molecule in the self-assembled monolayer.

One of the key elements of this strategy is the proper choice of molecules for experimental