UDC 004.652

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USE OF NANOBOTS IN THE LIIVING CREATURE BODY CONDITION DIAGNOSTICS

Abstract: This paper contains accurate living creature body condition diagnostics by using means of a nanobot and consists of 3 main components: the sequence of actions for manipulating nanobot in body; process of diagnosis characteristics calculation; schematic implementation of the appropriate diagnostic scanner.

Key words: nanobots, nano-robotics system, isotope, ionizing field, valence band, irradiation power.

Introduction

The relevance of the proposed study is due to the need for rapid and, importantly, accurate living creature body condition diagnostics.

The proposed topic combines two aspects: purely technical (functioning of nanobots) and biological - the condition of the body.

These aspects are themselves important enough scientific problems and their combination requires the creation of a technical and biological concept of diagnostics without damaging the functions of the living organism and its cells.

In this paper, we propose a technique for applying nanoscale robotic systems toward the specific place, which diagnostics need them to be.

The object of the study is the process of combining technical systems in the interests of diagnostics.

The subject of this study is a method for obtaining information about the body condition.

It is clear that such a complex problem has a number of limitations, namely:

- a very small robotic system must be used for means of diagnostics;
- the nanobot must emit an informative radio signal which can be able received and processed by modern radio systems;
- nanobot must not affect living cells;
- nanobots' delivery to the destination point must be as accurate as possible.

In addition to these limitations, the following partial tasks should be reviewed during the study:

- selection and verification of the operation requirements for the technical system;

- selection and verification of the place of disembarkation of the nanobot systems' into the living organism and ways of its delivery to the destination;
- selection and verification of the diagnostic signal type and their processing methods;
- way to safely remove nanobots from the body.

The complexity and the relevance of the proposed topic is confirmed by modern scientific and technical trends [1,2,3].

Main part

The use of nanobots in the field of diagnosis is strictly related to the prohibition of cell damage during its disembarkation or removal from the body. Appropriate size requirements can be achieved only by molecule or small molecular complex that can be used for functions diagnostics in a living system. Such functions can be done only with presence of an energy source. Furthermore, this function is accompanied by energy dissipation.

Such nano-robotic system, must be at one of following two states [4,5]: the pre-state – high energy state, which can be detected while nanobot is moving to destination place; the post-state – low energy state of nanobot that starts after arriving to the spot and sending information about it.

That means that diagnostic nanobot is robotechnic system has energy only for moving and sending information. Nevertheless, it's almost impossible without mechanical and biological damage of living body. Fast dissipation of energy comes after nanobot arrived to destination place, due to use of molecular complex. On the other side an advantage of injecting the nanobot in organism is still present. That means that there is probability of untimely transition of nanomolecular robot from pre-state to post-state.

There is a proposal of using an isotope atomic system as condition delivery nanobot, because of smaller object size. Calcium isotopes showed good results, such as group of: ^{45}Ca, ^{47}Ca.

This isotopes have existence period from 15,3 to 47 hours (on the other hand other isotopes are existing only for several minutes, for example, Silicon) [5,6]. Travel time of such isotope in living organism takes from 3 to 12 hours due to biochemical processes [7]. ^{47}Ca loses it's energetic activity after coming to post-state (W = 6.12eV). Natural using of ^{47}Ca as a building cell material after loss of energy activity place the extraction process of nanobot. The extraction of ^{45}Ca, with long half-life time, is placed by combining it with water [8]:

 ISSN 1560-8956

$$^{45}Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2 \quad (1)$$

^{45}Ca radiation is γ - radiation (with energy of W = 5.62eB). It can take restrictive nature and, in some cases, use as therapeutic agent.

That is the reason to focus on ^{47}Ca isotope due to the fact, that other isotopes of the named row are unstable and too active while live cells interaction. Other approaches to therapeutic use of other chemical elements are placed without radio-signal processing by robot as they are usually.

By all facts, the next mnemonic scheme of using nanobots methods while diagnosing a living organism is proposed.

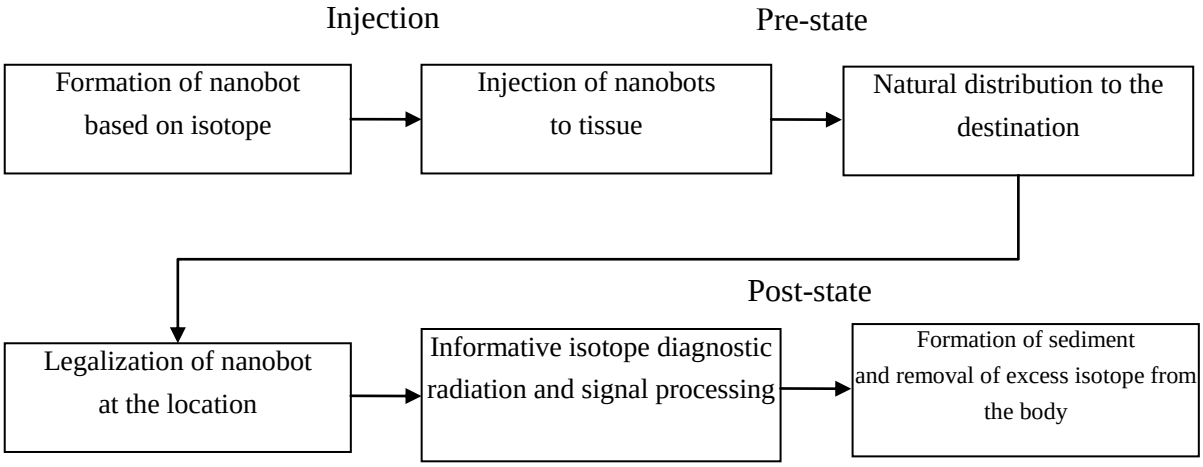

Figure. 1. Mnemonic scheme of the method of using isotope nanorobots

The next step of the technique being developed is to receive and process the isotope nanobot diagnostic signal. The half-life period of isotopes is accompanied by α, β, γ – radiation [9].

From the receiving and processing point of view of diagnostic signal, it this work is proposed to use γ - radiation, which is accompanied by electromagnetic signals at the nanometer wave range. In this case, a map of the destination of the diagnosing nanobot, which emits, can be obtained by radar scanning the surface of the body.

Another thing is to use the effect of secondary radioactivity, which causes the formation of local conduction bands and can be recorded as a source of high-frequency current on the impedance surface.

An important factor, which contributes to the creation of local conductivity, is the presence of electrons in an atom's conduction band, which is characteristic of conductors.

In semiconductors and dielectrics to which ^{47}Ca belongs, the conduction band and the valence band are separated by bandgaps.

In Calcium, the width of the bandgap area is 4.65 - 5eV [11].

The specified substance will exhibit conductor properties due to certain conditions when electrons from the atom's valence band will be moved to the conduction band. This will change the views on the use of some dielectrics. It is known that the transition of electrons to the conduction band occurs in the excited state of the atom. The excitation of an atom can be carried out under the influence of an external energy source, such as an ionizing field. The required power of the irradiation field, which is needed for the transfer of one electron from the valence band to the conduction band, is determined by the dependence [12]:

$$P = \frac{W}{\tau}, \tag{2}$$

where W - band gap (for Ca<5eV), τ - time of presence of an electron in the conduction band of an excited atom ($\tau \approx 10^{-5}...10^{-6} c$).

For Ca and its compounds, the required power is 8.6 · 10-13W. By the Avogadro's law, creating a local conduction band for calcium compounds requires an irradiation power of up to 104W, which has no practical content. However, if we consider that the energy transfer for the atom excitation will occur if the external radiation source frequency and phase resonance and the atom's own oscillations are achieved, then process need less energy for the formation of the secondary radiation and the local conduction band.

Secondary radiation is capable of producing of electricity with a voltage in the local conduction band at the resonance frequency of the atom oscillation. The next law determines it:

$$U_p = 2U_m \omega_p \tau \left| \frac{\sin\left(\frac{\omega_p}{2} \cdot \tau\right)}{\left(\frac{\omega_p}{2} \cdot\right)\tau} \right|, \tag{3}$$

where U_m - amplitude of the ^{Ca} atom's natural oscillations at frequency ω_p, ω_p - frequency of the harmonic of the signal spectrum resulting from Ca^{47} isotope irradiation with a wavelength $4700 \grave{A}$.

Accordingly, the power of the excited signal at a distance of D up to 10 meters will be based on $P=2,5 \cdot 10^{-16}$ W, from the expression

 ISSN 1560-8956

$$P = \frac{2P_1 G_T \sigma}{\left(4\pi D^2\right)^2}, \tag{4}$$

where G_T - gain of the receiver, σ - sensor area, P_1 - power of electromagnetic radiation.

If there is a phase coincidence or difference in frequency with constant value of the irradiation signal and oscillations of the sensor atoms on some distance, then such interaction should be considered as coherent. At the same time, there is excitation of the sensor atom due to the transfer of the irradiation field energy from the isotope. In this case, electrons from the valence band pass to the conduction band, which is accompanied by radiation of radio waves. The length waves are measured by the time of electrons being in restricted area, after transferring from balance state to the irritated state. It counts as approximately (0,5 - 1) mcs [13].

The resulting radiation energy is determined by the dependence

$$E_p = \left(\left(E_{Ca}\right)^2 + \left(E_{^{47}Ca}\right)^2 + 2E_{Ca} \cdot E_{^{47}Ca} \cdot \cos\Delta\varphi\right)^{\frac{1}{2}}, \tag{5}$$

where E_{Ca} - sensor electron energy; $E47_{Ca}$ - isotope irradiation energy; $\Delta\varphi$ - phase difference of these oscillations.

Calculations show that at a distance of up to 10 meters (when the sensor is irradiated by an isotope field), the power of the diagnostic signal from the destination point at organism is $1{,}602\times10^{-7}$ *W*. So it is possible to capture the diagnostic signal throughout the local area of the sensor conductivity by the length of 1,7 mcs.

The electrons entering the conduction band, i.e., a secondary static, explain the presence of this region electric field arises. In view of the foregoing, there is practical interest in radiation intensity of the sensor in the isotope`s radiating field. We can count it by the formula

$$I = \frac{\rho V U^2}{2}, \tag{6}$$

where ρ - density of the sensor material (*Ca*); *V* - velocity of field propagation; *U* - the oscillation amplitude of the sensor atom.

In our case, radiation intensity in the excited state is 16,2×10-15 Wm3.

This approach to remote scanning of the diagnostic signal has practical importance, because it can be implemented as a technical device with a simple construction.

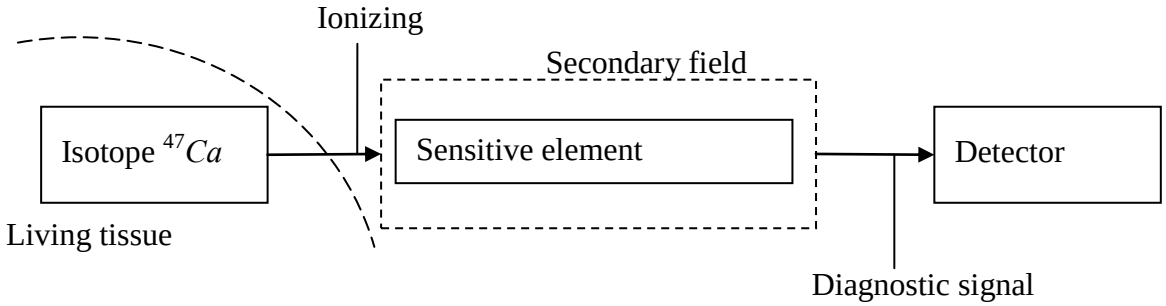

Figure. 2. Scheme of the elementary sensor-scanner
location of the nanobot in living cell

It should be noted that these elementary sensors must be grounded in the scanning grid, which should cover the area of the living organism, which is under diagnostics.

Conclusions and Discussion

The proposed technique for diagnosing a living organism with the help of nanobot includes three main components that are presented in the paper, namely: the sequence of nanobot manipulation actions in the body; calculation of quantitative characteristics of the diagnosis process; schematic implementation of the appropriate diagnostic scanner.

The analysis of preliminary results of the study suggests that the introduction, derivation and use of nanobots in living cells are safe.

The scheme of practical realization of the proposed scanner is easy to implement and operate, and the logic of the above methodology allows us to formulate a common approach (concept) in the future when creating the latest diagnostic tools.

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 ISSN 1560-8956

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