Molecule as an integrative component of biophysical systems

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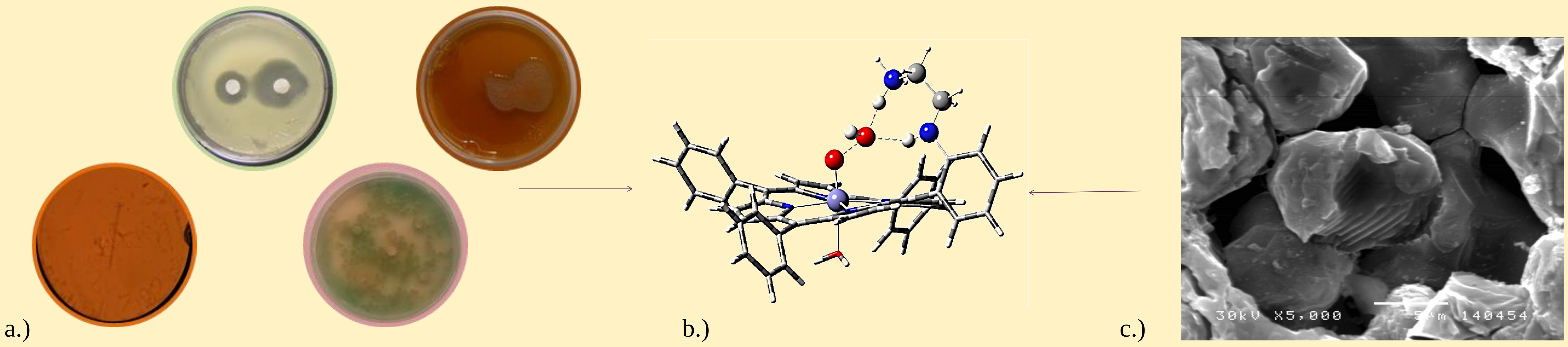
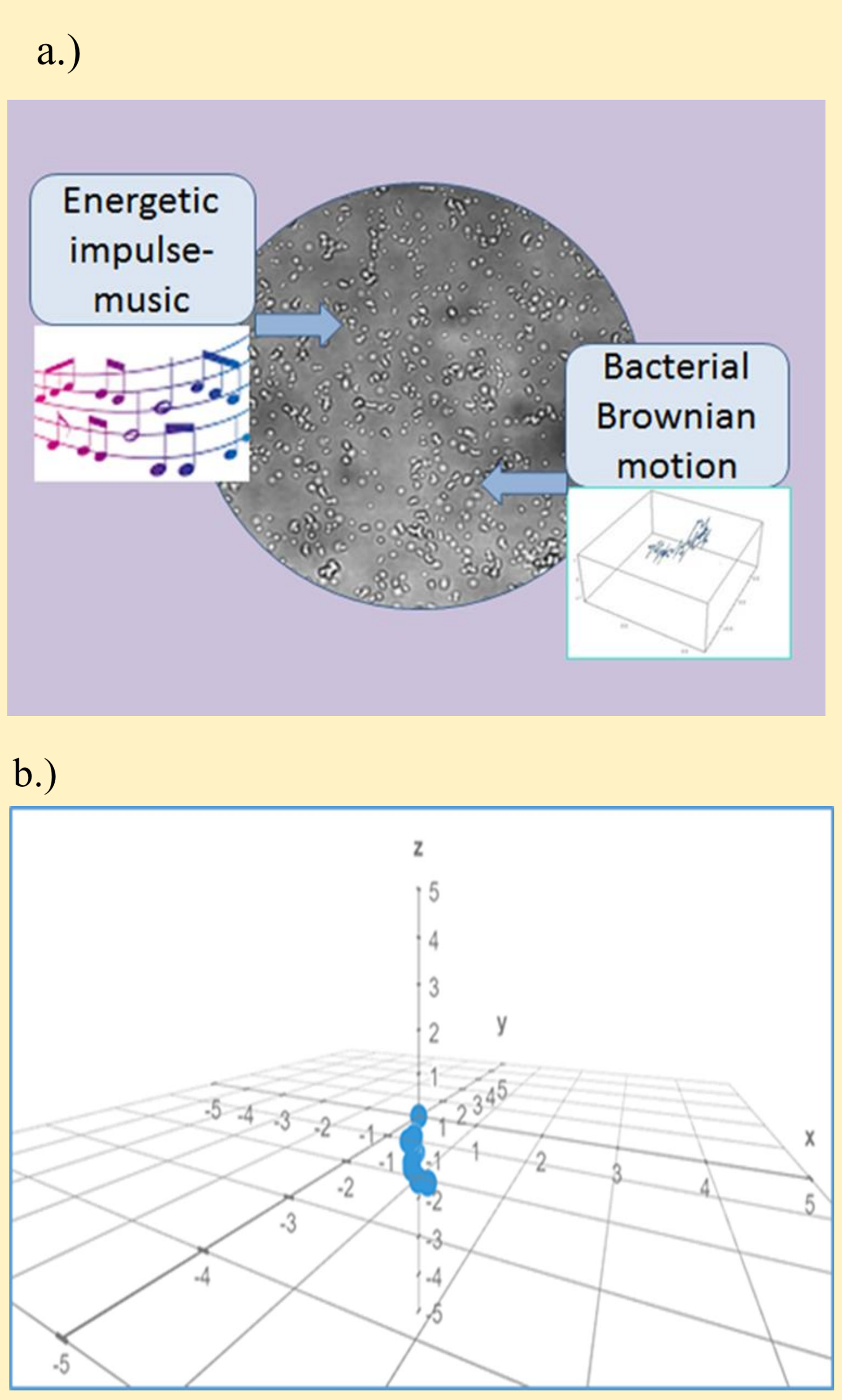


Fig. 1. Schematic representation of a molecule as an integrative component of bio and physical matter systems, a.) Bacteria samples - *Staphylococcus aureus*, *Pseudomonas aeruginosa* ; b.) schematic representation of a molecular structure [1]; c.) SEM image of $BaTiO_3$ – ceramic [2].

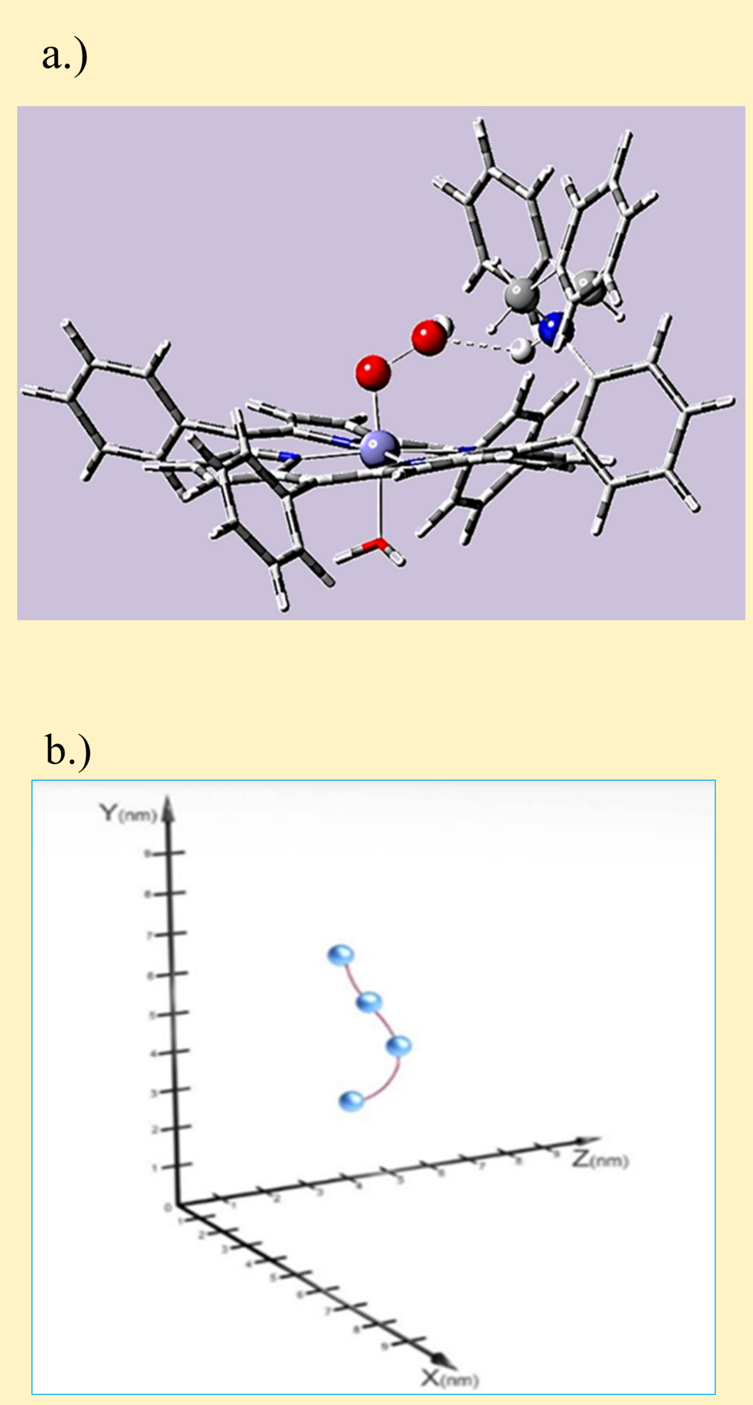
Abstract

Due to the fact that the fields of complex bionanomaterials and molecular microelectronics are constantly expanding, there is a huge interest in bio and physical systems further integration. The idea of this paper is to consider a molecule as an integrative component of these two systems that are dissimilar, even though they are consisting of identical submicroparticles. In this research we used some data regarding bacterial Brownian motion, obtained from the experiments with bacteria influenced by different energetic impulses, and also some data of the molecular motion from available research papers. By applying mathematical methods, like multiple linear regression and the least squares method, we established two mathematical forms describing motion, in order to define the relation at the submolecular, molecular and microorganisms levels, with the molecule as a central factor.



$$\varphi(x,y) = -0{,}746871x - 0{,}421536y - 0{,}306160$$

Fig. 2. Bacterial motion experiment,
a.) energetic impulses influence on bacterial motion [3];
b.) 3D diagram of the bacteria locations and the relating mathematical approximation function [4].



$$\varphi(x,y) = 1{,}4685067x + 0{,}0035386y + 0{,}973673$$

Fig. 3. The theoretical molecular motion experiment,
a.) schematic representation of a molecular structure [1];
b.) 3D diagram of the molecule locations and the relating mathematical approximation function [4].

Introduction

Electron and molecular motion belong within a research area of various sciences, like molecular biology, biophysics, bioelectronic, microelectronic, etc, because electrons and molecules are constituents of both alive and condensed matter systems. A complex and multydisciplinary approach to this phenomenon, from the aspects of different sciences, could provide original and interesting results regarding bio and physical systems structures further integration at the molecular and submolecular level.

Electrons’ intrinsic property, in living and nonliving systems, is their motion within a molecule, but also they are shifting as a part of a molecule that is moving. Furthermore, molecules, as well as biomolecules, are constituents of moving bacteria, thus, a molecule has a central role in connecting electron and microorganism levels. Also, the dimensions of microorganisms, as well as their motility, allow us to apply the biomimetic approach on condensed matter and biosystems particles, relying on Brownian motion fractal nature similarities, as their joint motion characteristic. Our goal is to mathematicaly define molecular and microorganisms motion, using their fractal characteristics, and in that way interconnect and integrate biophysical systems.

Experiment

We performed real experiments where we examined bacterial trajectories and motility behaviour influenced by music, as an energetic impulse [3], and also, a theoretical experiment, regarding the molecular motion, according to previously published results [1]. Based on the very important obtained results, we established adequate mathematical equations for bacterial and molecular motion.

Results and Discussion

Nowadays science is not able to determine electron motion, considering the quantum mechanical principles and Heisenberg uncertainty principle, therefore it should be observed indirectly, through the molecular and microorganisms motion. Adding the fact that Brownian motion is a joint property of electrons and microorganisms motion within its fractal similarity characteristics, we established mathematical functions in order to relate and more explicit describe these particles motion. In that sense, we created two 3D diagrams and two related equations, one for bacterial, and one for molecular motion, based on obtained data. Our aim is to highlight the molecular hierarchical level, as the major connection between electrons and microorganisms motion.

Conclusion

The biomimetic approach, applied in our research, could be one of the possible solutions for further complex and deeper integrations of alive and nonalive structures, which could be employed in designing new materials. Therefore, according to some experimental and theoretical results, we tried to connect living and nonliving systems, regarding their particles Brownian motion fractal nature, with a molecule, as an integrative component. Having in mind that a single bacterial cell comprises a couple of million molecules [5], and that we created, based on the experimental data, mathematical analytical forms just for one molecule and for one bacteria, in the next step we will try to interconnect them regarding molecule number ratio, what is the aim of our future research. This opens the possibility for integrating bio and condensed matter systems structures at the micro and nano scale, which is of substantial interest for further advanced and improved micro and nanoelectronic materials and technology development.

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