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On the Nature of Electric Current in Metals

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Abstract

In the article, based on the theory of compressible oscillating ether developed by the author, a theory of chemical bonding of atoms in a metallic crystal lattice of lithium is constructed. It is proven that the valence electrons of lithium are weakly bound by their intersecting parts, which ensures the stability of the crystalline structure of lithium and excludes the presence of free electrons in the conductor, which refutes the conclusions of the modern quantum band theory of solids about the causes of electrical conductivity of metals. A solution to the system of ether equations is found, in which the compression - expansion of the ether density in the ball of the valence electron will occur exclusively in the direction of the electron spin (the axis of rotation of the azimuthal wave inside the electron). Thus, the existence of a directed wave of oscillations with a certain frequency of interacting valence electrons in the conductor is proven. Based on the proven, a conclusion is made that electric current is not the movement of free electrons inside the crystal lattice of the conductor, as postulated by the modern band theory of conductivity of metals, but a directed wave of perturbations of interacting valence electrons running at the speed of light along the metal lattice of the conductor.

Key Words: compressible ether, chemical bond, metallic lattice of conductor, electric current.

1. Introduction

The modern quantum theory of electrical conductivity of solids is based on the so-called band theory of solids, which is a theory of electron motion in a solid depending on the type of electron energy spectrum [1-4]. According to this theory, the energy spectrum of electrons in a solid consists of separate allowed energy bands separated by bands of forbidden energies. According to the mutual arrangement of these bands, substances are divided into three large groups: conductors, semiconductors and dielectrics. It is believed that the conduction band and valence band of conductors overlap, forming one band, so that an electron can freely move between them, having any permissibly small energy. When a potential difference is applied to a body, electrons freely move from a point with a lower potential to a point with a higher potential, forming an electric current. Band theory is the basis of the modern theory of solids and is believed to explain the electrical conductivity of metals by the presence of a large number of free valence electrons (electron gas) and the possibility of their movement inside the metal. However, the band theory of conductivity of metals should be rejected for the following obvious reasons: 1) it has been experimentally confirmed that electrons are present in an atom at temperatures of up to several thousand degrees, which excludes the presence of free electrons in conductors and, as a consequence, the presence of an electron gas; 2) electrons, even if free for some unknown reason, cannot move inside a conductor, since they have Compton dimensions [5-6], which are approximately three orders of magnitude larger than the dimensions of atomic nuclei, determining the dimensions of the atoms themselves; 3) electrons, even if free and for some unknown reason able to move inside a conductor, can move at a speed of no more than 1 mm/sec, which in no way corresponds to the speed of electric current passing through a conductor (approximately 300,000 km/sec). Other, less glaring inconsistencies between the band theory of conductivity and experimental data can be found in [2, 7].

In the present work, another approach to solving the problem is proposed, following from the theory of compressible oscillating ether as a certain world medium, the perturbations and waves of which generate all fields and material objects in the Universe, developed by the author in [5–6]. A system of equations of such a globally motionless oscillating ether medium in a three-dimensional Euclidean space is proposed

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho u) = 0, \quad \frac{d\rho u}{dt} = \frac{\partial \rho u}{\partial t} + (u \cdot \nabla)(\rho u) = 0, \tag{1}$$

where ρ is the density of the ether, and $u = dr/dt$ is the propagation velocity of its perturbations. The equations of Maxwell-Lorentz, Biot-Savart-Laplace, Coulomb, and Ampere are derived from the system of equations of the ether (1). Solutions are found that describe the formation of elementary particles of matter: proton, electron, neutron. The numerical values of their internal energies, masses, magnetic moments, and binding energies coincided with experimental values, which are “anomalous” from the point of view of modern physical science, to within tenths of a percent. A formula for the binding energy of an electron with a proton has been derived, on the basis of which an etheric deterministic model of the hydrogen atom has been constructed, as well as etheric models of all other atoms of chemical elements from hydrogen to oganesson. In the work [8], the formula for the binding of a proton with an electron in a hydrogen atom, which is the quintessence of the etheric explanation of the chemical bond of atoms and molecules, is generalized to the bond of a proton with an electron and a proton with a proton in etheric models of the molecular hydrogen ion and the hydrogen molecule, which are the simplest examples of the binding of atoms of chemical elements.

In the present work, based on the results of works [5-6, 8], a theory of chemical bonding of atoms in a metallic lattice of lithium is constructed. It is proved that valence electrons of lithium are weakly bound by their intersecting parts, which ensures the stability of the crystalline structure of lithium and excludes the presence of free electrons in the conductor and, as a consequence, the presence of electron gas. A solution to the system of ether equations (1) is found, such that the compression - expansion of the ether density in the ball of the valence electron will occur exclusively in the direction of the electron spin (the axis of rotation of the azimuthal wave of ether perturbations inside the electron). Thus, the existence of a directed wave of oscillations with a certain frequency of interacting valence electrons in the conductor is proven. Based on the proven, the only conclusion is made that electric current is not the movement of free electrons inside the crystal lattice of the conductor, as postulated by the modern band theory of conductivity in metals, but a directed wave of perturbations of interacting valence electrons running at the speed of light along the metallic lattice of the conductor.

2. Fundamentals of the ether theory of chemical bonding of atoms and molecules.

The foundations of the ether theory of chemical bonding of atoms and molecules are laid in the author's work [8], which proposes a justification for the chemical bonding of atoms in a hydrogen molecule and in a molecular hydrogen ion, following from the theory of compressible oscillating ether. In the author's theory of ether, the main structural elements of matter are the electron e and the proton p, which have charges equal in absolute value q but opposite in sign. These particles, together with their antiparticles (positron and antiproton), are spherical wave solutions of the system of ether equations (1) generated by half-waves of curled photons and having Compton radii $r_{e,p}$ such that the quantities $2\pi r_{e,p}$ are equivalent to the Compton wavelengths of the particles $2\pi\hbar/(m_{e,p}c)$, where $\hbar$ is Planck's constant and c is the speed of light. The particles themselves have constant angular velocities of propagation of azimuthal waves of compressions - expansions of the density of the ether inside their spheres around their axes $\omega_{e,p} = c/r_{e,p}$. Consequently, the radius of the proton sphere is approximately 1836 times smaller than the radius of the electron sphere, and the ether inside the proton is slightly compressed, and inside the electron is slightly rarefied compared to the unperturbed ether of constant density ρ_0.

The radial stationary vectors of the electrostatic field strengths satisfy Coulomb's law, and outside the proton they are directed toward the proton, and outside the electron they are directed away from the electron. It follows that the electrons repel each other, the proton can push and pull the electron toward itself, but it does not follow that the protons must repel each other. The waves of ether density perturbations inside the proton and electron can interact in two different ways: having unidirectional or oppositely directed spins (the directions of the propagation axes of the azimuthal waves of ether density compressions - expansions). In this case, the neutron is a superposition of the balls of the electron and proton waves with a common center and with unidirectional spins, and the hydrogen atom is a superposition of the electron and proton waves with a common center, but with oppositely directed spins (see [5-6]). The ether inside a neutron is also slightly rarefied, as inside an electron, therefore the purpose of neutrons in the nuclei of atoms of chemical elements laid down by nature is to relieve excess compression of the ether caused by protons. Consequently, a limited number of neutrons must be present in the nucleus of an atom, and their number must increase with the growth of the number of protons. Thus, the nucleus of any atom must be a superposition (overlap) of waves of perturbations of the density of the ether in several protons and several neutrons having a common center and propagating around a common axis in one direction or in opposite directions, i.e. having unidirectional or oppositely directed spins. This explains the approximate equality of the sizes of all atomic nuclei. In this case, the radii of the protons and neutrons included in the atomic nuclei can change slightly, providing resonance relationships between the frequencies of their waves. Therefore, any atom whose nucleus consists of M protons and N neutrons actually consists of N + M protons and N + M electrons, some of which (N) have spins in the same direction and form nuclear neutrons, while the other part (M) have opposite spins, forming the so-called electron shell of the atom. The important conclusion that follows from this is that each electron of the electron shell is associated mainly with its proton in the nucleus and to a lesser extent with other protons.

2.1. The bond between a proton and an electron in a hydrogen atom

The main thing in understanding the structure of the hydrogen atom and all other atoms is the correct description of the bond between the electron and the proton in the atom, taking into account that the electron is not only not a point object, but has dimensions approximately 1836 times greater than the dimensions of the proton, which excludes the presence of electron orbits and orbitals in the atom. Since the centers of the electron and proton in the hydrogen atom coincide, and the azimuthal compression-rarefaction waves of the ether density move in them in opposite directions, this leads to the spinning of the electron in the atom with a decrease in its energy and an increase in the radius. The dimensions of the atom and its energy levels are determined by the energy levels of the proton-electron bond. The meaning of the bond between the proton and electron in the hydrogen atom is that their electric fields become bound (mutually compensated and not perturbed the ether) for all $r > r_b$, where r_b is the binding radius. In this case, the total energy of the proton-electron system decreases by the value of the binding energy E_b. There is no bond and the particles are free if the binding radius tends to infinity ($r_b \to \infty$). The binding energy of a proton and an electron in a hydrogen atom is calculated in [5-6] using the formula

$$E_b = \frac{1}{2}\iiint\limits_{r>r_b} \delta\varphi dV = \frac{1}{16\pi}\int_0^{\pi}\int_0^{2\pi}\int_{r_b}^{\infty}\left(\frac{c\rho_0 V(\theta)}{r^2}\sin\left(\frac{\xi}{2}\right)i_r\right)\cdot\left(\frac{q}{r^2}i_r\right)r^2 \sin\theta dr d\xi d\theta = \frac{q^2}{2r_b}, \qquad (2)$$

where $\delta = (\nabla \cdot E)$ is the electron charge distribution density, and $E = Ei_r$ is the vector of the electron electrostatic field strength at $r > r_b$, $\varphi = q/r$ is the potential of the proton field in this region of space (outside the sphere of the atom). Using formula (2) for the binding energy of a proton with an electron, the ground, excited, and hydrino states of the hydrogen atom were found in [5-6], the characteristics of which completely coincide with the experimental data. For example, the value of the binding energy E_b of a proton with an electron in a hydrogen atom in the ground stable state, which is the ionization energy of the hydrogen atom E_H, and the radius r_H of the hydrogen atom are equal to

$$E_b = E_H = \frac{\alpha^2 E_e}{2} \approx 13.598 \text{ eV}, \quad r_b = r_H = \frac{r_e}{\alpha} \approx 52.8 \cdot 10^{-10}\text{cm},$$

where $E_e = \hbar\omega_e$ and r_e are the energy and radius of a free electron, and $\alpha = q^2/\hbar c$ is the fine structure constant.

2.2. Chemical bonding of atoms in a hydrogen molecule

The application of the concept of binding energy to explain the formation of the hydrogen molecule H_2, gave the following results in [8]. The hydrogen molecule H_2 consists of two hydrogen atoms H. The values of the dissociation energy and ionization energy of the hydrogen molecule are experimentally known [9-12]:

$$D_{H_2}(H_2 \to H + H) = 4.478 \text{ eV}, \quad I_{H_2}(H_2 \to H_2^+ + e) = 15.429 \text{ eV}.$$

The bond length of a hydrogen molecule, i.e. the distance between two protons of the molecule, has also been measured experimentally [9-11, 14]: $d = 0.74\text{Å} = 0.74 \cdot 10^{-8}\text{cm} = 1.4r_H$, where $r_H = 0.528\text{Å}$ is the radius of the hydrogen atom. The energy spent on the dissociation of a hydrogen atom is equal to the energy released when two hydrogen atoms bind into a hydrogen molecule. And since the binding energy of an electron with a proton in a hydrogen atom, which is its ionization energy, is 13.598 eV, then the total binding energy of two electrons with two protons when a hydrogen molecule is formed from two free protons and two free electrons is (13.598 + 13.598 + 4.478) eV = 31.674 eV. The same result is obtained by adding the ionization energy to the total binding energy of the molecular hydrogen ion H_2^+, which is 16.245 eV. And since the binding energy of a hydrogen molecule consists of the energy required to bring two protons closer to a distance of $s = 1.4r_H$ and two binding energies of two electrons with two protons located at distances of $s = 1.4r_H$ and $s = 0$, then, consequently,

$$2E_{ep}(1.4r_H, r_b) + 2E_{ep}(0, r_b) - E_{pp}(1.4r_H) = 31.674 \text{ eV},$$

where $E_{ep}(s, r_b)$ is the binding energy (in electron volts) of an electron of radius r_b with one proton located at a distance s from the center of the electron, and $E_{pp}(s)$ is the energy that must be expended to bring two protons closer to a distance s between them. In [5], it is shown that the energy $E_{pp}(s)$ is a fraction of the Coulomb energy

$$E_{pp}(s) = 0.34\frac{E_H r_H}{s}, \qquad E_{pp}(1.4r_H) = 3.3 \text{ eV}.$$

where $E_H = 13.598$ eV is the ionization energy of the hydrogen atom. Then (see [6,8])

$$E_{ep}(s, r_b) = \frac{c\rho_0 q}{4\pi}\int_0^{\pi}\int_{r_b}^{\infty}\frac{V(\theta)\sin\theta(r - s\cos\theta)dr d\theta}{(s^2 + r^2 - 2sr\cos\theta)^{\frac{3}{2}}} = \frac{E_H}{\left(2a + \frac{\pi}{2}\right)}\int_0^{\pi}\frac{(1/7 + \sin\theta)\sin\theta d\theta}{\left(\left(\frac{s}{r_H}\right)^2 + \left(\frac{r_b}{r_H}\right)^2 - 2\left(\frac{s}{r_H}\right)\left(\frac{r_b}{r_H}\right)\cos\theta\right)^{\frac{1}{2}}}.$$

Note that $E_{ep}(0, r_H) = E_H = 13.598$ eV. Therefore,

$$2E_{ep}(1.4r_H, r_b) + 2E_{ep}(0, r_b) = 34.974 \text{ eV}.$$

Solving numerically the integral equation

$$\frac{2E_H}{(2a + \frac{\pi}{2})}\int_0^{\pi}\frac{(\sin\theta/7 + \sin^2\theta)d\theta}{(1.4^2 + x^2 - 2 \cdot 1.4x\cos\theta))^{1/2}} + \frac{2E_H}{x} = 34.974$$

relative to the parameter $x = r_b/r_H$, we find that $x = 1.47$, that is, the radii of electrons in the hydrogen molecule are $r_b = 1.47r_H = 0.776$Å (Fig. 1). Now we can find the diameter of the hydrogen molecule

$$D = 2 \cdot 0.776\text{Å} + 0.74\text{Å} = 2.292\text{Å} = 4.34r_H,$$

which almost exactly coincides with the experimentally found value of 2.3 Å, determined by the mean free path of the hydrogen molecule $l = 0.16$ μm [13, p.283]. The error is 0.4%.

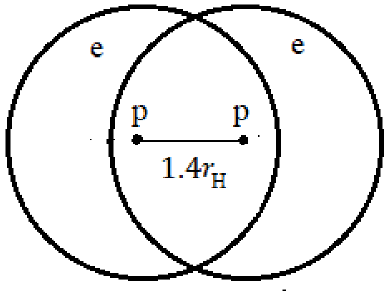

Fig. 1. Scheme of the hydrogen molecule with electrons radii $r_b = 1.47r_H$.

3. Chemical bonding of atoms in the metallic lattice of lithium.

The theory of chemical bonding of atoms in the crystalline metallic lattice of lithium will be constructed by analogy with the theory of chemical bonding of atoms in the hydrogen molecule proposed by the author in [8] and discussed above. The values of the dissociation energy of a gaseous lithium molecule, the ionization energy of a lithium molecule and the ionization energy of a lithium atom are experimentally known [9-11, 13]

$$D_{Li_2}(Li_2 \to Li + Li) = 1.128 \text{ eV}, \qquad I_{Li_2}(Li_2 \to Li_2^+ + e) = 5 \text{ eV}, \qquad I_{Li}(Li \to Li^+ + e) = 5.3927 \text{ eV}.$$

The bond length of a gaseous lithium molecule, i.e. the distance between the two nuclei of the molecule, was also measured experimentally: $\mathrm{d} = 2.67\text{Å} = 5.057\mathrm{r_H}$, where $\mathrm{r_H} = 0.528\text{Å}$ is the radius of the hydrogen atom.

Let us now consider metallic lithium, which has a body-centered cubic crystal structure with a metallic lattice parameter $\mathrm{a} = 3.49\text{Å}$ and the shortest possible distance between lattice sites of 3.03Å. The lithium atom has only three electrons, two of which are in the first energy level, close to the nucleus, and the third valence electron is in the third energy level. Therefore, although the radius of the lithium atom is 1.59Å, the radius of its ion $\mathrm{Li^+}$ is only 0.60Å. The inner, tightly bound electrons will be almost unaffected by other lithium atoms, so we conclude that one and only one valence electron of each atom imparts metallic properties to the crystal. All bonds of the atom with its nearest eight neighbors are due to this single electron (per atom), the binding force of which is thus "smeared out". This also follows from a comparison of the bond length (2.67 Å) in the diatomic molecule $\mathrm{Li_2}$ with the shortest possible distance (3.03Å) between atoms in the metal. The increased length of the "bond" in the metal means that the latter is weakened; at the same time, the number of bonds in the metal is greater, as a result of which the total bond energy per atom increases from 0.56 eV in the molecule to 1.692 eV in the metal. But the bond energy between two individual atoms is 1.12 eV in the molecule and 0.212 eV in the metal. Therefore, the valence electrons are bound more strongly in the metal than in the molecule, but their binding force is distributed among a larger number of objects. Thus, the energy expended on the bond between two lithium atoms in the metal is 0.212 eV.

By analogy with the hydrogen atom, we will assume that the bond between two lithium atoms in the metal is realized by binding two positive lithium ions $\mathrm{Li^+}$ with two electrons. On the one hand, the total binding energy of two electrons with two lithium ions during the formation of a metallic bond of two lithium atoms from two free lithium ions and two free electrons is equal to the sum of the energies of formation of two lithium atoms (the sum of two ionization energies (5.3927 eV+5.3927 eV) and the binding energy of two neighboring lithium atoms in the metal (0.212 eV). On the other hand, this binding energy consists of the energy required to bring two positive lithium ions located at the nodes of the crystal lattice closer to a distance of $\mathrm{a} = 3.49\text{Å} = 6.61\mathrm{r_H}$ and two binding energies of two electrons with two positive lithium ions located at distances of $\mathrm{s} = 6.61\mathrm{r_H}$ and $\mathrm{s} = 0$. That is, the equation takes place

$$2\mathrm{E_{ei}}(6.61\mathrm{r_H}, \mathrm{r_b}) + 2\mathrm{E_{ei}}(0, \mathrm{r_b}) - \mathrm{E_{ii}}(6.61\mathrm{r_H}) = 10.997\ \mathrm{eV} \approx 11\ \mathrm{eV},$$

where $\mathrm{E_{ei}}(\mathrm{s}, \mathrm{r_b})$ is the binding energy (in electron volts) of an electron of radius $\mathrm{r_b}$ with a lithium ion whose center is at a distance s from the center of the electron, and $\mathrm{E_{ii}}(\mathrm{s})$ is the energy that must be expended to bring the two ions closer to a distance s between them. Since the positive lithium ion has a proton charge, we can assume that $\mathrm{E_{ei}}(\mathrm{s}, \mathrm{r_b}) = \mathrm{E_{ep}}(\mathrm{s}, \mathrm{r_b})$. We will also assume that $\mathrm{E_{ii}}(\mathrm{s}) = \mathrm{E_{pp}}(\mathrm{s}) = 0.34\mathrm{E_H}\,\mathrm{r_H}/\mathrm{s}$. Although the latter statement requires additional justification, it does not significantly affect the conclusions from the results of this section. Under the assumptions made, $\mathrm{E_{ii}}(\mathrm{s}) = 0.7\ \mathrm{eV}$ and, following [8], the equation for determining the radius $\mathrm{r_b}$ of valence electrons in the metallic lithium lattice holds

$$\frac{2\mathrm{E_H}}{(2\mathrm{a} + \frac{\pi}{2})}\int_0^{\pi} \frac{(\sin\theta/7 + \sin^2\theta)d\theta}{(6.61^2 + \mathrm{x}^2 - 2\cdot 6.61\mathrm{x}\cos\theta))^{1/2}} + \frac{2\mathrm{E_H}}{\mathrm{x}} = 11.7\text{эВ}. \tag{3}$$

Solving numerically the integral equation (3) with respect to the parameter $\mathrm{x} = \mathrm{r_b}/\mathrm{r_H}$, we find that $\mathrm{x} = 3.525$, that is, the radii of the valence electrons in the metallic lattice of lithium are equal to $\mathrm{r_b} = 3.525\mathrm{r_H} = 1.861\text{Å}$, which is slightly larger than the radius of the crystal lattice $\mathrm{a}/2 \approx 1.75\text{Å}$ and approximately three times larger than the radius of the lithium ion $\mathrm{Li^+}$ (Fig. 2).

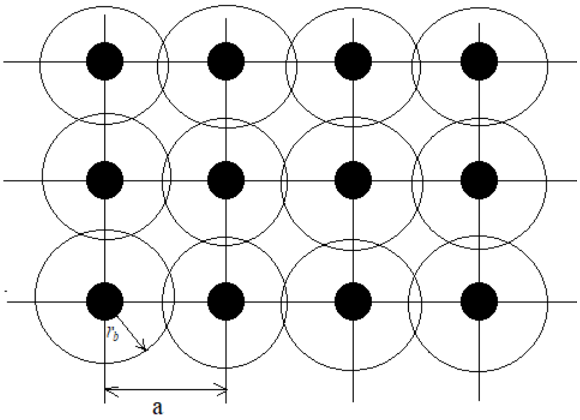

Fig. 2. Schematic diagram of the crystal lattice of metallic lithium

Since the size of the metallic crystal lattice of lithium is $a = 3.49$Å, and the radii of the valence electrons that bind the atoms in the crystal lattice are $r_b = 1.861$Å, we obtain as a result that the valence electrons are weakly bound by their intersecting parts, which ensures the stability of the crystal structure. It remains to understand how the structure shown in Fig. 2 ensures the passage of electric current through it at the speed of light and what electric current is. .

4. Ethereal representation of electric current in metals.

In modern science, the classical definition of current in a metal conductor as the directed movement of charged particles (electrons or ions) is accepted. Such a definition cannot be considered satisfactory due to the fact that electrons and ions have a size comparable to the size of the crystal lattice of the conductor's atoms, and it is unlikely that they perform any translational motion in the conductor at all. Electrons also cannot emit, since, contrary to the assertions of modern science, electrons have sizes three orders of magnitude greater than the sizes of nuclei, and do not perform orbital motion around the nuclei of atoms. At the same time, electrons, protons, neutrons, nuclei of atoms, their electron shells and the atoms themselves perform periodic oscillations of compressions and expansions of the ether volumes that form them. The centers of the nuclei of atoms, located in the nodes of the crystal lattice, remain motionless, and the atoms themselves are bound in the crystal lattice by valence electrons as shown in Fig. 2 using metallic lithium as an example. Therefore, the most probable hypothesis is that electric current is a wave of compressions and expansions of the increased in size interconnected valence electrons of atoms, transmitted from atom to atom and running at the speed of light along the crystal lattice of a conductor. To confirm this hypothesis, we will derive from the system of ether equations (1) the formula for the current element Idl, which is a directed wave of compressions-expansions of the valence electrons of the conductor atoms.

In [6], from the system of ether equations (1), formulas were derived for the elements of the electric field intensity and magnetic field induction created by the current element Idl of the conductor. The element dE of the electric field intensity created at point r of the L_1 conductor by the current element Idl at point s of the L conductor has the form

$$dE = -\frac{1}{c^2}\frac{\partial I}{\partial t}\frac{dl}{|r-s|} = -\frac{1}{c^2}\frac{\partial I}{\partial t}\frac{dl}{r}, \tag{4}$$

where r is the distance between the vectors r and s. And the induction element dB of the magnetic field created at point r of the L_1 conductor by the current element Idl at point s of the L conductor has the form

$$dB = \frac{1}{c}\frac{Idl \times (r-s)}{|r-s|^3} = \frac{1}{c}\frac{Idl \times r}{r^3}. \tag{5}$$

Note that expression (5) is the classical Biot-Savart-Laplace differential law, but derived in [5-6] directly from the ether equations (1). We will consider the valence electron of the atom of the metal lattice as an element of the current of conductor. This is a sphere, along any parallel of which the azimuthal wave of compressions -

expansions of the ether density in the radial and polar directions runs with a constant angular velocity. We will show that there is a solution to the system of ether equations (1), such that the compression - expansion of the ether density in the sphere of the valence electron will occur exclusively in the direction of the electron spin parallel to its axis. We will choose a spherical coordinate system (r, θ, φ) and align the origin with the center of the atom (a node of the crystal lattice), directing the z axis along the direction of the valence electron spin. We will write the system of ether equations (1) in a stationary spherical coordinate system, taking into account the fact that the vector u is the speed of propagation of perturbations in the ether, and not the speed of movement of the ether itself. Then

$$u = u_r i_r + u_\theta i_\theta + u_\varphi i_\varphi = V i_r + \Omega i_\theta + W i_\varphi;$$

$$V = \frac{dr}{dt}, \qquad \Omega = r\frac{d\theta}{dt}, \qquad W = r\sin\theta\,\frac{d\varphi}{dt},$$

where (V, Ω, W) are the radial, polar and azimuthal components of the velocity of propagation of perturbations in the ether. Since the ether is globally motionless, we can assume that the unit coordinate vectors of the stationary spherical coordinate system $(i_r, i_\theta, i_\varphi)$ do not depend on time, and their total derivatives with respect to time are equal to zero. Then from the system of ether equations (1) we obtain that

$$\frac{d\rho u}{dt} = \frac{d\rho V}{dt} i_r + \rho V\frac{di_r}{dt} + \frac{d\rho\Omega}{dt} i_\theta + \rho\Omega\frac{di_\theta}{dt} + \frac{d\rho W}{dt} i_\varphi + \rho W\frac{di_\varphi}{dt} = \frac{d\rho V}{dt} i_r + \frac{d\rho\Omega}{dt} i_\theta + \frac{d\rho W}{dt} i_\varphi = 0.$$

By writing the last vector equation along with the scalar continuity equation in coordinates, we obtain a system of equations for a compressible oscillating ether in a stationary spherical coordinate system

$$\begin{gathered}
\frac{\partial\rho}{\partial t} + \frac{1}{r^2}\frac{\partial(r^2\rho V)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial(\rho\sin\theta\ \Omega)}{\partial\theta} + \frac{1}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi} = 0,\\[2ex]
\frac{\partial(\rho V)}{\partial t} + V\frac{\partial(\rho V)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho V)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi} = 0, \qquad (i_r)\\
\frac{\partial(\rho\Omega)}{\partial t} + V\frac{\partial(\rho\Omega)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho\Omega)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho\Omega)}{\partial\varphi} = 0, \qquad (i_\theta)\\
\frac{\partial(\rho W)}{\partial t} + V\frac{\partial(\rho W)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho W)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi} = 0, \qquad (i_\varphi)
\end{gathered}\tag{6}$$

Let a forced periodic oscillation in the form of a helical ether wave (photon, see [6]) with a frequency ω, $\omega r_b < \omega r \ll c$, be applied to a conductor, where r_b is the radius of the valence electron, and r is the distance at which the considered element of the conductor L_1 is located from the current element Idl of the conductor L (for the frequencies used in practice, this is always true). We will look for a solution to the system of equations (6) outside the conductor with current L in the form

$$W = \omega r\sin\theta, \quad \rho = \rho_0(1 + g(t, r, \theta, \varphi)), \qquad |g(t, r, \theta, \varphi)| \ll 1,$$

$$|V(t, r, \theta, \varphi)| \ll 1, \qquad |\Omega(t, r, \theta, \varphi)| \ll 1.$$

Substituting the desired type of solution into the system of equations (6) and neglecting the terms of the second order of smallness, as well as the product of small terms, we obtain for the functions $V(t, r, \theta, \varphi)$, $\Omega(t, r, \theta, \varphi)$, $g(t, r, \theta, \varphi)$ the system of equations

$$\frac{\partial g}{\partial t} + \frac{\partial V}{\partial r} + \frac{2V}{r} + \frac{1}{r}\frac{\partial\Omega}{\partial\theta} + \frac{\Omega}{r}\frac{\cos\theta}{\sin\theta} + \omega\,\frac{\partial g}{\partial\varphi} = 0,$$

$$\frac{\partial V}{\partial t}+\omega\frac{\partial V}{\partial \varphi}=0,\quad (i_r)\qquad \frac{\partial \Omega}{\partial t}+\omega\,\frac{\partial \Omega}{\partial \varphi}=0,\quad (i_\theta) \tag{7}$$

$$\frac{\partial g}{\partial t}+\frac{V}{r}+\frac{\Omega\cos\theta}{r\sin\theta}+\omega\,\frac{\partial g}{\partial \varphi}=0,\quad (i_\varphi)$$

We will seek the solution to system (7) in the form:

$$V(t,r,\theta,\varphi)=\frac{cd}{r}\cos\theta\sin(\omega\,t-\varphi),$$

$$\Omega(t,r,\theta,\varphi)=-\frac{cd}{r}\sin\theta\sin(\omega\,t-\varphi) \tag{8}$$

$$g(t,r,\theta,\varphi)=\frac{c^2d}{\omega^2r^3}\cos(\omega\,t-\varphi),$$

where d is the diameter of the valence electron in the crystal lattice of the conductor. We will show that functions (8) are indeed a solution to the system of equations (7). Obviously, they satisfy the second, third and fourth equations of system (7), since

$$\frac{\partial g}{\partial t}+\omega\,\frac{\partial g}{\partial \varphi}=0,\qquad \frac{\partial V}{\partial t}+\omega\,\frac{\partial V}{\partial \varphi}=0,\qquad \frac{\partial \Omega}{\partial t}+\omega\,\frac{\partial \Omega}{\partial \varphi}=0,\qquad \frac{V}{r}+\frac{\Omega\cos\theta}{r\sin\theta}=0.$$

The first equation of system (7) is also satisfied, since the fourth term can be neglected in it for small $\omega r \ll c$, that is

$$\omega\,\frac{\partial g}{\partial \varphi}+\frac{1}{r}\frac{\partial\,\Omega}{\partial \theta}=\frac{c^2d}{\omega r^3}\sin(\omega\,t-k\varphi)\left(1-\frac{\omega r\cos\theta}{c}\right)\approx\,\omega\frac{\partial g}{\partial \varphi},\qquad \text{and}\qquad \frac{\partial V}{\partial r}=-\,\frac{V}{r}.$$

For the found solution, in the first approximation we obtain

$$V\frac{\partial(\rho W)}{\partial r}+\frac{\Omega}{r}\frac{\partial(\rho W)}{\partial \theta}=\frac{cd}{r}\rho_0\omega\,\sin\,(\omega\,t-\varphi)(\cos\theta\sin\theta-\sin\theta\cos\theta)=0.$$

Consequently, the system of ether equations (7) on the found solution in the first approximation takes the form:

$$\frac{\partial g}{\partial t}+\frac{\partial V}{\partial r}+\frac{2V}{r}+\frac{\Omega\cos\theta}{r\,\sin\theta}+\omega\,\frac{\partial g}{\partial \varphi}=0,$$

$$\frac{\partial(\rho V)}{\partial t}+\frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial \varphi}=0\;\;(i_r),\quad \frac{\partial(\rho\Omega)}{\partial t}+\frac{W}{r\sin\theta}\frac{\partial(\rho\Omega)}{\partial \varphi}=0\;\;(i_\theta),\quad \frac{\partial(\rho W)}{\partial t}+\frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial \varphi}=0\;\;(i_\varphi).$$

Thus, the current element $Idl = Idi_z$ ($dl = di_z$) directed along the z axis (the spin of the valence electron) forms two force fields around itself, one of which, having the direction i_φ under an angle φ around the direction of the current, can naturally be called the magnetic field of the current. The element of the induction vector dB of the magnetic field of the current element Idl is given by the formula

$$dB=\frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial \varphi}di_\varphi=\omega^2r\sin\theta\frac{\partial \rho}{\partial \varphi}di_\varphi=\frac{\rho_0c^2}{r^2}\sin\theta\sin(\omega\,t-\varphi)di_\varphi.$$

Considering that $r\sin\theta\,di_\varphi = dl\times r$, the expression for the induction element dB of the magnetic field of the current element Idl can be rewritten as

$$dB = \frac{c^2 \rho_0 \sin(\omega t - \varphi) dl \times r}{r^3}. \tag{9}$$

Comparing the expression for the element of magnetic field induction of the current (9) with the differential Biot-Savart-Laplace law (5), we find a representation for the linear current I of the element dl of the conductor in the form

$$I = c^3 \rho_0 \sin(\omega t - \varphi) . \tag{10}$$

Let us now find the element of electric field strength dE - the second field created by the current element Idl of the conductor. This field is the sum of two fields directed along the radius r and angle θ:

$$dE = \frac{W}{r \sin\theta} \frac{\partial(\rho V)}{\partial\varphi} i_r + \frac{W}{r \sin\theta} \frac{\partial(\rho\Omega)}{\partial\varphi} i_\theta =$$

$$-\frac{\omega c \rho_0 d \cos(\omega t - \varphi)(\cos\theta\, i_r - \sin\theta\, i_\theta)}{r} = -\frac{\omega c \rho_0 \cos(\omega t - \varphi) d i_z}{r}.$$

The surprising and remarkable fact is that the vector dE of the sum of these two fields is everywhere directed along the vector i_z (along the direction of the spin of the valence electron), which determines the possibility of electric current passing through the conductor. Since $di_z = dl$, then, expressing the element dE of the electric field strength through the current I, given by formula (10), we find that

$$dE = -\frac{1}{c^2} \frac{\partial I}{\partial t} \frac{dl}{r}, \tag{11}$$

which coincides with the differential law (4) for the element of intensity dE of the electric field created by the element of current Idl. The obtained complete correspondence between the classical expressions for the intensity of the electric field and the induction of the magnetic field of the current with their expressions found directly from the equations of the ether (1) is another weighty argument in favor of the existence of the ether and the fact that all electromagnetic processes, including electric current, are processes of transmission of perturbations and oscillations of a globally motionless ether medium.

Note that all elements of the balls of valence electrons, located at any angle φ to their common axis, vibrate in the same direction along this axis. Thus, from (10) it follows that in each valence electron, the current element is the azimuthal wave of ether perturbations, running with an angular velocity ω around the axis i_z of the electron spin and causing oscillations of the electron along this axis. Consequently, if the valence electron balls of the conductor have a sufficiently large intersection, then their spins line up in one direction along the conductor, and a longitudinal-transverse helical wave of ether (photon) runs along the conductor with the speed of light and frequency ω:

$$u(t, r) = \omega r_0 \sin(\omega t - kz) i_x + c i_z + \omega r_0 \cos(\omega t - kz) i_y, \quad \omega = kc, \quad r_0 \le r_b. \tag{12}$$

It is easy to verify that wave (12) is also a solution to the system of ether equations (1). From (10) it follows that the amplitude of the current in the conductor is determined by the ether parameters ρ_0 and c that do not depend on the conductor, as well as the frequency ω of the external action on the conductor. In addition, the amplitude of the current depends on the size of the intersection region of valence electrons, with an increase in which the electrical conductivity of the conductor increases. Thus, the current is a directed wave of perturbations of interacting valence electrons, that runs at the speed of light along the metal lattice of the conductor

Note. Since all the above reasoning is valid not only for the tube of interacting valence electrons, but also for some of its neighborhood, the dimensions of which depend on the oscillation frequency, then, perhaps, the longitudinal-transverse helical wave of current (12) can propagate in the ether not only inside the conductor, but also in some of its neighborhood.

5. Results and discussion

The problem of electrical conductivity of metals is considered. A review and criticism of the main provisions of the modern quantum-mechanical band theory of conductivity is given, considering the electric current in metals as the movement of free valence electrons along a conductor. It is proved that the process of electron movement along a conductor is fundamentally impossible. Based on the theory of compressible oscillating ether, another approach to explaining the electrical conductivity of metals is proposed, within the framework of which a model of the chemical bond of lithium atoms in its metallic crystal lattice is constructed and an explanation is given for the passage of electric current along the metallic lattice of lithium in the form of a directed wave of oscillations of interacting valence electrons. Based on the obtained results, a hypothesis is put forward and mathematically rigorously substantiated that the electric current in a conductor is not the movement of free valence electrons, but precisely this directed wave of perturbations of interacting valence electrons running at the speed of light along the metallic lattice of the conductor.

The plans for developing the direction of research related to the further study of the electrical conductivity of solids include the construction of ether models of chemical bonds of atoms in the crystal lattices of multivalent metals, semiconductors and dielectrics. The main problem in further research will be the problem of finding a mathematical law for the energy of repulsion of positive ions of atoms, which depends on the increasing stresses of the ether when they approach each other, but is not Coulomb, which is strictly proven in the work [8]. Electrical engineering, in general, is the most favorable area of science, allowing both theoretically and experimentally to demonstrate the absurdity of many provisions of modern physical science, which is in deep crisis, but continues to stubbornly deny the existence of the world ether.

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References

[1] Kittel Ch. Quantum theory of solids. – N.-Y.: Wiley, 1963.
[2] Ashcroft N., Mermin N. Solid state physics.- Orlando: Harcourt Inc., 1976.
[3] Vonsovsky S., Katsnelson M. Quantum Solid-State Physics. - Berlin: Springer-Verlag, 1989.
[4] Sivukhin D. General course of physics. V.3. Electricity. – M.: Fizmatlit, 2004. (in Rus.)
[5] Magnitskii N.A. Theory of compressible oscillating ether. Results in Physics, 2019, (12): 1436.
[6] Magnitskii N. A. Theory of compressible oscillation ether. India, UK: BPInternational, 2022. ISBN 978-93-5547-843-6 (Monograph). DOI: 10.9734/bpi/mono/978-93-5547-843-6
[7] Bonch-Bruevich V., Kalashnikov S. Physics of Semiconductors. – M.: Science, 1977
[8] Magnitskii N.A. Fundamentals of the ether theory of chemical bond . Theoretical Foundations of Chemical Engineering, 2024, 58(4): 479–485 (in Rus). DOI: 10.31857/S0040357124040082
[9] Murrell J.N., Kettle S.F., Tedder J.M. The chemical bond. N.-Y.: Willey, 1978.
[10] Haberditzl W. The structure of matter and chemical bond. Berlin: Germ. Sci. Pub. House, 1972.
[11] Gray H. Electrons and chemical bonding. N.-Y.: Benjaming Inc., 1965.
[12] Liu J., Sprecher D., Jungen C., Ubachs W. and Merkt F. Determination of the ionization and dissociation energies of the deuterium molecule. The journal of chemical physics, 2010, (132): 154301.
[13] Aleshkevich V.A. General Physics Course. Molecular Physics. M.: Fizmat-lit, 2016 (in Rus).
[14] Nikolsky B.P., Rabinovich V.A. Chemist's Handbook. Vol. 1. General information. Structure of matter. Properties of the most important substances. Laboratory equipment. M.–L.: Chemistry, 1966 (in Rus).