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Structural-energy Interaction in the System: Electron - Nucleus - "Chemical individual" – Substance

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***Abstract*— In this article considered the structural - energetic correspondence of the constituent elements of the "chemical individual" - the elementary link of macroscopic formation. The identity of the nature of "electromagnetic particles" and elementary heat carriers - "theplotrons" is proposed. The dependence of temperature of substance on pulsation of electromagnetic particles combines the micro-macroscopic characteristics of matter.**

***Index Terms*— energy, structure, electron, "electromagnetic particle", pulsation, "chemical individual", "theplotron".**

I. INTRODUCTION

It is common knowledge that the impact of heat, light, electricity, etc. on material objects first of all changes their structural and energy state of microstructures, which accordingly reflects on the physicochemical properties of macroscopic formation. It is known [1-5] that in the composition of a molecule or a non-molecular compound atoms enter in the form of chemical elements. At the same time, there are enough definitions about the "chemical element", however, many of them do not express its physical essence. In [6] we described the concept of "element", where atoms in a chemical bond between themselves or other atoms represent a "chemical element", and the formed structure is a "chemical compound". In the scientific literature it is accepted that the smallest part of the substance preserving its physico-chemical properties is called a molecule, although there are substances of a non-molecular structure. In [6], we proposed a microstructure of the elementary link of macroscopic formation, consisting of chemical elements and preserving their physicochemical properties as a "chemical individual". Those. we assume that the "chemical individual" represents an elementary cell of the lattice of a solid substance or a group of atoms bound in the form of chemical elements into a liquid or gas molecule that exhibit the properties of this macroscopic system (the size effects of a substance on its physicochemical properties requires separate consideration). In turn, "chemical individuals" consisting of a single type of chemical elements are called **simple substances** (in English textbooks- **an element**), and from different – **complex substances (**in English textbooks- **compound**). Thus, the "chemical element" is a conceptual expression, where an atom in a chemical bond with another atom forms a "chemical compound", which is a structural element of the "chemical individual". In this respect, the "chemical compound" may or may not correspond composition of the molecule. For example, ***NaCl*** (*a formula unit of chemical compound*) is a chemical compound where the atoms of sodium and chlorine enter into its composition as a chemical element, and the molecule is represented as $(NaCl)_6$. However, there are substances that, when their dimensionality decreases after a certain value, although they contain a sufficient number of "chemical individuals", the properties of the microstructure differ from their macroscopic properties. In this connection, to determine the influence of constituent elements of a substance on its properties, it follows that it is necessary to consider the structural and energy state of these substances at the atomic - molecular level. Consequently, to obtain micro-macroscopic characteristics of substances expressing their physicochemical properties as a single interconnected material object, it is necessary to study the interaction of chemical elements consisting of nuclei and electrons. In this connection, "***chemical element"→"chemical compound"→"chemical individual" → "simple substance***" or "***chemical compound"→"chemical individual" → "complex substance***" are at first sight perceived **as one and the same object, although in listed series, each forthcoming "subject" is a constituent element of the next, carrying out the transition from the simple to the complex**. For example, carbon atoms in the form of a chemical element primarily form "chemical individuals" of graphite, diamond, carbene, fullerene or others, which then form the corresponding allotropic modifications of simple substances that differ in their properties. And in this article we consider interactions in the system: electron - nucleus - "chemical individual" – substance.

II. DISCUSSION.

From the point of view of quantum mechanics [7], a molecule is a system not of atoms, but of electrons and atomic nuclei interacting with each other(chemical elements). In this case, it is assumed that the electron is in motions around the nucleus with certain values of energy. At first glance, the word "energy" seems to be a very simple concept, however, it is impossible to find a book in which its rational definition would be given. In mechanics of continuous media, energy plays the role of an independent structure [8], and the scientific direction - energetizm- the occurring phenomena of nature is reduced to the law by controlling energy flows [9]. In our opinion, all this is connected with the separate consideration of energy from a material object, which distorts objective reality. At the heart of the General Relativity (GTR), the central core is the principle of the equivalence of

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energy and mass [10], and they should be considered in the relationship of space, time and the material world. Moreover, in [11], A Einstein notes: "A ray of light carries energy, and energy has mass." These conclusions mean that the carriers of energy, including the beam, are "elementary material particles." In this connection, it is necessary to take the category of "**energy" as a conceptual expression - describing the movement of material objects quantitatively and qualitatively taking into account their relative rest**. Equivalence of energy and mass of material objects for microsystems is expressed by the equation $\varepsilon = mc^2$, and for massive bodies the potential ($E = mgh$) and kinetic ($E = mv^2/2$) energies that provide mechanical work. It is appropriate to note here, regardless of whether the substance is in motion or in relative rest, the elementary particles constituting the "chemical individual" are in motion and characterize the **internal energy** of this system. The law of conservation of energy for thermodynamic systems that establishes the relationship between the change in internal energy (ΔU), work (W) and heat (Q) for the first law, is:

$$Q = \Delta U + W$$

The equation does not detail the energy transformations occurring within the system at the microscopic level [12], and work and heat are taken as forms of energy transfer depending on the nature of the motion of the particles making up the given system. In statistical physics, the energy of different types of motion and the interactions of elementary particles entering the system are included in the internal energy of the system: the energy of translational, rotational and vibrational motion of them, within and intermolecular interaction, the energy of the electron shells of atoms, etc. [13]. In this case, expressing the dependence of energy on the temperature of the system, the physical meaning of temperature with respect to unit elementary particles is not disclosed.

According to the scientific literature, the nucleus and electrons are charged particles of the microstructure and macroscopic formation consists of alternating opposite charges, which, when moving relative to each other, create electric and magnetic forces. These forces are closely related, and they do not be separated from each other: they act simultaneously and are called electromagnetic forces [14]. According to Faraday's data, each charge creates its own field, then it is natural to assume the presence of electric and magnetic fields in nuclei and electrons. Assuming that the substance consists of alternating nuclear-electronic structure, then with an accelerated motion of an electron in this system, an electromagnetic wave must be emitted [15]. However, according to the reference data, the average velocity of electrons in metals is 10^6 m/s, and at such a speed of motion of electrons, under normal conditions, the emission of electromagnetic waves in the form of electricity, light, heat, etc. does not appear. Consequently, the electron moves without acceleration, but oscillates between the nuclei and their interactions are realized by a special form of matter-the "electromagnetic field" [15]. However, until now there is no clarity about the nature of the "field" proposed by M. Faraday.

It is generally known that mechanical rubbing of the woolen material with the ebonite stick causes heat to be released due to a change in the structural and energy state (SES), and the rod is electrified. These manifestations indicate the transfer of energy in the form of heat and electricity. Those. this simple experiment means that in the structure of the "chemical individual", in addition to the nucleus and electrons, there are elementary particles - energy carriers, which manifest themselves in the form of heat, light, etc. under the influence of energy from outside. In [16] it is noted that all manifestations of electricity (thermal, light, chemical, physiological, magnetic and mechanical) are exactly the same, regardless of the source of its production. In turn, energy from the system is released (absorbed) during the course of the process with the change in the SES of the "chemical individual". For example, the combustion of fuels, which refers to chemical processes, where, as a result of the change in the structural and energy state of "chemical individuals", valence electrons are redistributed and huge amounts of heat are released (a set of "theplotrons" [17-20]) and light (a set of photons) related to components of the electromagnetic wave. In Hertz's works, the identity of the basic properties of electromagnetic and light waves is established [21]. The data and analysis of Hertz's experimental work, as well as the dialectical structure of the matter, allow us to conclude that there are "bound" elementary energy carriers in the system - "**electromagnetic particles**" of **dipole nature**. The presence of dipoles is also noted in the "General Theory of Interactions" [22], where "**biones**" are taken as the dipole. According to this theory, the entire space of the universe, and the vacuum, and the particles, consist of bions. The frequency of an electromagnetic wave is equal to the number of revolutions of the bion per second, where the energy of one revolution of the "bion" corresponds to the Planck's constant. The existence of such a view serves our reasoning, but unlike "bions", the "dipoles" that we offer represent an elementary material particle. In addition, in "bions" the concept of energy is considered separately from matter and by their suggestion, the energy is converted into a field and then elementary particles are formed. Moreover, referring to the "Superstring theory" [23], the dimensions of Compton waves (10^{-35} m) and their mass are indicated. In our opinion, regardless of the theories of "Superstring" and "General Theory of Interactions", if there is an object dimension, then it refers to the matter (independently as we call it), and energy characterizes its movement.

Thus, in the system: nucleus- electron and electromagnetic particles, the vibrational kinetic energy of the electrons, the Coulomb interaction forces impart a pulsating character to the "electromagnetic particles" located between the charged particles. This is evidenced by the work of the Hertz's vibrator, where on the surface of the electrodes at high voltages of alternating current, charges with "electromagnetic particles" accumulate creating a potential difference. Quickly changing the direction of the electromotive force (poles) of the electrodes, and newly formed potential repels "electromagnetic particles" and throws them into the environment in the form of "electromagnetic particles". Collective motion of pulsating "electromagnetic particles" creates a traveling wave. In addition, at values of the breakdown voltage, when electrons from the cathode are directed toward the anode, an electric current is created, and "electromagnetic particles" from the system are emitted in the form of an electromagnetic wave. Here it should be noted that the **sinusoid**s and **cosines** of electromagnetic waves described in the literature represent a change in the **values of electrical and magnetic strengths in time** and **there are no waves**

there. It should be emphasized that **the wave is a trajectory of particles**. Consequently, the "**electromagnetic wave**" is the trajectory of **"electromagnetic particles**". They are located in the electron-nucleus system and participate in the energy exchange between the structural elements of the "chemical individual". Thus, with the unchanged structure-energy states of microstructures of macroscopic formation, the Faraday "field" represents pulsating "electromagnetic particles". The pulsation of "electromagnetic particles" governs the structural-energetic correspondence of the interaction of the system according to the principle of Newton's third law. In addition, pulsating "electromagnetic particles" located between two electrons, regulates the Coulomb and magnetic interactions of the system and keeps them in one energy cell **(Pauli prohibition**). ***Perhaps such an analogy of the structure has a nucleus consisting of protons and neutrons connecting with "electromagnetic particles"!***

Here it is of interest to find the "electromagnetic particles" in the nuclear-electron system. In connection with the fact that the nuclear-electronic structure of micro-macroscopic formation is considered, therefore, the Born-Oppenheimer approximation should be taken into account, which consists in a separate description of the state of the nucleus and electrons. It is known that the mass of the nucleus is much larger than the mass of the electron and the electrons move faster by adjusting to the position of the nucleus. In physicochemical manifestations (*by the exception of radioactive transformations*), the nucleus of chemical elements remains unchanged and electrons participate in the processes. Redistribution of valence electrons between nuclei leads to the formation of a new "chemical individual" where the movement of them proceeds simultaneously with the release (absorption) of heat, light, etc. with a constant number of electrons in the system. For example, in the combustion of organic compounds, the flow of electrons in an electric discharge, etc. These practical results suggest **a combination of "electromagnetic particle" with an electron,** where they do not exhibit properties characteristic of them in free states [24-25]. It was noted in [25] that external influences by heat in the "chemical individual" create a "thermoelectrochemical potential", which is the driving force for the course of physicochemical transformations. With the attainment a certain value of electromotive force (**e.m.f**.) such as the breakdown voltage of the "Hertz's vibrator", the flow of electrons changes the energy state of the structural elements of the "chemical individual", which leads to the disintegration of combinations of the electron and "electromagnetic particles". The set of "electromagnetic particles" separated from combination system manifested in the form of heat, light, etc. This situation is similar to a chemical reaction, when hydrogen reacts with oxygen and turns into water. And in the composition of water to look for gaseous hydrogen or oxygen is meaningless, but if necessary, you can get hydrogen and oxygen, back by the decomposition of water. Based on the work of Faraday, Hertz and according to our data [17-20], it can be concluded that the elementary energy carriers are pulsating "electromagnetic particles". Consequently, for given temperature, where the substances are in thermal equilibrium with the surrounding medium, the following equation is valid [24]:

$$5kT = hv.$$

where $5kT$ represents the total contribution of the kinetic energy of the thermal motion of the "elementary particles" of the substance (k is Boltzmann's constant, T is the thermodynamic temperature), and the right-hand side hv, the energy of the quantum of thermal radiation of these particles in equilibrium with the surrounding medium (h is Planck's constant $6{,}62\cdot10^{-34}$ $J\cdot s$), v - frequency of pulsation of "electromagnetic particle" – the elementary carrier of energy, Hz). Using the above equation, we determine the temperature dependence of the pulsation frequency in the form: $T = 0.959 \cdot 10^{-11} \cdot v$. Consequently, a change in the ambient temperature affects the state of the system, i.e. on the frequency of pulsations of the "electromagnetic particle", which determines the structural and energy state of the "chemical individual". "Electromagnetic particles", which are in dynamic equilibrium with elementary particles of the environment, create an individual "electromagnetic field" of a given "chemical individual", i.e. substance.

Based on thermochemical and spectroscopic reference data, we calculated the mass, energy of elementary particles of heat and light carriers [24]. Depending on the value of the frequency, "electromagnetic particles" behave like "theplotrons", photons, etc. in the microcosm the law on the interconversion of elementary particles acts (table 1). A large difference in the mass of elementary particles is due to the fact that when hydrogen is burned the energy carriers are the combinations of photon and "theplotron" ($5.280\cdot10^{-36}$ **kg;** $v = 7.16\cdot10^{14}$ **Hz**). The calculated mass of "theplotron" is $2.432\cdot10^{-36}$ **kg** and frequency of pulsation is $v = 3.31\cdot10^{14}$ **Hz**.

Table 1. Comparative data of elementary particles of energy carriers

Physical quantity	Calculated by the proposed formulas[24] and reference data [26]	By thermochemical hydrogen combustion data [27] and reference data [26].
The mass of "theplotrons", kg	$2{,}435\cdot10^{-36}$ ($8.98755\cdot10^{16}$ J/kg) $2{,}432\cdot10^{-36}$ ($m=\varepsilon/c^2$)	$5{,}280\cdot10^{-36}$ ($8.98755\cdot10^{16}$J/kg) $5{,}279\cdot10^{-36}$ ($m=\varepsilon/c^2$)
The energy of the particle is ε, J	$2{,}189\cdot10^{-19}$(IR region)	$4{,}75\cdot10^{-19}$ (For the visible region $\varepsilon \approx 2{,}55\cdot10^{-19} - 5{,}23\cdot10^{-19}J$)
Pulsation of the particle -**v**, Hz	$3{,}31\cdot10^{14}$ (IR region)	$7{,}16\cdot10^{14}$ (For the visible region $v\approx 3{,}84\cdot10^{14} - 7{,}89\cdot10^{14}$)

The IR region belongs to thermal radiation, where the carriers of heat are the "theplotrons", the visible region are photons, and both are related to "electromagnetic particles". Using the data in Table 1, it is possible to determine the individual characteristics of a photon and a "theplotron", where they can participate together in any physicochemical process.

III. CONCLUSION

Analysis of scientific and experimental data on the structure of substances allows us to conclude that in the microstructure of the "chemical individual", in addition to the **nucleus** and **electrons**, there are "**electromagnetic particles" - "pulsating dipoles of electromagnetic nature" associated with electrons in combinations.** These particles are a Faraday "field" created by charges. Pulsating dipoles

represent **a standing wave**, and a set of them in the movements creates a picture of the **traveling wave**. And, as a consequence, it can cause interference and diffraction. With this approach to electromagnetic waves, the **difference in the particle and wave views of the propagation of light rays is solved**.

The change in the structural-energetic state of "chemical individuals" of substances from outside is a driving force for the flow of various processes. The temperature expresses the thermal state of the system, characterizing the frequency of pulsations of "electromagnetic particles" in combinations with an electron.

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