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***Short Communication***

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# Cluster model of formation of mutational keratin under the effect of irradiation

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## Abstract

Background: Malignant areas (tumours) of near-surface layers of skin (epithelium) can be formed and developed into flat cell cancer under the effect of irradiation. Aim and Objective: We consider possible mechanism for beginning this disease and we develop simple physical-mathematical model of the process under consideration. An attempt has been made to consider formation of mutational keratin without creating polypeptide nanochains. Such mutational keratin has not any biological code. Method: Cluster approach based on uncertainty principle of quantum mechanics is used. Results: It has been demonstrated that the diameter of protein nanofiber increases significantly in the course of vibrational levels excitation in glycine molecules. For one example, the diameter of fibrous nanoparticle equals to 5 nm at a basic vibrational level of glycine, and when exciting the second vibrational level of glycine the diameter raises up to 7.5 nm. The last magnitude equals to the typical keratin diameter. It is possible that such mutation (production of «pseudokeratin ») can cause flat cell cancer of skin under the effect of irradiation. Conclusion: The proposed cluster model admit to formation of mutational keratin under the effect of irradiation as well as under excitation of vibrations of all crystalline bonds in glycine molecules.

**Keywords:** Flat cell cancer of skin, Mutational keratin.

### INTRODUCTION

It is well known that malignant areas (tumours) of near-surface layers of skin (epithelium) can be formed and developed into flat cell cancer under the effect of irradiation [1]. So far a mechanism for beginning this disease has not been studied up to full clarity. It can be supposed that a formation of malignant areas of skin is caused by mutations of its substance structure at a molecular level. For example, these mutations can be arised as a result of vibrational levels excitations in polyatomic amino acids molecules of glycine and alanine when absorbing outer radiation energy. These excitations, in its turn, can lead to changes in properties of keratin protein, entering into the structure of epithelium and containing, for the most part, the mentioned amino acids. In this work an attempt has been made to consider a possible mechanism for forming mutational keratin without creating polypeptide nanochains consisted of glycine and ribonucleic acids molecules. Such mutational keratin has not any biological code. On the basis of cluster approach developed in [2] it has been demonstrated that a diameter of such protein nanoparticle increases significantly in the course of vibrational levels excitation in glycine molecules under the effect of irradiation.

### METHODOLOGY

Physical-mathematical formalism for the proposed method [2] is based on uncertainty principle of quantum mechanics. Following by notions [2], we will describe the process of the irreversible aggregation of objects using the concept of distribution density wave $\varphi(a,t)$ in the space of cluster sizes $a$. The wave propagates with the time $t$ toward an increase in the cluster size. Such one-dimensional approach allows one not to take into account deviation of a geometric shape of the object from the ideal one. On the assumption of the universal relation $\Delta a \cdot \Delta k \geq 1/4\pi$ ($k$ is wave number) for a wave packet half-width and a spectral line half-width for coherent processes one can write down the following uncertainty relation for a coordinate and a momentum in the space of cluster sizes:

$$\Delta a \cdot \Delta p \cong \frac{\hbar}{2}. \qquad (1)$$

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Here, $\Delta p \sim p = m\Delta a/\Delta t$ is momentum uncertainty, $m$ is cluster mass, $\hbar$ is reduced Planck constant. Momentum uncertainty is equal to the momentum itself in the order of magnitude, *i.e.*, interaction of objects either occurs or does not occur. Physical meaning of relation (1) is in the fact that during the time interval $\Delta t$ of elementary (single) act of interaction between objects the exact cluster size cannot be determined until this interaction is finished either through capture of one object by another or their partial or complete disruption, or elastic scattering. It is connected with the fact that unless the elementary act is finished, it is impossible to determine to which object each of the interacting surface elements is assigned. In ours case such elements are external atoms of crystalline bonds C–C, C–O, and C–N in amino acid molecules, which are germs of the quasicrystalline cluster. At the limit, the above interval $\Delta t$ is equal to time scale $t_i$ of interaction between cluster and germ.

One can write the following condition for mass conservation at elementary act during which the germ is captured by cluster:

$$m(a) + m_0 = m(a + \Delta a) \Rightarrow$$
$$m_0 \frac{V(a)}{V_0} + m_0 = m_0 \frac{V(a + \Delta a)}{V_0}. \quad (2)$$

Here $m_0, a_0$ are the mass and size of germ, $V(a)$ is cluster volume before interaction with germ, $V(a + \Delta a)$ is cluster volume after the interaction, cluster mass is presented as $m(a) \cong m_0 (V(a)/V_0)$, $V_0$ is germ volume.

**RESULTS AND DISCUSSION**

One can obtained from the relations (1), (2) that the diameter of continuous nanofiber with circular section can be written as

$$d \cong a_0 \left( \frac{32 m_0 a_0^2}{\pi^2 \hbar t_i} \right)^{1/4}. \quad (3)$$

The following expression for external diameter of hollow nanofiber has been obtained in [2]:

$$d \cong a_0 \left( \frac{2 m_0 a_0^2}{\pi^2 \hbar t_i} \right)^{1/2}. \quad (4)$$

By this the thickness of nanofiber capsule equals to germ size.

The time scale of vibrational interaction for single bound between atoms can be written in the following form with regard to Heisenberg rule:

$$t_i \equiv t_v = \frac{\hbar}{E_v} = \frac{1}{(v + 1/2)\omega_e c}, \quad v = 0, 1, 2, \ldots \quad (5)$$

Here, $c$ is the velocity of light i n vacuum, $\omega_e$ is wave number of own vibrations. This value for the above bonds approximately equals to $\omega_e \cong 2 \times 10^5$ 1/m [3]. Then $t_i \equiv t_v \cong 3.3 \times 10^{-14}$ s. In case of vibrational excitations of $n$ time scale equals to $t_i = n t_v$.

We consider glycine molecules ( $m_0 = 1.25 \times 10^{-25}$ kg, $a_0 = 0.42$ nm [4]) as the germs, and we take that characteristic time scale on the basic vibrational level equals to $t_i \equiv t_v \cong 3.3 \times 10^{-14}$ s. We assume that to capture such small germ by nanoparticle it is enough single vibration of last bond CO or CN at under-barrier coming off hydrogen atom. A probability of such coming off process is notable for zero [5]. One can obtain from the formula (3) that the diameter of continuous nanofiber equals to $d \approx 5$ nm at basic vibrational level, and nanofiber diameter is increased to $d \approx 7.5$ nm under excitation of second vibrational level because of time scale is reduced by factor of 5 with regard to formula (5) when $v = 2$. The excitation of second vibrational level can occurs under the effect of irradiation. Such nanofiber without of biological code can be considered as pseudo-keratin. Further, one can obtain from the formula (4) that the diameter of hollow nanofiber equals to $d \approx 7.5$ nm at basic vibrational level when all crystalline bonds of glycine molecules become excited and $t_i = n t_v = 4 t_v \cong 1.32 \times 10^{-13}$ s.

The obtained value $d \approx 7.5$ nm corresponds to typical diameter of keratin [6]. It can be supposed that mutations in kind of formation of continuous pseudo-keratin at irradiation, and formation of hollow object under excitation of all crystalline bonds in glycine molecules can cause flat cell cancer of skin.

**CONCLUSION**

The proposed cluster model based on uncertainty principle of quantum mechanics admit to formation of mutational keratin under the effect of irradiation as well as under excitation of vibrations of all crystalline bonds in glycine molecules.

Conflicts of interests are excluded.

My conclusion is presented in References [2, 5] and in submitted short communication.

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