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Atomic-Molecular Structure of Substances and Energy Manifestations

By B. T. Utelbayev, E. N. Suleimenov & A. B. Utelbayeva

Kazakhstan-British Technical University

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Keywords: *matter, energy, elementary particle, electron, “theplotron”, photon, electromagnetic field, “electro- magnetic particle”, “chemical individual”.*

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ATOMIC-MOLECULARSTRUCTUREOFSUBSTANCESANDENERGYMANIFESTATIONS

Atomic-Molecular Structure of Substances and Energy Manifestations

B. T. Utelbayev [α], E. N. Suleimenov [σ] & A. B. Utelbayeva [ρ]

Abstract- At the International Congress of Chemists in 1860 in Karlsruhe (Germany), the concepts of the molecule and atom that make up the substance were adopted. The property of matter consisting of these interconnected particles is mainly characterized by mass, which expresses a measure of inertia and energy - a measure of its motion. For the rational use and management of forms of energy transfer is interesting to clarify the nature of elementary matter in the atomic-molecular structure of substances, i.e. elementary particles constituting internal energy. Based on the analysis of scientific and experimental data published in the press, it can be concluded that the elementary particles called photons, "theplotrons", "electromagnetic particles", "electromagnetic waves" or others shows that they are elementary "material objects" depending on the condition and of the character of movement are manifested in the various forms of energy transfer. It should be noted that the release of heat, light, electromagnetic waves or others depends on the nature of substances containing in the atomic-molecular structure "elementary particles" formed from various ratios of "magnetic and electrical components". These elementary particles were called by us conventionally "electromagnetic particles", which participate in the structurally – energy correspondence of "chemical individuals" of substances. Transition a system from one state to another is carried out by the movement of electrons and elementary "electromagnetic particles" of substances combined in the atomic-molecular structure. The data presented by us in this article lead to conclude that in the structure of atoms there are containing combined elementary particles characterizing energy as a measure of the movement of them and require revise the structure of substances.

Keywords: matter, energy, elementary particle, electron, "theplotron", photon, electromagnetic field, "electro-magnetic particle", "chemical individual".

I. Introduction

It is well known that scientific achievements in the field of atomic-molecular structure of substances have revealed unusual properties of micro-objects [1-6], which affect on the characteristic of macroscopic formations. However, near the boundary of the value of Planck's constant, it is difficult to judge the forms and structures of micro-objects, which is complicated by the lack of the possibility of direct instrumental measurements. In our discussion we proceeded from the thesis formulated by M. Faraday on the identity of energy manifestations in the interaction of material objects. Given the interconnectedness of micro-macroscopic properties, the inductively-deductive character of the information, and based on the logical sequence of the laws of structural-energetic correspondence of the constituent elements mathematical calculations are made, hypotheses are formulated, "definitions" of phenomena and others are accepted to describe the objective reality of the system under consideration. According to modern concepts, a substance consists of interconnected atoms-electroneutral particles consisting of a positively charged nucleus and negatively charged electrons [4-9]. In turn, the properties of matter are mainly characterized by mass, which expresses a measure of inertia and energy- a measure of its motion. In the relative rest of substances, its state is described by internal energy- a general characteristic of the constituent elements of a given system. The change of internal energy affect to the state of a system, which manifest in the form of energy transfer- the performance of work and appear as heat, light, electricity, magnetism, etc. In these processes the nuclear-electronic structure of substances plays an important role, where an increase the charge of the atomic nucleus, the structure of the electron shell changes periodically, which leads to a periodic change in their properties. However, all the details of the role of electrons and their distribution in the atomic-molecular structure of substances are still unknown. Regarding modern theories about atomic structures, we can say that they are too cluttered with complex calculations and assumptions, which, in our opinion, need significant refinement. This article discusses these issues based on real processes taking place in the environment.

Author α: Institute of Chemical Sciences named after A. Bekturov, Almaty, Kazakhstan. e-mail: metallaim@mail.ru
Author σ: Kazakhstan-British Technical University, Almaty, Kazakhstan.
Author ρ: South Kazakhstan State University named after M. Auezov, Shymkent.

II. Discussion

Despite the similarity of the structures of atoms consisting of protons, neutrons and electrons, a set of certain quantities individualizes of them which form a molecular or non-molecular structure of this compound between themselves or other atoms. The presence of compounds of the nonmolecular structure led to different interpretations, and this in [8] it is noted as follows: "... due to the fragmentation of chemistry into many "separate" disciplines, different authors use different versions of it as the most important basic fundamental concept, such as "chemical individual", "molecule", "chemical compound", "chemical substance", etc., which applies to all substances formed from atoms". And for the correct perception of objective reality, clarity should be introduced into the concept expressing the states and structures of atoms in a chemical bond and their compounds formed. First of all, it is necessary to accept that atoms in a chemically bound form do not exhibit their individual atomic properties and are in the state of "chemical elements" [8]. If we assume that molecules are formed from chemical elements as the smallest particle of a substance possessing all its physical and chemical properties, then this definition does not include compounds of a non-molecular structure. In this regard, for a general discussion of the micro-macroscopic properties of material formations, regardless of the molecular or non-molecular structure, we propose the concept of "chemical individual" in the following version [7]:

A "chemical individual "represents a unit cell of a lattice of condensed matter or a minimal group of chemical elements connected in the form of chemical, metal, coordination and intermolecular bonds that determine the properties of a macroscopic system.

According to the scientific literature electrons play a significant role in chemical and intermolecular bond formations, however, the gaps noted in [9] and the processes occurring in reality require a review of the role of electrons and the atomic-molecular structure of substances. For example, electrons are the commonly accepted carriers of electricity in metals; under voltage, EMFs move at approximately $1{\cdot}10^{-4}$ - $1{\cdot}10^{-5}$ m / s. However, it is known that the speed of an electron in electric current is very differ from the speed of the electric field, which must have been created by the electrons. Electricity as a form of energy transfer usually represents an electric current, which represent the ordered movement of charged particles, and in metals generally electrons are accepted [10]. In practice, despite the insignificant speed of the electron, regardless of the distance of the source generating EMF, an electromagnetic field and an electric current appear along the entire length of the conductor. In this regard, it is necessary to find out the participation of the electron and the electromagnetic field in the creation of the electric current. For example, in [11] for a copper conductor the electron velocity *(v)* was calculated by the formula:

$$v = I\mu / qdN_AS$$

Where I is the current strength, μ is the molar mass of the conductor, q is the electron charge, d is the density of the conductor, N_A is the Avogadro number and S is the cross-section of the conductor. The Substitution of the numerical values from the reference material characteristic of copper gives the value of the electron velocity $\approx 5{\cdot}10^{-5}$ m/s, while the alternating electric current goes without changing the "chemical individual" of the conductor. Similarly, to calculate the electron velocity at constant current, we used the data of galvanizing iron with an area of 1000 cm^2 at a current strength of 2.5 A and a zinc density of 7.15 g / cm^3 [12]. Our calculation according to the above formula gives the following value for the electron velocity:

$$v = 2.5{\cdot}0.0327 / 1.6{\cdot}10^{-19} \cdot 7.15 \cdot 10^{3} \cdot 6.02{\cdot}10^{23} \cdot 1{\cdot}10^{-1} \approx 1.1 \cdot 10^{-9}\ \text{m / s}.$$

Therefore, during electrolysis, the electron velocity is $1.1{\cdot} 10^{-9}$ m / s and the transition time from one lattice to another is $2{\cdot}10^{-10}$ / $1.1{\cdot}10^{-9}$ = 0.18 s. The calculated electron velocity along the conductor is $\approx 5{\cdot}10^{-5}$ m /s and the electron transition time from one lattice (distance $2 \cdot 10^{-10}$ m) to another is approximately $2{\cdot}10^{-10}$ / $5{\cdot}10^{-5}$ = $4{\cdot}10^{-6}$ s. This value, compared with 0.18s is very insignificant, i.e., the limiting stage of electrolysis is the inhibition of the heterogeneous-heterophase electrochemical reaction at the electrode-solution interface, phase transitions and rearrangement of the crystal lattices of metals determining the electrochemical kinetics of the process. All these experimental data are in favor of the fact that in the atomic structure of the conductor, in addition to the nuclear – electronic component, there should be some "elementary particle" responsible for creating an electric field, which stimulates the flow of displacement of charged particles and the appearance of an electric current.

In [9], authors believe that the carriers of electricity are electrons bound into rigid complexes with a magnetic field. According to this view when to a conductor a voltage is applied, an electric field propagates along it at the speed of light and interacts with conduction electrons causing them to move. As a result of the motion a magnetic field is excited, and form a single complex "electron - magnetic field" which move at speed equal of light. With this approach, at an alternating current frequency of 50 Hz and at the speed of light, the proposed "magnetic field-electron" complex travels a distance in a single oscillation:

$$3 \cdot 10^{8}\ (\text{m / s}){:}\ 50\ (\text{s}^{-1}) = 6 \cdot 10^{6}\ \text{m}$$

Thus the electric current carrier - electron - is located not only outside the lattice structure of the conductor (approximately a distance of $2{\cdot}10^{-10}$ m, but to be from the conductor at decent distances destroying its lattice. The reality shows that the transmission of electricity with alternating current is carried out using constituent elements of the conductor without their destruction.

In [13], it is stated that electric current is transported through the wire by electromagnetic waves, and not by the movement of electrons. However, the waves are the trajectory of material substance, and the material nature of the wave components of the components of the electromagnetic field remains unknown. The propagation of the electromagnetic field in a conductor depends on its dielectric (ε) and magnetic (μ) permeability and in $(\varepsilon\mu)^{1/2}$ less speed compared to vacuum. For a copper conductor, the dielectric constant (ε) is 978, and the magnetic permeability (μ) 0.999 and the propagation velocity of the electromagnetic field (*v*) along the copper conductor is:

$$v = s / (\varepsilon\mu)^{1/2} = 3 \cdot 10^8 / (978 \cdot 0.999)^{1/2} = 3 \cdot 10^8 / 31.26 = 0.959 \cdot 10^7 \ m/s.$$

The calculated velocity of $0.959 \cdot 10^7$ m / s compared with the electron velocity of $1 \cdot 10^{-4}$ - $1 \cdot 10^{-5}$ m / s differs by 11 - 12 orders of magnitude and, therefore, electrons at this speed cannot create an electromagnetic field. This means that in the atomic-molecular structure of the conductor there is a certain “material object” containing a “magnetic and electric component”, which creates an electromagnetic field under the influence of the EMF of the source. That is, under the influence of the EMF of the source, the electrical component of the “material object” undergoes polarization creating a potential difference, and the moving component is affected by the magnetic component enhancing the polarization. An electro-magnetic field is created along the conductor, which induces the movement of valence electrons in the nuclear - electronic system. The alternating direction of the electromagnetic field leads to the oscillatory motion of the valence electrons of the conductor. For one oscillation at an AC frequency of 50 Hz and an electron velocity of $5 \cdot 10^{-5}$ m / s, the electron travels a distance of$5 \cdot 10^{-5}: 50 = 1 \cdot 10^{-6}$ m, which is much larger than the lattice parameter, i.e., this length corresponds to approximately $1 \cdot 10^{-6}$m: $2 \cdot 10^{-10}$m $= 5 \cdot 10^3$ the number of gratings. The transition of an electron from one lattice (distance $2 \cdot 10^{-10}$ m) to another requires approximately $2 \cdot 10^{-10} / 5 \cdot 10^{-5} = 4 \cdot 10^{-6}$ s. When implementing the sequential mechanism of the electron transition through the lattice, in one alternating current oscillation, the electron overcomes $5 \cdot 10^3$ lattice parameters in a time of $5 \cdot 10^3 \cdot 4 \cdot 10^{-6} = 2 \cdot 10^{-2}$ s, and by the simultaneous electron transition $4 \cdot 10^{-6}$ s is enough. Therefore, in spite of the insignificant electron velocity of $5 \cdot 10^{-5}$ m / s, the creation of an alternating electric current with a frequency of 50Hz along the entire length of the conductor from the source to the destination requires time from $4 \cdot 10^{-6}$ to $2 \cdot 10^{-2}$ s. It is possible as a result of the creation of an electromagnetic field - a driving force for the movement of electrons by the relay mechanism along the entire length of the conductor. Moreover, practice shows that the structure of the “chemical individual” of the conductor does not change with alternating current, and the value of the self-induction EMF ($\mathcal{E}_{ind}$) is expressed by the well-known equality [14]:

$$\mathcal{E}_{ind} = -L dI / dt$$

Where, L- circuit inductance or self-induction coefficient, the value of which depends on the geometric properties of the circuit and of the nature containing magnetic components; dI / dt - an infinite small change in current strength over time. The movement of charges takes the work determined by the product of *IU* per unit time, and Ohm's law at each moment of time matters:

$$IR = \mathcal{E}_{stor} + \mathcal{E}nd = \mathcal{E}_{stor} - L dI / dt.$$

Consequently, the participants in the electric current are the elementary "material substance" in *the* atomic-molecular structure of the "chemical individual" created by the electromagnetic field under the influence of the EMF source and inducing the movement of electrons through the conductor.

According to modern scientific literature, an electromagnetic field is the propagation of electromagnetic waves in space and time. The propagation of electromagnetic waves is described by Maxwell's equations [15], and the existence of “electromagnetic waves” was experimentally proved by the works of Heinrich Hertz [16], where it is argued that the rays of the sun also represent electromagnetic waves.

In the case of an electric current, under the influence of an electromagnetic field, the electron shifts from its stationary position until the potential difference in the nuclear - electronic structure is compensated by the external EMF source. A variable direction EMF the source leads to oscillatory motion of electrons performing electrical work accompanied by energy manifestations in the form of release (absorption) of heat, light, electromagnetic waves, etc. [17]. These energetic manifestations mean that elementary “material substances” are distinguished from the atomic-molecular structure of the “chemical individual”. For example, the light pressure predicted by Maxwell was experimentally discovered and measured by the Russian physicist P. N. Lebedev. The pressure of electromagnetic radiation is a consequence of the fact that, like any material object characterizing the energy ε and moving at the speed of light, it has a momentum $p = \varepsilon / c$. This formula allows us to determine the mass of a photon as a kind of “electromagnetic particle”, where according to the spectroscopic data of optics for visible light, its frequency varies from $3.31 \cdot 10^{14}$ to $7.81 \cdot 10^{14}$Hz. It is known from the Planck equation that $\varepsilon = hv$, and the momentum of a material particle is equal to the product of its mass (*m*) and velocity (*v*):

$$p = mv$$

At a particle speed equal to the speed of light, we write the formula for the photon momentum in the form (Compton effect):

$$p = mc.$$

In these cases, the equality is true:

$$mc = hv / c \ \ (i.e., mc^2 = hv) \text{ and } m = hv / c^2$$

Substitution of numerical values from the reference literature into the formula gives the mass of a photon at the corresponding frequencies:

$$m = 6.62 \cdot 10^{-34} \cdot 3.31 \cdot 10^{14} / (3 \cdot 10^8)^2 = 2.43 \cdot 10^{-36} kg$$

$$m = 6.62 \cdot 10^{-34} \cdot 7.81 \cdot 10^{14} / (3 \cdot 10^8)^2 = 5.43 \cdot 10^{-36} kg$$

In [18-22], based on the basis of thermodynamic and quantum - mechanical representations, we proposed a hypothesis about heat carriers - "thermotrons" and calculated its mass. Based on the classical equations of physics (quantum mechanics), the mass of the photon and the "thermotron" were calculated [22]. The data numbers $2.43 \cdot 10^{-36}$kg and $5.43 \cdot 10^{-36}$kg are close to the mass of "theplotrons" $5.27 \cdot 10^{-36}$kg, which we calculated using thermodynamic data for hydrogen combustion and exactly coincides with the calculations. Similarly, when performing work (chemical, biological, electrochemical, etc.), the movement (redistribution) of electrons and elementary particles with the same energy manifestations is characteristic. In all these changes, the number of electrons involved in the process before and after remains constant and only their redistribution occurs between the structural elements of the "chemical individuals", and elementary particles representing their energy movements are scattered in the environment forming combinations with their components.

In [23], M. Faraday pointed out that regardless of the thermal, light, chemical, physiological, magnetic or mechanical source of energy, all of them can manifest themselves in the form of the same electricity. This conclusion of M. Faraday means the identity of the nature of elementary particles representing the concept of "energy" (electric, magnetic, light, thermal, etc.) by their movements. The preceding allows us to state that the noted "elementary particles" representing "energy" are contained in the atomic-molecular structure of substances and are in dynamic equilibrium with the environment. And the question arises: "*In what form are these particles in the atomic-molecular structure of the" chemical individual* "? For example, a photon and a "theplotron" which are carriers of light and heat, and why are they not explicitly detected in the composition of substances? On this question answer the elementary particles themselves participating in the connection between the structural elements of the "chemical individual". Let us consider the interactions of gaseous hydrogen with oxygen, where the redistribution of their structural elements in combination gives water, i.e., they turn into constituent elements of water and, as simple substances hydrogen and oxygen are not contained in water. However, if necessary, they can be obtained by decomposing water. Similarly, the sun's energy absorbed by plants, when they burn, it is again released in the form of heat and light. A clear example of a combination of elementary particles is the dispersion rays of the sun, where a colorless ray is decomposed into monochromatic components by passing through a prism [24]. In a similar way, the elementary "material objects" characterizing the concept of "energy" form combinations in the atomic-molecular structure of the "chemical individual" of a substance [25-27]. When external energy applied to the system, the combination decays and "elementary particles" are released, which manifests itself in the form of heat, light, etc. For micro-objects near the boundary, the Planck's value is difficult to determine with the structure and form of the elementary "material objects" and in the scientific literature this concept is presented in different ways: in the form of a "particleless form" [28], "particle-field dualism of Matter" [30], "particle -wave dualism" [30] and others. *In this regard, the motion of elementary substances called photons," theplotrons", "electromagnetic particle ", "electromagnetic wave "or others are the same objects of matter, which, depending on the conditions and the actor's movements are manifested in various forms of energy transfer.* It should be noted here that the release of heat, light, electromagnetic waves or others depends on the nature of substances containing in the atomic-molecular structure "elementary particles" formed from various ratios of "magnetic and electrical components" conventionally called by us "electromagnetic particles" [18-22, 25-27, 31-33]. The content of the "magnetic and electrical components" in the "electromagnetic particle" gives them a rotationally pulsating motion [32–33], which determines the structural and energy stability of the "chemical individuals" and is reflected in the physicochemical properties of the substance as a whole. And these data characterize that the photon as a kind of "electromagnetic particle does not have a rest mass. Usually radiation frequencies of electromagnetic waves, in fact, represent the frequency of pulsations of the "electromagnetic particle" as result interaction of "electrical and magnetic components" containing in it.

III. Conclusion

We used the thesis of M. Faraday on the identity of energy manifestations in the interaction of material objects. The views expressed in this article and in our other publications about the transfer of energy between material objects and their manifestation in various forms require a revision of the atomic-molecular structure of substances taking into account the combined elementary particles characterizing the energy as a measure of the movement of "electromagnetic particles".

The transfer of energy characterizes performance of work accompanied by energy manifestations, depending on the conditions created from the outside to the system, strictly in accordance by the universal law of conservation of matter and energy conversion.

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